CHAPTER 8
Electronic Commerce

SOON-YONG CHOI
University of Texas

ANDREW B. WHINSTON
University of Texas

1. INTRODUCTION

Unlike applications based on electronic data interchange (EDI) and other previous uses of computer networks, the Internet has brought integration and versatility to existing computer and network technologies to the extent that firms and consumers are said to be in a virtual economic arena. A variety of commercial and economic activities fall within the realm of electronic commerce as long as they are carried out in the electronic marketplace. In this chapter, we present an overview of business and industrial applications of the Internet technologies.

Specific advantages of the Internet over previous closed, proprietary networks are numerous. First, the investment cost necessary to establish an Internet presence is relatively small compared to earlier

Handbook of Industrial Engineering: Technology and Operations Management, Third Edition.
Edited by Gavriel Salvendy

private value-added networks, which limited EDI applications to large corporations. Lower costs in turn allow small firms and individuals to be connected to the global network. Open TCP/IP protocols of the Internet also ensure that communicating parties can exchange messages and products across different computing platforms and geographic regional boundaries.

In physical markets, geographical distance and political boundaries hinder the free movement of goods and people. Similarly, closed proprietary networks separate virtual markets artificially by establishing barriers to interoperability. This is equivalent to having a railway system with different track widths so that several sets of identical rail cars must be maintained and passengers must be transferred at all exchange points.

Neither computing nor networking is new to businesses and engineers. Large-scale private networks have been an essential ingredient in electronic data interchange, online banking, and automatic teller machines. Business investments in information technology over the past decades have enabled firms to reengineer manufacturing, inventorying, and accounting processes. Nevertheless, the strength of the Internet lies in its nature as an open network. Economically speaking, the open Internet allows easy entry and exit into a market because of lower costs and greater market reach. A store located on a small tropical island can effectively reach global partners and consumers, collaborating and competing with multinational corporations without investing in international branches and sales presence.

While computers and networking technologies have advanced steadily over the past decades, they have lacked the characteristics of a true infrastructure. An infrastructure needs to be open and interoperable so as to allow various private enterprises with differing products and goals to collaborate and transact business in a seamless environment. As an infrastructure, the Internet provides open connectivity and uniformity as the first technological medium of its kind that supports a persistent development of universal applications and practices.

2. ELECTRONIC COMMERCE FRAMEWORKS

An apparent rationale for implementing electronic commerce is to reduce transaction costs related to manufacturing, distribution, retailing, and customer service. Many such uses involve automating existing processes through the use of computers and networks. But more importantly, new technologies now enable economic agents to move from simple automation to process innovation and reengineering. The complex web of suppliers, distributors, and customers doing business on the World Wide Web is allowing businesses to transform traditional markets and hierarchies into a new form called a network organization. Unlike hierarchies and centralized markets common in the physical economy, this structure based on networks allows a high degree of flexibility and responsiveness, which have become two pillars of the digital economy (see Section 2.3).

The Internet-based economy is multilayered. It can be divided into several layers that help us in grasping the nature of the new economy. Barua et al. (1999) have identified four layers of the Internet economy in their measurement of the Internet economy indicators. The first two, Internet infrastructure and Internet applications layers, together represent the IP or Internet communications network infrastructure. These layers provide the basic technological foundation for Internet, intranet, and extranet applications. The intermediary/market maker layer facilitates the meeting and interaction of buyers and sellers over the Internet. Through this layer, investments in the infrastructure and applications layers are transformed into business transactions. The Internet commerce layer involves the sales of products and services to consumers or businesses. According to their measurements, the Internet economy generated an estimated $301 billion in U.S. revenues and created 1.2 million jobs in 1998. Estimates of revenues and jobs contributions by each layer are presented in Table 1.

TABLE 1 Internet Revenues and Jobs in 1998, U.S.

	Estimated Internet Revenues (millions of dollars)	Attributed Internet Jobs
Internet infrastructure layer	114,982.8	372,462
Applications layer	56,277.6	230,629
Intermediary/market maker layer	58,240.0	252,473
Internet commerce layer	101,893.2	481,990
Total	301,393.6	1,203,799

Source: Barua et al. 1999. Reprinted with permission.

