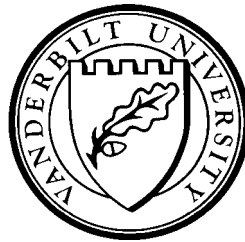


**BUSINESS -TO - BUSINESS ELECTRONIC COMMERCE**

by

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## **Introduction**

Firms carry out both manufacturing and merchant functions. Whereas the industrial revolution saw the mechanization of firms' manufacturing functions, the information revolution is now completing the picture by automating their merchant functions, including retailing, wholesaling, and input procurement. The information revolution is dramatically lowering transaction costs and changing the way that firms carry out both buying and selling.

Electronic commerce (hereafter e-commerce) substitutes capital, in the form of computer data processing and Internet communication, for labor services in the production of economic transactions, thus raising the speed and efficiency of transactions relative to more labor-intensive alternatives. The costs of labor services employed include the time spent by managers and employees searching for customers and suppliers, communicating with counterparts in other companies regarding transaction details, and monitoring routine aspects of contractual performance. Transactions over computer networks avoid many of the associated costs of interpersonal economic exchange, including the costs of travel, physical space for meetings, and processing paper documents. Moreover, transactions over computer networks allow companies to link their internal computer systems, thus increasing the frequency, rapidity and accuracy of communication and allowing links to production and inventory management systems within each organization.

The first businesses to attract wide attention on the Internet were business-to-consumer (B2C) retail institutions, such as Amazon and CDNow, providing approximately \$16 billion of the \$3 trillion in U.S. retail sales in 1999. A few businesses, such as the eBay auction site, also facilitate consumer-to-consumer (C2C) commerce. By contrast, the focus of this article is on business-to-business (B2B) e-commerce, which has attracted considerable interest and investment capital because its current volume and potential for growth are many times greater than retail transactions. Estimates of the size and growth rate of B2B e-commerce vary widely. Construction of such estimates begins with observations about the size of the interbusiness transactions. For example, transactions between businesses in 1999 in the U.S. were reported to equal approximately \$14 trillion, of which approximately \$90 billion were conducted over the Internet (Uchitelle, 2000).

Future growth of intercompany business over the Internet depends on projections of the rate of growth of intercompany transactions overall and assumptions about the rate at which such business will migrate to the Internet. For example, Goldman-Sachs (2000) projects worldwide B2B e-commerce transactions equal to \$4.5 trillion worldwide by 2005. The Gartner Group estimates B2B e-commerce in 1999 as \$145 billion and projects an increase to \$7.3 trillion in 2004, including over \$3 trillion in electronic data interchange (EDI) not on the Internet (Oppel, 2000, see also [emarketer.com](http://emarketer.com), 2000).

By using electronic commerce to lower the costs of processing transactions, B2B e-commerce companies in large markets may achieve cost efficiencies relative to direct exchange between buyers and sellers. We note that B2B e-commerce firms act as intermediaries in transactions between businesses. An intermediary is an economic agent that purchases from suppliers for resale to buyers or that helps buyers and sellers meet and transact. Spulber (1996, 1999) shows how intermediaries reduce transaction costs by reducing the costs of search, mitigating moral hazard, alleviating adverse selection and reducing contractual hold-up. B2B firms perform many of these intermediary functions. They centralize exchange by attracting and matching buyers and sellers. Some B2B firms provide value-added services by guaranteeing product quality, certifying buyer and seller credit worthiness, supplying escrow services, and communicating industry information.

Market makers aggregate demand and supply, match buyers and sellers, provide mechanisms for pricing, and step in to buy and sell when additional market liquidity is required. Although the role of market makers in financial markets is generally recognized, Spulber (1998) emphasizes that companies in markets for goods and services also carry out market making functions; they create institutions of exchange, adjust and communicate prices, clear markets, allocate goods, and provide immediacy through their purchasing, inventory-holding and manufacturing activities. Accordingly, B2B companies are market makers in factor markets. Indeed, B2B companies seek to create electronic markets for goods and services in some cases by establishing exchanges that resemble financial markets; see, for example, Sculley and Woods

(1999).

Financial markets for standardized contracts involving commodities are nothing new, of course – there are well-established spot markets for oil, natural gas, electric power, and precious metals, and futures markets for grain, cattle, pork bellies, orange juice, and so on. However, B2B e-commerce seeks to extend market making to more complex goods including manufactured inputs (steel, paper, chemicals, plastics), components (automobile and aircraft parts), office supplies, and business services. Although neglected in popular discussions, wholesale transactions between manufacturers and retailers also should be included in B2B e-commerce.

The purpose of this paper is to examine the establishment of business-to-business electronic commerce within an economic framework. We begin by defining the scope of B2B e-commerce, and describing its possible benefits. Next, we consider the intermediation services and transaction mechanisms offered by B2B companies, drawing on models of market microstructure and of auctions. We provide an overview of the new entrants, examining the markets they propose to serve and the types of services that they propose to provide. Next, we comment on the possible effects of B2B e-commerce on economic productivity. We then examine competition between B2B companies and the industry structure we might expect this competition to generate. Finally, we explore the potential effects of B2B e-commerce on the organizational structure of the companies that are the purchasers and suppliers in the B2B markets.

