

Business-to-Business Electronic Commerce

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Business-to-business commerce includes 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. It also includes some types of financial transactions between companies, such as insurance, commercial credit, bonds, securities and other financial assets. The popular phrase B2B e-commerce refers to the substitution of computer data processing and Internet communications for labor services in the production of economic transactions. Many companies engaged in B2B e-commerce are intermediaries between other companies that buy and sell goods and services.

The potential size of B2B e-commerce in the economy is vast, though somewhat difficult to pin down. Jupiter Communications (2000) estimates that overall transactions of goods (excluding services) between businesses in the United States should amount to \$11.5 trillion in 2000, of which \$336 billion are conducted electronically.¹ By 2005, they expect the online component to represent \$6.3 trillion out of a total of \$15.1 trillion. A bit more modestly, Goldman Sachs (2000) projects B2B e-commerce transactions to reach \$4.5 trillion worldwide by 2005. The Gartner Group estimates that there were \$90 billion in Internet B2B transactions in 1999, by comparison with only \$16.7 billion in Internet business-to-consumer transactions, including brokerage fees for online financial trading as well as retail sales of goods (Uchitelle, 2000).

Expectations about productivity gains from B2B e-commerce can be usefully divided into four areas: possible efficiencies from automation of transactions, potential economic advantages of new market intermediaries, consolidation of demand and supply through organized exchanges, and changes in the extent of vertical integration of companies.

¹ Note that total transactions are revenue measures that may well exceed GDP, which is a measure of total value added.

Cost Efficiencies from Automation of Transactions

Traditionally, interbusiness transactions begin with a buyer looking for inputs or a supplier seeking buyers for its goods and services. Buyers and suppliers search for each other through advertising, trade shows, brokers, and dealers. Suppliers send out sales agents. 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 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. At every stage, e-commerce avoids the need to translate computer files into paper documents, a process that generally involves errors, delay and costly clerical personnel. E-commerce automates this process by mediating transactions through Web sites and electronic data interchange (EDI)².

Before the transaction, Internet technology may lower the cost of searching for suppliers or buyers and making price and product comparisons. Search costs can be significant relative to the value of the product, particularly for small purchases. Alf Sherk,

² EDI is an e-commerce technology older than the World Wide Web that involves point-to-point communications done over proprietary networks, rather than over the Internet. Relative to EDI, Internet commerce offers considerable advantages in terms of cost and convenience. Internet commerce typically makes use of open standards and off-the-shelf technology on a global network, while EDI relies on customized hardware and software. However, 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). According to the Commerce Department, EDI is currently used at more than 250,000 companies in the United States, processing an estimated \$3 trillion in transactions in 2000 (Phillips and Meeker, 2000, p. 25).

the founder of e-Chemicals, claims: "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). 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 information services, e-commerce relieves sales personnel of these tasks, allowing them to concentrate on account management and marketing strategy (Slade, 2000).

During the transaction, e-commerce can reduce the cost of communicating with counterparts in other companies regarding transaction details. Transactions over computer networks avoid many of the associated costs of interpersonal economic exchange, including the costs of travel, time spent on communication, physical space for meetings, and processing paper documents.

After the transaction, electronic commerce allows companies to lower costs of communication, to monitor contractual performance, or to confirm delivery. In addition, companies can apply information generated by the transaction to update their inventory, production and accounting records by automatically linking their transactions to software used for managing all aspects of the firm including sales, purchasing and operations.

The potential cost savings in this area are substantial. 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 or more. There is anecdotal evidence that such cost reductions are possible. British Telecom estimates that by moving external procurement functions to electronic commerce, it has reduced its costs from \$113 to \$8 per transaction (Phillips and Meeker, 2000, p. 31).

MasterCard estimates that the cost of processing purchase orders has fallen from \$125 to \$40, with the time involved cut from 4 days to 1.25 days (Alaniz and Roberts, 1999, p. 13). Lehman Brothers finds that a financial transaction is \$1.27 for a teller, \$0.27 for an ATM and \$0.01 for an online transaction (The Economist, 2000). Online brokerage fees have fallen to below \$5 in comparison with traditional discount brokerage fees exceeding \$50, suggesting a decrease in costs in back-office operations and brokerage transactions with financial exchanges. Even if such estimated savings are greater than average or vary across industries, their aggregate impact is likely to be enormous. By lowering the costs of transactions, e-commerce will change not only operating costs but also the characteristics and scope of feasible transactions.