2.1. Economics of the Digital Economy

The digital revolution is often viewed as the second industrial revolution. But why does the Internet have such a great effect on business activities and the economy? How is the Internet-driven economy different from the previous industrial economy? Despite its obvious usefulness, a comparison to the industrial revolution is misleading—the digital revolution operates on quite different premises. In many respects, the digital revolution is undoing what we achieved in the previous age of industrial production. For example, the primary commodity of the digital age—information and other knowledge-based goods—behaves quite differently than industrial goods.

Industrial goods and production technologies that can churn out millions of an item with the least unit cost have been the hallmark of the modern economy. From ordinary household goods such as silverware and dishes to mass-produced industrial goods like automobiles and consumer appliances, increasing availability and decreasing price of these goods have brought an unimaginable level of mass consumption to the general public. Nevertheless, mass-produced industrial goods, typified by millions of identical Ford Model Ts, are standardized in an effort to minimize costs and as a result are unwieldy in fitting individual needs.

The characteristics of the industrial economy are summarized in Table 2. Business processes of an industrial firm are optimized for a supply-driven commerce, while the digital economy is geared toward customer demand. The economics of industrial goods has promoted least-cost solutions and a pervasive focus on costs that has become the limiting factor in both product choices offered to customers and manufacturing options open to producers. Values are created not from maximizing user satisfaction but from minimizing costs, not from flexibility in production but from production efficiency, which often disregards what the customers want and need. Value creation in the Industrial Age flows in a linear, rigid, inflexible, and predetermined stage of preproduction research, manufacturing, marketing, and sales. The need to minimize costs is so overwhelming that firms apply the same cost economics to nonmanufacturing stages of their business, such as distribution, inventory management, and retailing.

Partly because of the economic efficiency achieved during the industrial revolution, manufacturing now rarely accounts for more than half of a firm's total operating costs. Product research, marketing and advertising, sales, customer support, and other nonproduction activities have become major aspects of a business organization. This trend towards a nonmanufacturing profile of a firm is reflected in today's focus on business strategies revolving around quality management, information technology, customer focus, brand loyalty, and customization.

The Internet economy departs from the cost-minimization economics of the industrial age, but this transformation is not automatic simply because one is dealing with digital goods. For example, typical information goods such as news and databases are subject to the same economics as industrial goods as long as they are traded as manufactured goods. Cost minimization is still a necessary concern in the newspaper business. Limitations of the industrial age will translate into the Internet economy even when newspapers and magazines are put on the Web if these online products are nothing more than digitized versions of their physical counterparts. Many content producers and knowledge vendors may be selling digital goods but be far from participating in the digital economy if their products still conform to the cost-minimization economics of the industrial age.

2.2. Product and Service Customization

Knowledge is a critical part of economic activities in both industrial and digital economies, but they differ significantly in the way knowledge is utilized. While the main focus in generating and applying knowledge during the industrial age was on maximizing efficient production through lower costs, the use of knowledge in the digital economy focuses on providing customers with more choices. Instead of standardizing products, the digital revolution drives firms to focus on maximizing customer satisfaction by customizing products and meeting consumption needs.

To offer more choices and satisfaction to customers, business processes must be flexible and responsive. Web-based supply chain management, trading through online auctions, targeted marketing

TABLE 2 Industrial Economy vs. Digital Economy

Industrial Economy	Digital Economy
Supply-driven	Demand-driven
Cost minimization	Value maximization
Standardization	Customization
Linear value chain	Nonlinear value Web
Price competition	Service competition

and sales, and interactive customer service create values not simply by reducing costs but by allowing firms to be responsive to customers' needs.

2.3. Flexible and Responsive Organization

Just as new products have been born from the technologies of the Internet, so has a new organizational form. The nonlinear technology of the Web makes it possible to have an organization that represents the highest level of flexibility. In this new form, defining or classifying virtual firms and markets based on traditional organizational structures such as a hierarchy or an M-form can be very difficult. Indeed, a very flexible organization may exist only as a network organization that defies any structural formula.

In physical markets, a firm is organized into a functional hierarchy from the top-level executive to divisions and managers on down the hierarchy. It may structure its divisions following various product groups that rarely intersect in the market. The markets are organized under the natural order of products and producers from materials, intermediate goods, consumption goods, distributors, and retailers. Firms operating in traditional physical markets organize their business activities in a linear fashion. After the planning and product selection stage, the materials and labor are collected and coordinated for manufacturing. The manufactured products are then handled by the distribution and marketing divisions, followed by sales and customer service activities. These functions flow in a chain of inputs and outputs, with relatively minor feedback between stages. The value embedded in the materials is increased in each step of the manufacturing and marketing processes by the added labor, materials, and other inputs. In a linear market process such as this, the concept of the value chain can be used to highlight the links between business processes.