### **What Is Business-to-Business E-Commerce?**

As we use the term, business-to-business refers to a broad range of intercompany transactions, including wholesale trade as well as company purchases of services, resources, technology, manufactured parts and components, and capital equipment. B2B also includes many types of financial transactions between companies, such as reinsurance, commercial credit and electronic networks for trading bonds, securities and other financial assets. B2B transactions exclude those involving households, such as retail sales, interconsumer exchange, and employment.

Companies in B2B e-commerce offer innovative economic transactions. Acting as

intermediaries, many B2B companies propose to design innovative transactions between a company and its many suppliers; that is, they reorganize supply chains. For example, some B2B companies provide centralized online auctions. Such centralized markets are intended to replace decentralized markets in which buyers and sellers search for each other and engage in bilateral negotiation. Centralized markets create efficiencies by reducing search costs, allowing buyers and sellers to meet each other through the central exchange. When there are many buyers and sellers, centralized markets also can reduce time costs by replacing bilateral negotiation with formal bidding mechanisms and information about transaction prices.

Moreover, by partially supplanting the procurement function of buyers and the sales function of suppliers, B2B intermediaries affect company decisions about procurement and intra-firm transfers of goods and services. Companies may choose to rely more on outside intermediaries for procurement and sales activities, and less on internal purchasing and sales personnel. Also, companies can reorganize organizational processes for allocating and manufacturing intermediate goods and services, sometimes referred to as value chains, by applying Internet technology to the management of internal operations.

B2B e-commerce is directed toward alleviating transaction inefficiencies in the supply chain. Companies in manufacturing, mining, construction, transportation, public utilities, and other sectors all buy from and sell to other firms. There is substantial intercompany exchange in the financial sector as well, in such areas as securities trading, investment banking and reinsurance. Such transactions consume substantial efforts involving marketing and sales, purchasing, financing, technology procurement, and accounting.

E-commerce promises to reduce the costs of interbusiness transactions by automating many individual steps in the procurement process. Traditionally, interbusiness transactions begin with a company evaluating the input purchasing required to carry out its business strategies or a supplier seeking buyers for its goods and services. Next, buyers search for suppliers (and vice versa), through advertising, trade shows, brokers, and dealers. Buyers then negotiate with potential sellers concerning product specifications and prices, and perhaps conclude a spot transaction or form a

long-term contract. After the agreement has been reached, the transaction itself still involves ordering, billing, arrangements for transportation, confirmation of payments, and acceptance of delivery.

E-commerce innovations aim to reduce the cost of procurement before, during and after the transaction. Before the transaction, Internet technology may lower the cost of searching for suppliers or buyers and making price and product comparisons. The B2B intermediary coordinates the activities of buyers and sellers by acting as a central meeting place, thus reducing search costs. Search costs can be significant relative to the value of the product, particularly for small purchases. Alf Sherk, the founder of e-Chemicals, claims that “When you’re dealing with one or two drum quantities, the cost of comparison shopping can be more than the value of the product” (Jones, 1999). Intermediaries reduce search costs by consolidating markets, providing an assortment of goods and services that gives buyers the cost efficiency of one-stop shopping.

Online intermediaries further lower search costs by providing information. By merely providing a comprehensive list of potential suppliers of a specialized product, the intermediary can significantly reduce search costs for a buyer. Second, costs can be reduced by providing catalogs of product information from different suppliers, enabling easy product comparisons, rather than requiring the buyer to use up costly time to contact the suppliers for the information. Third, intermediaries can provide price information for each product. The intermediary may even provide dynamic pricing mechanisms, such as auctions or automated negotiation rules, which cause prices to respond quickly to variations in demand and supply.

Furthermore, B2B e-commerce attempts to create markets that will replace intra-firm transfers of goods and services. Vertically integrated firms engage in substantial internal sales and procurement activities. B2B e-commerce can enable outsourcing of the management of these external and internal transactions; that is, specialized intermediaries may handle many of these transactions. For companies that purchase externally, these intermediaries would substitute for many of the activities of company purchasing departments. Vertically integrated companies might reorganize to outsource production of goods and services that were previously produced internally,

and again rely on intermediaries to help with procurement. The end result would be a fundamental change in the way that businesses transact with each other as well as the way in which businesses are organized.

Such innovations in economic transactions depend on advances in computer networking technology that significantly reduce the costs of data communication. The Internet and its associated hardware and software technologies can lower the costs of communicating data, both data transmission between companies and within organizations. Although advances in computer networking technology provide the impetus, advances in Internet commerce depend on innovations in the way that transactions are organized. Lowering transaction costs often entails the design of novel types of transactions. For example, the oil companies BPAmoco, Royal Dutch/Shell Group and Totalfina Elf Group along with financial services companies Deutsche Bank, Goldman Sachs, Morgan Stanley Dean Witter and Société Generale have announced a new electronic marketplace for over-the-counter energy, metal, and other commodities called the Intercontinental Exchange, that will replace transactions that were largely conducted by telephone (Shmukler, 2000). The Intercontinental Exchange market will have various novel features including the provision of information to traders regarding their counterparties, such as their credit worthiness, and information regarding market aggregates (Market News Publishing, 2000).