Economic Efficiency Gains from Intermediation in B2B E-Commerce

Intermediation and market-making are central activities in a market-oriented economy, bringing buyers and sellers together. Intermediaries can reduce transaction costs relative to direct exchange, by reducing the costs of search, certifying product quality, mitigating communication costs, and providing guarantees for buyer or seller commitments (Spulber, 1996, 1999). Companies acting as market-makers enhance transaction efficiency by creating institutions of exchange, adjusting and communicating prices, clearing markets, allocating goods, and providing liquidity and immediacy (Spulber, 1998).

Business-to-business e-commerce appears likely to transform the traditional patterns of intermediation in ways large and small. Intermediaries reduce search costs by

consolidating markets, providing market information and offering an assortment of goods and services, so that buyers obtain the cost efficiency of one-stop shopping, rather than spending time contacting multiple suppliers. Many business-to-business intermediaries seek to offer a broader range of services including communication of price information and price adjustment. Centralized markets often reduce time costs by replacing bilateral negotiation with formal bidding mechanisms and information about transaction prices.

B2B e-commerce companies cover a wide spectrum of industries. 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 products for maintenance, repair, and operations (MRO) because materials like belts, pumps, and light fixtures are required by almost all firms in all industries, and therefore are seen as a large potential market.³

Many business-to-business companies hope to create additional intermediation services. Many B2B companies propose to design innovative procurement transactions between a company and its many suppliers. Other firms are setting up markets that can

³ 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 maintenance, retail and operations 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

provide novel types of transactions that aggregate supply and demand. 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 Générale, have announced a new global electronic marketplace for over-the-counter energy, metal, and other commodities called the Intercontinental Exchange to replace transactions that were largely conducted bilaterally by telephone (Shmukler, 2000). The Intercontinental Exchange market will have various novel features including the provision of information to traders regarding the creditworthiness and other characteristics of their counterparties, along with information regarding market aggregates (Market News Publishing, 2000).

A number of online companies described ambitious plans for offering some of the value-added services frequently offered by established dealers: trade credit, supply-chain-management services, appraisal, transportation, storage and other wholesale activities. For example, ChemConnect, an online exchange for chemicals and plastics, arranged for Optimum Logistics to provide transportation services. VerticalNet provides consulting services to complement its intermediation activities on the dozens of specialized websites it operates in different markets. VerticalNet's websites also feature services often referred to as "community and content," including industry news, reviews, and other editorial features.

Popular discussions often suggest that efficiencies in B2B e-commerce are obtained by disintermediation: that is, by "cutting out" middlemen and supplanting presumably costly intermediaries with direct transactions. However, less expensive intermediation and lower transactions costs do not necessarily mean fewer intermediaries. If B2B e-commerce

distinction terribly helpful from an economic point of view, but we find that understanding this language helps in deciphering industry reports.

encourages outsourcing to replace some transactions previously internal to the firm, or if firms can use intermediaries to outsource some of their current external purchasing and sales efforts, or if firms can employ specialized intermediaries to avoid inefficient one-on-one direct meetings between companies and their suppliers, the end result would be a greater number of intermediaries (Spulber, 1999).

E-commerce intermediaries can be classified into four main categories: brokers, auctioneers, dealers, and exchanges. These categories depend on the intermediary's pricing mechanism and whether or not the intermediary takes ownership of the goods and services.

Brokers match buyers and sellers for a fee. Some brokers offer referral services that resemble yellow-page directories, but with more comprehensive information and search facilities. Buyers generally do not pay for access, using the directories to contract sellers who in turn pay listing fees. Examples include Buzzsaw (construction) and Bakery Online (bakery supplies).⁴ Sellers also can place product listings that resemble classified ads. At the web sites of some B2B brokers known as "catalog aggregators," buyers can view sets of catalogs that contain information about products and prices from different sellers. Examples are iProcure (office supplies) and Chemdex (laboratory chemicals). catalog aggregators take orders for products on the sellers' behalf, typically leaving order fulfillment up to sellers.

Auctioneers take a more active role in transactions by setting up a mechanism to determine prices. Internet technology significantly reduces the cost of running an auction relative to using posted prices, and auctions are useful in situations where there is enough

⁴ Though these two sites provided only referral services at the time we visited them, both had plans to add additional services to facilitate transactions. This is a general trend among B2B e-commerce markets; most advertise plans to provide many more services than they currently have available. Building up a user base on a "referral" site may well prove to be a good strategy for eventually creating a market where transactions take place explicitly.

uncertainty about market-clearing prices.⁵ Some auctioneers hold auctions of surplus inventory for sellers; examples include MetalSite (steel) and One Media Place (advertising space). Other auctioneers hold reverse auctions for buyers, in which sellers compete against each other for a procurement contract. FreeMarkets Online, founded in 1995, is perhaps the largest "reverse auctioneer;" their 1999 financial statements report over \$2.7 billion in transactions and \$20.9 million in corporate revenues. FreeMarkets has conducted procurement auctions for dozens of clients, including Quaker Oats, Deere & Co., and the Pennsylvania Department of Transportation, with bidding from over 4,000 vendors from more than 50 countries in over 70 categories (Gupta, 2000).