Internet commerce offers many of the benefits of electronic data interchange (EDI) without its high costs. Like EDI, Internet commerce offers the benefits of speed and accuracy. By linking their computers, companies can communicate without the costs of translating computer files into paper documents, a process that involves errors, delay and costly clerical personnel. EDI provided these benefits years ago for some companies, but costs were relatively high because EDI involves proprietary software and point-to-point communications. By contrast, Internet technology typically involves open standards on a global network. In order to add a new supplier to their EDI purchasing system, for example, a firm would have to establish a new network link with that supplier, and have new software installed on that supplier's computer systems. By contrast, Internet-based electronic purchasing connections can be much less costly to set up, since they



involve hardware connections that the company is probably already using for other purposes, and can likely be established using off-the-shelf software rather than customized proprietary solutions. Despite the relative advantages of Internet commerce, the installed base of EDI connections will likely coexist with the Internet for some years into the future. (Eriksen, 2000, p. 14).

After the transaction, electronic commerce may allow companies to communicate at very little cost to confirm delivery and to monitor contractual performance. In addition, companies will more readily be able to use the information generated by the transaction to update their inventory and accounting records. Companies can automatically link their transactions to software used for supply chain management, enterprise resource planning, and final customer sales.

A key technology expected to facilitate B2B e-commerce is the application of Extensible Markup Language (XML). The language is a refinement of the Standard Generalized Markup Language (SGML), which is a language used to define languages. The XML language allows documents to be treated as data, so that computers can exchange data more effectively, thus aiding the automation of data exchange between companies. Standardized XML data-description “tags” are being developed for different market applications, in order to capture the types of data that are most important in each market (sizes, prices, material grades, colors, delivery methods, etc.). If the standards are generally adopted, this will help manufacturers, suppliers and distributors to exchange commercial information without creating customized formats for each partner (Mitchell, 1999). Hypertext Markup Language (HTML) speeded the development of Internet web sites by establishing a standard format for documents that allows users to use a standard browser to view styled text, graphics, and hyperlinks to other Web pages. The XML standard promises similar advantages for exchange of information between businesses, including data on sales, inventory, production, payments and transportation.

Using XML, a person can receive and analyze data obtained on the Internet without the need to go back to the host server on which the data is stored, thus vastly speeding up communication and making more efficient use of scarce server capacity and reducing Internet traffic. For example, a user can obtain information from a travel agency about flights on a given day and then compare

airfares and itineraries without relying on data processing by the travel agency's server (Bosak and Bray, 1999). Because of its flexibility, XML should allow each industry to establish simple standards for the exchange of data and the execution of commercial transactions.

## **Intermediation**

Online B2B companies have proposed or instituted a variety of intermediation services. Intermediaries bring buyers and sellers together, lowering transaction costs relative to direct exchange in a variety of ways (see Spulber, 1999). They reduce search costs, by providing a central place of exchange, and bargaining costs, by standardizing contracts and negotiation procedures. They reduce adverse-selection costs by providing market information, product guarantees and price-discovery mechanisms, and they reduce moral-hazard costs by providing monitoring services. They also reduce the likelihood of contractual hold-up, by establishing a reputation as a guarantor of transactions.

Popular discussions often suggest that efficiencies in B2B e-commerce are obtained by disintermediation: "cutting out the middlemen," or supplanting presumably costly intermediaries with direct transactions. However, if B2B e-commerce encourages outsourcing to replace some transactions previously internal to the firm, the end result would be more intermediation rather than less. Furthermore, much B2B intermediation is targeting inefficient direct meetings between companies and their suppliers, which would also increase the amount of intermediation activity.

The economics of intermediation can be illustrated using the following simple example. Suppose that the transaction costs to a buyer and seller in a direct exchange equal \$100. This includes the costs of searching for the other party, negotiating the terms of exchange, and the communication costs involved in completing the exchange, such as billing and payments. The buyer and seller have an incentive to switch to an intermediary if the intermediary can carry out the exchange with total transaction costs to buyer, seller and intermediary of say \$20. If the intermediary has monopoly power, it can attract the buyer and seller with a bid-ask price spread equal to the transaction costs of direct exchange,  $P_B - P_A = \$100$ , supposing that the intermediary

bears all the transaction costs. The intermediary's profit will equal the price spread net of transaction costs, that is,  $\$100 - \$20 = \$80$ . If other intermediaries enter the market and engage in Bertrand-type price competition, the price spread will fall to the transaction cost of an intermediary, that is,  $PB - PA = \$20$ .

Although it is difficult to know for sure what the exact figures may be, we believe that the cost savings illustrated in our example above are of the right order of magnitude. For example, according to a recent report by Morgan Stanley Dean Witter (Phillips and Meeker, 2000, p. 31), British Telecom estimates that by moving procurement functions to electronic commerce, it has reduced its costs from \$113 to \$8 per transaction. MasterCard estimates that the cost of processing purchase orders have fallen from \$125 to \$40, with the time involved cut from 4 days to 1.25 days (Alaniz and Roberts, 1999, p. 13). We suspect that these estimates are less precise than most industry observers would admit; they do not report standard errors. Processing a purchase order manually, including paperwork, data entry, phone calls, faxes, and approval requests, can be quite expensive, so online transactions might easily reduce costs by a factor of five or ten.

### **Transaction mechanisms**

There are four main types of e-commerce intermediaries, ordered roughly in terms of the participation of the intermediary in the exchange: brokers, auctioneers, exchanges, and dealers. The participation of the intermediary is primarily defined in terms of the pricing mechanism and whether or not the intermediary transfers ownership of the goods and services. We define the types of intermediaries and apply them to a classification of selected companies.

Brokers match buyers and sellers for a fee. Some brokers offer simple referral services, providing buyers with information about sellers. These services somewhat resemble yellow-page directories, but with more comprehensive information and search facilities. Sellers may pay fees to be listed, or to provide additional information about themselves, while buyers generally do not pay for access. Buyers can then contact sellers through links to their Web sites, and through email or offline communications, see Kaplan and Sawney (2000). Some broker sites also allow sellers to

place listings, resembling classified ads, for specific products. At the sites of more comprehensive B2B brokers, sometimes called “catalog aggregators,” buyers can view catalogs of catalogs, containing information about products and prices from different sellers. These catalog-oriented brokers take orders for products on the sellers’ behalf, typically leaving order fulfillment up to the sellers themselves.

Auctioneers take a more active role in the transaction by setting up a mechanism to determine the transaction price. Internet technology significantly reduces the cost of running an auction relative to using posted prices, and auctions may be particularly useful in situations where there is enough uncertainty to make it unclear what the market-clearing price should be. Auctions have become popular among individual consumers on the Internet; see Lucking-Reiley (2000). In B2B e-commerce, sellers have held auctions of surplus inventory, including items as diverse as rolls of steel and advertising space. Buyers have held reverse auctions, in which sellers compete against each other for a procurement contract. FreeMarkets Online is perhaps the largest “reverse auctioneer,” having assisted in procurement for clients as diverse as Quaker Oats and the Pennsylvania Department of Transportation. FreeMarkets claims a total of over \$5.4 billion in contracts between 1996 and mid-2000, with the involvement of over 4,000 vendors from more than 50 countries in over 70 categories (Gupta, 2000). A key difference between forward auctions and reverse auctions is who gets to specify the good being auctioned: typically the good is defined by the seller in an ordinary auction, and by the buyer in a reverse auction.

Exchanges are double-sided markets, similar to existing markets for financial instruments and some commodities (such as those traded on the Chicago Mercantile Exchange), but B2B firms promise to extend such markets to a variety of new products, including manufactured goods, primary inputs, and services. Exchanges provide a host of services including rules for trading, price transparency, and centralized clearing. Trading rules can be structured so that buyers and sellers expect to receive the best available price for their transactions. Price transparency allows buyers and sellers to observe the prices of transactions as they occur. Centralized clearing reduces transaction costs because buyers and sellers need only settle with the exchange based on their net position at

the end of the day relative to all transactions on the exchange, rather than settling each transaction individually.

Centralized clearing is a straightforward service in stock exchanges or with limited numbers of well-defined commodities, but it presents more of a challenge in B2B markets with a proliferation of different specialized products. With many different product specifications possible (thousands of types of plastic moldings, of printed circuit boards, etc.), exchanges may often look more like negotiations (with only two or three parties involved) than like financial double markets (with thousands of participants trading shares of the same stock in a given day, and centralized clearing reducing the total number of required bookkeeping operations).

In some of the online B2B markets we have observed, the exchange has been organized like a bulletin board: a buyer may post a bid for a desired commodity, say 4 tons of grade-3 low-density polyethylene to be delivered to St. Louis on October 1, with some bid price in dollars. In response, a seller can post a counteroffer - and rather than merely posting an ask price somewhat higher than the bid on this commodity, she may also decide to change the product specifications somewhat. For example, she might post the information that while she has no grade-3 product available for October 1, she might instead provide a grade-2 product on October 10, along with her new ask price. The original buyer - or even a new buyer - could then respond with a new bid on the newly defined commodity. Perhaps as the market grows and the number of participants increases, there will be enough transaction volume to support a separate double auction for each separate commodity, just as in markets for precious metals or for shares of stock. Another possibility is that intelligently designed computer software will make it less cumbersome to conduct these types of negotiations with lots of permutations of product attributes. Already, computer text search facilities make it possible for buyers and sellers to be matched intelligently when they put related posts on a bulletin board. Creating an exchange for such products will likely entail specialized auction procedures that adjust prices for multidimensional product attributes; the development of such mechanisms is still in its infancy.

Dealers take ownership of goods provided by suppliers and resell them to buyers. Dealers

post ask prices for buyers and bid prices for sellers. They earn returns from the bid-ask spread, adjusting prices to changes in market conditions. At the early stages of development of B2B e-commerce, few of the new online companies have attempted to become dealers. Instead of building the physical infrastructure required for inventory and shipping, most have chosen to focus on building the electronic infrastructure of markets (broker, auction, or exchange).

In addition to the services described above, a number of online companies describe ambitious future plans for offering some of the value-added services frequently offered by established dealers, such as trade credit, supply chain management services, appraisal, transportation, storage and other wholesale activities. For example, ChemConnect, an online exchange for chemicals and plastics, has an arrangement with Optimum Logistics to be its provider of transportation services. VerticalNet provides consulting services to complement its intermediation activities on the dozens of specialized Web sites it operates in different markets, . VerticalNet's Web sites also provide services often referred to as "community and content," including industry news, reviews, and other editorial features, as well as the referral and listing services described above as broker functions.