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. In the early stage of development of B2B e-commerce, few of the new online companies attempted to become dealers. Instead of building the physical infrastructure required for inventory and shipping, most chose to focus on building the electronic infrastructure of markets (broker, auction, or exchange).

Online dealer intermediaries tend to be subsidiaries of "old economy" distributors with existing physical infrastructure. Established distributors have certain advantages, including industry expertise and customer and supplier contacts. W.W. Grainger takes advantage of its long-standing distribution network. 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

⁵ Auctions have also become popular among individual consumers on the Internet; see Lucking-Reiley (2000).

customer-specific contracts, so that each customer views a customized set of prices after logging in to Grainger.com. EnronOnline is an online extension of Enron's business of buying and selling contracts for natural gas and other commodities with over-the-counter brokers, other wholesale merchants and its own sales and marketing unit. Enron migrated its trading from dealing over the phone to online buying and selling at posted prices. According to Enron's quarterly report for the third quarter of 2000, EnronOnline conducted 350,000 transactions worth \$183 billion since their launch in November 1999.

Exchanges are double-sided markets, similar to existing markets for financial instruments and some commodities (such as those traded on the Chicago Mercantile Exchange). 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. Typically, buyers and sellers can 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, rather than settling each transaction individually. B2B exchanges typically deal in unregulated forward contracts and thus differ from financial futures exchanges, which are governed by the Commodity Futures Trading Commission and other government agencies.

Examples of B2B companies organized as exchanges are AlmondEx (almonds), Altra Energy (oil and gas), Arbinet (telecommunications bandwidth), CheMatch (chemicals), e-Steel (steel), and PaperExchange (paper and pulp). Cantor Fitzgerald, the parent company of eSpeed, provides an important example of a company establishing an

online service that will cannibalize its existing business. Cantor Fitzgerald operates about 50% of the global wholesale market for fixed-income securities such as treasuries, corporate bonds, and municipal bonds.⁶

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 -- say, thousands of types of plastic moldings -- exchanges may often look more like small-party negotiations with only two or three participants, rather than like financial double-auction markets with thousands of participants trading shares of the same stock in a given day.

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, the seller may also decide to change the product specifications. For example, the seller might post the information that while it has no grade-3 product available for October 1, it might instead provide a grade-2 product on October 10, at a specified ask price. The original buyer -- or a new buyer -- could then respond with a new bid on the newly defined commodity.

⁶ Cantor Fitzgerald 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). 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 brokers but rather to offer them its bond trading technology and service. 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>>).

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. Creating an exchange for such products will likely entail specialized auction procedures that adjust prices for multidimensional product attributes. The exchanges also will improve economic efficiency of input markets by creating standardized products, allowing competitive bidding by multiple buyers and sellers, as in commodity futures markets.

Some firms fall into more than one of these categories. For example, PlasticsNet runs auctions for some transactions, but also operates as a broker by allowing its users to place classified ads for products. Similarly, MetalSite runs single-sided auctions for some clients, but operates a double-sided exchange as well.

Market Structure and Ownership of B2B Intermediaries

At the formative stage of B2B e-commerce, segments of the intermediary marketplace appeared to be highly competitive. There were hundreds of entrants with projections of thousands more (Latham, 2000, p. 3). Rapid initial entry suggests that entry costs were low relative to expected returns. Entry costs also appeared to be low because companies could rent communications and computer facilities without incurring irreversible capital costs. Moreover, market entrants could outsource operation of their website to

specialized service providers, the so-called e-commerce platforms. For example, Ariba and CommerceOne developed software platforms for running e-commerce marketplaces (either via fixed-price catalogs or via bidding to determine prices), and they provided the software to a number of companies. A wide variety of software applications became available. Thus, for many B2B companies entry costs were primarily focused on the design of e-commerce services and on marketing and sales expenditures to attract buyers and sellers.