### **Early B2B E-Commerce Marketplaces**

By mid-2000, there were already at least 600 online trading exchanges funded by venture-capital firms, with projections of thousands more potential entrants (Latham, 2000, p. 3). Industry reports, and our own visits to dozens of e-commerce sites, indicate that less than 15 percent of these companies were actively operating markets. Most were "vaporware," premature announcements designed to stake out market territory for companies before their service was actually available. Substantial shakeouts are predicted over the next few years by industry pundits, as the markets become established. (King, 2000). See Table 1 for several dozen examples of B2B e-commerce sites with demonstrated market-making functionality. Our list is by no means comprehensive; we present a selection of sites to illustrate the variety of different markets served and market mechanisms employed. [Footnote: Comprehensive, up-to-date lists of B2B e-commerce companies

can be found at these helpful reference sites: <<http://www.line56.com/b2bprofiles/verticals.cfm>> and <<http://www.nmm.com/knowledgebase>>.]

\*\*\*TABLE 1 Here \*\*\*

B2B companies cover almost the entire spectrum of interbusiness commerce. Companies have been formed to trade items from advertising to almonds, from lighting fixtures to laboratory equipment, from cattle embryos to circuit boards. Online markets have been established (or at least announced) for aircraft parts, agriculture, apparel, automotive parts, chemicals, computers and electronics, energy, financial instruments, food and beverages, health care, intellectual property, freelance services, laboratory supplies, industrial machinery, advertising, metals, office supplies, plastics, paper, printing services, telecommunications, shipping, and travel services. One market receiving particular attention has been “MRO,” or products for “maintenance, repair, and operations,” because these are indirect materials (belts, pumps, light fixtures, etc.) required by almost all firms in all industries, and therefore seen as a very large potential market. We note that industry insiders typically refer to a marketplace targeting a single industry, such as for steel or paper, as a “vertical” market, while a marketplace targeting many industries, such as for MRO products or for shipping services, as a “horizontal market.” For example, VerticalNet has made a name for itself on Wall Street by developing trading communities in a variety of different “verticals,” including sites such as Bakery Online, E-Hospitality.com, Machine Tools Online, and SolidWaste.com. We do not find this distinction terribly helpful from an economic point of view, but we find that understanding this language helps us to decipher industry reports.

The ownership structure of each marketplace has been an interesting issue in the early years of market organization. Many early B2B e-commerce companies have been startups financed by independent partners or by venture capital. Some, like VerticalNet, have become publicly traded companies. A number of these companies also obtained equity investments from large potential customers: for example, ChemConnect includes BASF and Dow as equity partners, while

PaperExchange similarly includes International Paper and Staples. Because successful B2B companies have been expected to generate substantial returns from transaction cost savings relative to existing market organization, large buyers and sellers have displayed an interest in obtaining ownership stakes in B2B companies in return for directing transactions to that particular company.

The first half of 2000 saw the development of a different type of ownership structure, with a flurry of announcements made by alliances of established manufacturers planning to sponsor their own new marketplaces. For example, Boeing, Lockheed Martin, BAE Systems, and Raytheon have formed an exchange for aerospace parts and services with the potential for over \$70 billion in business with 37,000 suppliers. Similarly, International Paper (despite its previous equity investment in PaperExchange) joined with Georgia Pacific and Weyerhaeuser to announce the development of a trading exchange for paper and forest products. These examples of industry-sponsored exchanges illustrate two different types of ownership; the aerospace exchange is owned by firms who are primarily buyers, while the paper exchange is owned by firms who are primarily sellers. In these arrangements, the ownership tends to be on the side of the market with the greatest concentration of market power (few buyers and many suppliers in automotive parts, many buyers and few suppliers in paper products). By mid-2000, it was estimated that 60 buyer-dominated consortia, representing over 278 companies and \$3 trillion in annual purchasing, planned to establish their own electronic markets rather than relying on independent exchanges (Roberti, 2000).

These industry-sponsored exchanges base their strategy on the idea that the technology of Internet marketplaces should be relatively easy to reproduce, and that the most important asset of an intermediary is the business of its key buyers and sellers, so these key buyers and sellers hope to be able to obtain the intermediary's profits for themselves. Moreover, since the type of transaction mechanism (for example auctions, reverse auctions or double auctions) may impact the distribution of rents between buyers and sellers, large buyers and sellers may use ownership stakes as a means of influencing the choice of the pricing mechanism. By contrast, smaller buyers and sellers have had incentives to favor independently-owned exchanges offering transparency, neutrality in



execution of trades and up-to-date pricing information. At this writing none of these industry-sponsored exchanges have yet begun operating, so it is far from certain which types of market makers will eventually become dominant.

A final category of B2B e-commerce companies is the relatively small group of “old economy” distributors who have moved aggressively into online methods of intermediation. Established companies with existing manufacturing or distribution plant and equipment are sometimes referred to as bricks-and-mortar companies as distinct from online companies with minimal facilities. Existing distributors have certain advantages over independent, publicly traded, or industry-owned companies, including expertise in value-added services, and customer and supplier contacts that can be used to establish and operate Internet markets. For example, the on-line chemical marketplace Chempoint is a subsidiary of the traditional distributor Royal Vopak. Grainger, a distributor of supplies for maintenance, repair, and operations founded in 1927, has made its catalog of hundreds of thousands of items available for online ordering. (Interestingly, Grainger negotiates different pricing contracts with different customers, so each customer views a customized set of prices after logging in to Grainger.com.) DoveBid, a decades-old industrial machinery auctioneer that recently entered into online auctions, has established business arms for value-added transportation, appraisal, and inspection services, in contrast to many Internet start-up companies that primarily operate web sites. Eriksen (2000, p. 7) reports that “To date, there are no examples of vertical marketplaces disintermediating existing channels,” and it is not clear whether traditional distributors will be displaced by the new companies, or whether they will instead evolve to become online-oriented businesses. Instead, distributors are shifting some of their business online or taking equity shares of online markets.

Cantor Fitzgerald, the parent company of eSpeed, provides an important example of a company establishing an online service that will cannibalize its existing business. The company estimates the total value of fixed income securities around the world at \$45 trillion, (advertisement in the New York Times, May 11, 2000, p. C3). According to the company, Cantor Fitzgerald operates about 50% of the global wholesale market for fixed-income securities such as treasuries,

corporate bonds, and municipal bonds. The company offers an electronic trading alternative to established bond trading most of which has traditionally been carried out by telephone conversations (Raynovich, 2000). ESpeed does not plan to disintermediate dealers but rather to offer its bond trading technology and service to brokers. ESpeed characterizes itself as a business-to-business market maker, with a service allows investors to trade bonds and other financial assets just as they trade stocks (Casey, 2000). By mid-2000, ESpeed's systems handled over \$150 billion in daily transactions, well over four times the daily volume of the New York Stock Exchange (see <<http://www.eSpeed.com>>).

## **Productivity**

Robert Solow's (1987) well-known observation, "You can see the computer age everywhere but in the productivity statistics," might apply to e-commerce as well. The Solow paradox continues to cast doubt on the effects of advances in information technology on productivity improvements in the U.S. economy and elsewhere. Will the advantages of technological change and market reorganization in e-commerce translate into enhanced productivity?

Predictions of vast efficiency gains from business-to-business e-commerce are based on conjectures about how many intercompany transactions will shift to the Internet. Expectations about cost gains from electronic commerce depend on possible efficiencies from automation of transactions and the potential economic advantages of intermediation and centralized exchanges. To date, the overall effect on productivity of advances in computers and communications has been decidedly mixed (see Gordon, 2000). This presents a puzzle, given the high level of investment that companies have made to apply these new technologies. It may be that the costs of adjusting to new technologies may offset the productivity benefits. Gordon's analysis shows that in the latter half of the 1990's at least, information technology fails to measure up to the standard set by the industrial revolution; productivity has exploded in the manufacturing of computers, semiconductors and other types of durables but productivity growth has decelerated in the rest of the economy. David (2000)

suggests that the productivity benefits of information technology are delayed but will show up eventually in productivity data, while Gordon argues that “the speed at which diminishing returns have taken hold makes it likely that the greatest benefits of computers lie a decade or more in the past, not in the future.” Moreover, according to Jorgenson and Stiroh (2000), “the empirical record provides little support for the “new economy” picture of spillovers cascading from information technology producers onto users of this technology.” In contrast, Oliner and Sichel (2000) find that the use of information technology, including not just computer hardware and software but also communications equipment, contributed substantially to productivity growth in the late 1990s.

The mixed record of observed impacts on productivity may be due to difficulties in measuring the effects of technological change. Because the market reorganization and technological investment required to implement B2B e-commerce is in its initial stages, it is difficult to evaluate the productivity impacts. Measurement of productivity growth in services presents special problems. Productivity measures are geared to manufacturing, while B2B e-commerce targets merchant activities. Triplett and Bosworth (2000) observe that economic changes attributable to e-commerce cross the traditional production boundary used in national accounts. As an example, they compare the purchase of a book from a traditional retailer with the purchase of a book from an online retailer. Comparing the prices in the two settings ignores various differences, by ignoring the costs of travel and time involved in visiting the traditional retailer while explicitly counting the costs of shipping and handling for the online purchase. In the case of B2B e-commerce, measurement of productivity gains should accurately reflect the total net benefits that result from shifting bilateral intercompany transactions to intermediated exchange. Evaluating the productivity gains from lowered search and procurement costs for buyers and sellers poses difficult measurement problems.

### **Industry structure**

What is the expected industry structure of the B2B market? Rapid entry has led to a proliferation of many competitors in each segment of B2B e-commerce, but most of these entrants

are doing very little business so far. Several factors suggest significant shakeouts in this sector: low entry costs, increasing returns to scale, and uncertainty about demand and costs. These factors suggest that in the initial stages, segments of the e-commerce market place have the characteristics of contestable markets.

First, entry costs appear to be very low relative to expected returns, as suggested by the rapid entry of so many companies. Companies can rent communications and computer facilities without incurring irreversible capital costs. Moreover, market entrants can outsource operation of their website to specialized service providers. By partnering with other companies that provide software and website design, the so called e-commerce platforms, companies can avoid some of the sunk costs of creating e-commerce applications. For example, the companies Ariba and CommerceOne have developed software platforms for running e-commerce marketplaces (either via fixed-price catalogs or via bidding to determine prices), and they have provided the software to a number of companies such as those found in our Table 1. Firms like SAP, PeopleSoft, and Oracle have developed enterprise resource planning (ERP) software over the past decade to help companies integrate their payroll, accounting, inventory, and other systems to provide managers with improved information for decisions, and a company called WebMethods has specialized in helping market participants integrate their ERP systems with marketplace software. The new firm i2 specializes in providing “supply chain management” software to use downstream order data to make better demand predictions for manufacturers and enable them to reduce inventories. Older software companies, from Oracle to IBM to Microsoft, have also been developing software applications for use by B2B intermediaries. Thus, for many B2B companies the sunk costs of entry are primarily focused on designing specific e-commerce services and on marketing and sales expenditures to attract buyers and sellers.