Returns to scale and the importance of liquidity suggest that eventually only one or two markets will operate in each product or service category. Economies of scale result from the fact that creating an Internet-based market involves large fixed costs, while the marginal costs of providing transaction information to market participants appear to be near zero. Moreover, as the number of participants at a site increases, buyers and sellers both find it easier to realize transactions in a market, so that a 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. These scale and liquidity effects would be reduced if industries managed to settle on open standards for the exchange of information about products because then a smaller exchange could easily gather information and trading partners from a larger exchange, but it is unclear whether such interoperability between markets will materialize.

The history of commodity futures markets demonstrates that new markets often can fail. Carlton (1984, p. 256) observes that between 1921 and 1983, 180 different futures contract markets existed, with an average lifetime of less than 12 years. Those contract 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. An individual futures exchange can encompass many futures contract markets, so the failure of an individual market need not alter the lifespan of futures exchanges. Carlton points out that futures exchanges compete with each other for volume, and that the industry has tended to converge to highly concentrated market structures.

The rate at which concentration takes place in B2B e-commerce will depend on the speed at which buying and selling migrates to the Internet, what sorts of intercompany transaction mechanisms prove popular, and what methods evolve for standardizing transactions of goods that come in many closely related varieties. Some concentration appears to be occurring globally in equities exchanges. For example, the Paris, Brussels and Amsterdam exchanges have merged to form the Euronext exchange. This concentration of equities exchanges occurred partly in response to the efficiency of electronic communications networks such as Instinet, Island and Archipelago, which had captured 30 percent of NASDAQ trades in the United States (Morgenson, 1999).

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. Industry reports and our own observations of dozens of e-commerce sites indicate that less than 15 percent of B2B exchanges were actively operating markets.⁷ Many were "vaporware," premature announcements designed to stake out market territory for companies before their service was actually available. Some observers predicted substantial shakeouts within several years as the markets become established (King, 2000).

⁷ 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>>.

There are several different forms of ownership of B2B e-commerce companies: independent firms that operate a web site, traditional dealers who also operate online markets, and industry-operated exchanges. It is not clear whether one type of ownership structure will be more successful than others.

Many early B2B e-commerce companies were independent startups financed by venture capital. Some, like VerticalNet, became publicly traded companies. By mid-2000, there were at least 600 online trading exchanges funded by venture-capital firms (Latham, 2000, p. 3). ChemConnect also included customers BASF and Dow as equity partners, while PaperExchange included customers International Paper and Staples

Many established distributors are shifting part of their business online or taking equity shares of online markets, as noted previously. At least to date, there are no prominent examples of an existing distributor being displaced by a purely online business (Eriksen, 2000, p. 7). 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. The on-line chemical marketplace Chempoint is a subsidiary of the traditional distributor Royal Vopak. Other large established dealers entering B2B e-commerce include electronics and computer industry companies such as Arrow Electronics, Avnet, Ingram Micro, and Tech Data.

Alliances of established manufacturers announced plans to sponsor market places. These industry-sponsored exchanges base their strategy on the idea that the technology of Internet marketplaces is relatively easy to reproduce, and that the most important asset of an intermediary is the business of its key buyers and sellers. For example, Weirton Steel, LTV and Steel Dynamics formed MetalSite, which conducts thousands of transactions monthly.

Sears, Carrefour, and several other major retailers started GlobalNetExchange to organize purchases from over 50,000 vendors. Boeing, Lockheed Martin, BAE Systems, and Raytheon 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 ForestExchange trading exchange for paper and forest 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).

The establishment of B2B exchanges has raised several critical antitrust issues. Antitrust policy makers are concerned that B2B web sites will allow competitors to exchange price information thus facilitating collusion to fix prices. Also, antitrust authorities worry that B2B web sites will foreclose participation by competitors, leading to their exclusion from segments of the market. The FTC negotiated with the auto makers regarding the independence of the industry-sponsored parts exchange Covisint (Leonhardt, 2000). These concerns recall antitrust scrutiny of airline computer reservation systems that alleged collusion, exclusion and biased listings. Buyer- or seller-dominated web sites allegedly could become mechanisms for the exercise of market power.