Second, e-commerce appears to exhibit returns to scale. E-commerce operations will generally involve a relatively high proportion of fixed costs relative to incremental costs. Once the market systems are designed and put into service on a server on the Internet, the traffic-sensitivity of incremental operating costs appears relatively low. The marginal costs of providing price

information to market participants is near zero. Moreover, as is well known in financial markets, increasing the number of market participants on B2B exchanges enhances liquidity. Liquidity refers to the ease with which buyers and sellers realize transactions in a market, so that greater number of sellers attracts more buyers and conversely a greater number of buyers attracts more sellers. Accordingly, buyers and sellers have an incentive to trade on the highest volume exchange. The liquidity benefits of increased market concentration are evident in financial markets with much of securities trading centralized by the New York Stock Exchange and NASDAQ. The advantages of market concentration are also reflected in the success of online C2C auctions, where eBay has become a dominant player with 90% market share; see Lucking-Reiley (2000).

Finally, there is uncertainty about the costs of operating such markets and about the demand for e-commerce services. The costs of operating computer and communications systems may be relatively well understood. However, the costs of establishing and operating a central market place are less well known since companies are experimenting with different types of services. The rate at which buying and selling will migrate from traditional channels to the Internet is difficult to predict, and it is unknown which types of intercompany transactions will prove popular. Accordingly, entrants in e-commerce frequently change their business models, and competitors within specific industries may offer substantially different types of transactions. Evolution of B2B e-commerce is likely to result in standardization of business models and transactions, as has occurred in financial markets.

For these reasons, industry observers predict that only one or two markets will operate in each product or service category. To understand the projected shakeouts in B2B e-commerce, it is useful to compare experiences in establishing other types of markets. The history of commodity futures markets is instructive. Carlton (1984, p. 256) observes that between 1921 and 1983, 180 different futures markets existed, with an average lifetime of less than 12 years. Those markets founded after 1921 had an average lifetime of about nine years, with only three specific commodity contracts continuously listed in the Wall Street Journal for the entire period studied. Carlton also points out that futures exchanges compete with each other for volume, and that the industry tends to

converge to highly concentrated market structures.

Commodity futures markets are feeling pressure from B2B e-commerce. The Chicago Mercantile Exchange has chosen to demutualize, or shift from a holding company mutually owned by members to a publicly traded company. The New York Mercantile Exchange (NYMEX), which specializes in energy markets, is also contemplating demutualization. NYMEX chairman Daniel Rappaport stated that before it could consider an initial public offering, the exchange “would have to establish good e-commerce capability”(Sales, 2000).

Consolidation and exit of B2B exchanges is likely to eliminate duplication of effort and to concentrate transactions. Such concentration would be similar to the recent international consolidation of equities exchanges. For example, the Paris, Brussels and Amsterdam exchanges have merged to form the Euronext exchange. Subsequently, the Deutsche Börse, which owns the Frankfurt Stock Exchange, has merged with the London Stock Exchange to form the international exchange called iX, while announcing a close partnership with NASDAQ. The concentration of equities exchanges has occurred partly in response to the efficiency of electronic communications networks (ECNs) such as Instinet, Island and Archipelago, which had captured 30% of NASDAQ trades in the U.S. (Morgenson, 1999). Moreover, the exchanges have been under pressure, particularly from institutional investors, to increase liquidity and reduce costs by combining national exchanges (Andrews, 2000). These consolidations in financial markets suggest that the proliferation of B2B exchanges is likely to be a short-run phenomenon, with eventual concentration of volume in specific markets through mergers and by the exit of smaller exchanges.

### **Effects on the organization of firms**

Ronald H. Coase (1937) was the first to argue that companies compared the costs of organizing production of inputs with the transaction costs of using the market. To the extent that e-commerce technology lowers the costs of intercompany transactions, there will be substantial effects on the organization of firms.

As transaction costs fall, there are returns to setting up organized exchanges for external

markets, so companies will reduce the number of people they employ in purchasing and sales. Sales personnel acting as sales representatives have traditionally carried out such mundane tasks as tracking product availability and pricing and supplying such information to customers. By automating these services through Web sites and electronic data interchange, e-commerce relieves sales personnel of these tasks, allowing them to concentrate on account management and marketing strategy (Slade, 2000).

As market transaction costs fall, there are greater returns to outsourcing and vertical disintegration. Companies will break up, resulting in more independent entities along the supply chain. Companies may grow horizontally as costs fall. When firms are less vertically integrated, they may achieve greater returns to scale by focusing on a smaller set of activities.

To illustrate the scope of these changes, consider the automobile industry. At the beginning of the 20<sup>th</sup> century, the automobile industry exhibited a strong preference for vertical integration, as illustrated by Ford's slogan "From Mine to Finished Car, One Organization" (see Casadesus-Masanell and Spulber, 2000). By 1920, General Motors (GM) "had extended its scope so that not only all the engines used in its cars, but a large proportion of such units as gears, axles, crankshafts, radiators, electrical equipment, roller bearings, warning signals, spark plugs, bodies, plate glass, and body hardware, were produced either by a General Motors unit or by a subsidiary" (Edmonds, 1923). At the beginning of the 21st century, the automobile industry has begun to reevaluate its organizational structure. GM has spun off its parts manufacturing unit Delphi Automotive Systems Corp. to create the world's largest auto parts supplier with over 200,000 employees, and Ford has announced plans to spin off its Visteon parts division, thus converting internal transactions into B2B transactions. GM, Ford, and DaimlerChrysler have announced a plan to start a company called Covisint that will handle auto parts transactions from suppliers. The supply chains of these three companies totals almost \$250 billion, so if it succeeds, Covisint has the potential to be the largest business on the Internet (Moore and Trenker, 2000).