In industry-sponsored exchanges as they have been announced, ownership tends to be on the side of the market with the greatest concentration of market power; for example, few buyers and many suppliers in automotive parts, many buyers and few suppliers in paper products. In contrast, smaller buyers and sellers may favor independently-owned exchanges offering transparency in execution of trades and up-to-date pricing information (Brown,

2000). Competition between exchanges should create incentives to avoid foreclosure or the exercise of market power. Owners of exchanges have incentives to increase volume and to foster liquidity by attracting more buyers and sellers, which should in turn lead to the development of independent neutral exchanges.⁸

Effects of E-commerce on the Organization of Firms

Ronald H. Coase's (1937) classic article introduced the concept of transactions costs. Coase explained that the costs of using the market were an important determinant of whether firms would carry out an economic activity within their organization or rely on purchases from other firms. When using the market is costly relative to management costs, companies have an incentive to vertically integrate. Yet, outsourcing is compelled by the buyer's need for flexibility and focus, supplier economies of scale and scope, and supplier expertise. To the extent that e-commerce technology lowers the costs of intercompany transactions, it should tip the balance toward greater use of external markets.

The potential effects of B2B e-commerce extend beyond saving money on transactions between existing firms. Cost and allocative efficiencies in e-commerce suggest a more fundamental change in the way that businesses are organized. Vertically integrated firms engage in substantial internal sales and procurement activities. With B2B e-commerce, such vertically integrated companies might reorganize to outsource production of goods and

⁸ According to AMR Research (2000), Covisint "has come to the understanding that its main customers aren't GM, Ford or DaimlerChrysler, but the suppliers." According to AMR Research Consortium Trading Exchanges "must behave like vendors and actively market themselves, manage expectations and deliver value in order to survive.

services that were previously produced internally, as well as outsourcing of the management of these transactions. For companies that purchase externally, B2B e-commerce intermediaries would substitute for many of the activities of company purchasing, sales, marketing, and even accounting departments. As market transaction costs fall with the maturation of business-to-business e-commerce, outsourcing and vertical disintegration will occur, resulting in more independent entities along the supply chain.

The automobile industry offers a vivid example of this change. At the beginning of the 20th century, the automobile industry exhibited a strong preference for vertical integration. Ford had a slogan: "From Mine to Finished Car, One Organization" (Casadesus-Masanell and Spulber, 2000). By 1920, General Motors "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).

But by the beginning of the 21st century, the automobile industry had begun to reevaluate its organizational structure. GM had spun off its parts manufacturing unit Delphi Automotive Systems Corp., thus creating the world's largest auto parts supplier with over 200,000 employees. Similarly, Ford had spun off its Visteon parts division in summer 2000, 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 one of the largest business on the Internet (Moore and Trenker, 2000). The pattern of greater reliance on coordination through markets

and less emphasis on vertical integration and organizational governance seems likely to proliferate.

Conclusion

Advances in computers and communications clearly hold great promise for reducing transaction costs between businesses.⁹ Productivity gains may result from the automation of transactions, the potential economic advantages of intermediation, the organization of centralized exchanges, and the reorganization of firms.

An important research question is the measurement of these economic efficiency gains. Yet, estimation of productivity growth in services such as B2B e-commerce presents some difficulties. 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 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, one would like measurement of productivity to reflect total net benefits, including lower search and procurement costs for buyers and sellers. A related question is how much of the current activities of companies in manufacturing, construction, energy, transportation are devoted to production operations and how much are attributable to transactions.

One of the challenges faced by companies in B2B e-commerce is the development of software and communications standards. Extensible Markup Language (XML) is being applied to develop data descriptions and protocols to describe practically all aspects of a transaction, including product features, transportation, prices, and credit terms. If standards are generally adopted, manufacturers, suppliers and distributors will be able to exchange commercial information using generally-recognized formats (Mitchell, 1999, Bosak and Bray, 1999). Such standardization enables the computers of both parties to a transaction to understand precisely what is being traded, so that each party can automatically update its internal records, such as billing and inventory. Developing such protocols will require extensive cooperation of buyers and sellers within industries.¹⁰ An important question for economic observers is what types of goods and services can be standardized and what types of transaction protocols will emerge.

Business-to-business e-commerce seems likely to engender a significant reorganization of industry, with a certain amount of vertical disintegration and new roles for intermediaries and market makers. The extent to which e-commerce will change the organization of firms has empirical significance for the theory of the firm. Another important issue is what types of market mechanisms will be favored by e-commerce and the relative importance of different types of intermediaries. Will B2B exchanges be owned by industry consortia or will they tend toward independence? 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.

⁹ For a discussion of the overall effect on productivity of advances in computers and communications, see the Symposium on Computers and Productivity in the Fall 2000 issue of this journal.

¹⁰ RosettaNet is an example of an organization devoted to the coordinated development of industry standards for information interchange.

The economic significance of intercompany transactions suggest that even small enhancements in the efficiency of transactions will eventually produce extremely large overall savings in the economy.

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