## **Conclusion**

The enormous growth predictions for business-to-business electronic commerce must confront the realities of reorganizing industry. It is evident that advances in computers and communications hold great promise for reducing transaction costs between businesses. Moreover, some of the many innovative proposals for market reorganization by intermediaries and market makers should help to reduce the costs of search, contracting, and monitoring performance in market for inputs. However, it will take time to implement the significant changes in the merchant functions of firms that are needed to realize these cost savings. Moreover, some of these savings are to be achieved not simply by changing market transactions but by changing the make-or-buy decisions of companies. As a result, the benefits of lower transaction costs might not be achieved without significant changes in the manufacturing activities of companies through outsourcing and expansion of external suppliers. Finally, allocating intercompany transactions through electronic intermediaries will require improved infrastructure for transportation and logistical coordination.

It is evident that the application of electronic commerce will proceed unevenly across industries. Different XML protocols are needed for each type of industry, and the negotiations needed to set standards will depend on the difficulty of the task and the extent of coordination within industry groups. Moreover, the ability to standardize transactions will vary based on the types of goods and services. Standardization of transactions will be accomplished with greater ease in industries selling basic commodities in comparison with parts and more complex components. The plethora of entrants and business models, and the significant returns to market consolidation, suggest that substantial entry and exit of firms will take place before the benefits of B2B e-commerce are obtained. Despite these caveats, the economic significance of intercompany transactions suggest that even small enhancements in the efficiency of transactions will produce large overall savings in the economy.



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**Table 1.** Examples of B2B Online Intermediaries.

Online Intermediary	Market	Date founded	Market mechanism
AlmondEx	Almonds	2000	Exchange
Altra Energy	Energy (oil and gas)	1996	Exchange
ApparelBids	Apparel	1999	Auctioneer
Arbinet	Telecommunications bandwidth	1996	Exchange
AutoTradeCenter	Autos	1997	Auctioneer, Broker (classified ads)
AviationX	Aircraft parts	1999	Broker (referrals)
Bakery Online	Bakery supplies and services	1997	Broker (referrals)
Buzzsaw	Construction	1999	Broker (referrals)
CheMatch	Chemicals	1995	Exchange
ChemConnect	Chemicals	1995	Exchange, Auctioneer
Chemdex	Biological chemicals	1998	Broker (catalogs)
Commerx PlasticsNet	Plastics	1995	Auctioneer, Broker (classified ads)
DoveBid	Industrial capital assets	1998	Auctioneer
e-Chemicals	Chemicals	1998	Broker (catalogs)
E-Hospitality.com	Vacation ind. supplies and services	1997	Broker (referrals)
e-Steel	Steel	1999	Exchange
ecFood.com	Food & beverage	1999	Auctioneer, Broker (catalogs, referrals)
eLance	Freelance services	1999	Auctioneer, Broker (classified ads)
Enron Online	Energy (oil and gas)	1999	Exchange
eSpeed	Government bonds	1999	Exchange
FarmBid	Agricultural supplies	1999	Broker (catalogs, classified ads)
Fast-Net	Auto parts	1996	Broker (catalogs, classified ads)
FastParts	Electronics	1991	Exchange, Auctioneer
FreeMarkets	Misc. procurement	1995	Auctioneer
Grainger.com	Industrial parts (MRO)	1995	Dealer
Guru.com	Freelance services	1999	Broker (classified ads)
Houston Street Exch.	Energy (oil and electricity)	1999	Exchange
iMark	Industrial capital assets	1999	Auctioneer
iProcure	Office supplies	1997	Broker (catalogs)
Logistics.com	Shipping services	1996	Auctioneer
Machine Tools Online	Machine tools	1997	Broker (referrals)
MedSite	Physicians' supplies	1999	Dealer
MetalSite	Metals	1998	Exchange, Auctioneer

MuniAuction	Municipal bonds	1997	Auctioneer
Nat'l Transportation Exch.	Partial-truckload shipping	1993	Exchange
NeoForma	Healthcare supplies	1996	Auctioneer, Broker (catalogs, referrals)
NetworkOil	Petroleum machinery and services	1999	Auctioneer, Broker (catalogs, referrals)
One Media Place	Advertising	1997	Auctioneer, Broker (classified ads)
PaperExchange	Paper and pulp	1998	Exchange
Patent & License Exch.	Intellectual property	1999	Auctioneer
RateXchange	Telecommunications bandwidth	1997	Exchange
Retail.com	Apparel and jewelry	1999	Auctioneer, Broker (catalogs, referrals)
RetailExchange	Apparel and housewares	2000	Exchange
SciQuest	Laboratory equipment	1995	Auctioneer, Broker (catalogs)
Solid Waste.com	Solid waste ind. supplies and services	1997	Broker (referrals)
TradeOut	Misc. surplus inventory and assets	1998	Auctioneer, Broker (classified ads)
Tradeweave	Apparel	1999	Auctioneer
XSAg	Agricultural supplies	1999	Auctioneer
ZoneTrader	Misc. surplus inventory	1994	Auctioneer, Broker (classified ads)