On the other hand, a networked economy is a mixture of firms that is not restricted by internal hierarchies and markets and does not favor controlled coordination like an assembly line. Businesses operating in this virtual marketplace lack incentives to maintain long-term relationships—based on corporate ownership or contracts—with a few suppliers or partners. Increasingly, internal functions are outsourced to any number of firms and individuals in a globally dispersed market.

Rather than adhering to the traditional linear flow, the new digital economy will reward those that are flexible enough to use inputs from their partners regardless of where they are in the linear process of manufacturing. In fact, the linear value chain has become a ''value web'' where each and every economic entity is connected to everyone else and where they may often function in a parallel or overlapping fashion. Electronic commerce then becomes an essential business tool to survive and compete in the new economy.

3. ENTERPRISE AND B2B ELECTRONIC COMMERCE

Sharing information within business and between businesses is nothing new. Electronic data interchange (EDI) has allowed firms to send and receive purchase orders, invoices, and order confirmations through private value-added networks. Today's EDI now allows distributors to respond to orders on the same day they are received. Still, only large retailers and manufacturers are equipped to handle EDI-enabled processes. It is also common for consumers to wait four to six weeks before a mail order item arrives at their door. Special order items—items not in stock—at Barnes & Noble bookstores, for example, require three to four weeks of delay. In contrast, an order placed on a website at Land's End (a clothing retailer) or an online computer store arrives within a day or two.

The business use of the Internet and electronic commerce enables online firms to reap the benefits of EDI at lower cost. The ultimate fast-response distribution system is instantaneous online delivery, a goal that a few e-businesses in select industries have already achieved. By their very nature, on-demand Internet audio and video services have no delay in reaching customers. In these examples, the efficiency stems from highly automated and integrated distribution mechanisms rather than from the elimination of distribution channels as in more traditional industries.

3.1. Web-Based Procurement

A traditional business's first encounter with e-commerce may well be as a supplier to one of the increasingly common Internet Web stores. Supply chain management is in fact a key, if not a critical, factor in the success of an Internet retailer. The number of products offered in a Web store depends not on available shelf space but on the retailer's ability to manage a complex sets of procurement, inventory, and sales functions. Amazon.com and eToys (http://www.etoys.com), for example, offer 10 times as many products as a typical neighborhood bookstore or toy shop would stock. The key application that enables these EC enterprises is an integrated supply chain.

Supply chain management refers to the business process that encompasses interfirm coordination for order generation, order taking and fulfillment, and distribution of products, services, and information. Suppliers, distributors, manufacturers, and retailers are closely linked in a supply chain as independent but integrated entities to fulfill transactional needs.

In physical markets, concerns about existing investments in warehouses and distribution systems often outweigh the desire and cost to implement fast response delivery. Some retailers still rely 100% on warehouses and distribution centers to replenish its inventory. Other retailers such as Tower Records have moved away from warehousing solutions to drop shipping, which entails shipping directly from manufacturers to retail stores. Drop shipping, just-in-time delivery, and other quick-response replenishment management systems address buyers' concerns about delays in receiving the right inventory at the right time. Many quick-response systems take this a step further and empower suppliers to make shipments on their own initiative by sharing information about sales and market demand.

Applications for a supply chain did not appear with the Internet or intranets. The supply chain concept evolved during previous decades to address manufacturers' needs to improve production and distribution where managing parts and inventories is essential in optimizing costs and minimizing production cycles. EDI on the Internet and business intranets, used by large corporations such as General Electric Information Services and 3M, are aimed at achieving efficient supply management at the lower costs afforded by the Internet. Intermediaries such as FastParts (http://www.fastparts.com) further facilitate corporate purchasing on the Internet (see Section 7.2 below for a detailed discussion of B2B auctions). Traditional retailers such as Dillard's and Wal-Mart have implemented centralized databases and EDI-based supply and distribution systems. The Internet and EC now allow small to medium-sized retailers to implement technologies in their procurement system through a low-cost, open, and responsive network.

An efficient procurement system and software, once installed, can enable firms to cross market boundaries. In a highly scalable networked environment, the size of a retailer depends only on the number of customers it attracts, rather than on capital or the number of outlets it acquires. The infrastructure set up for one product can also be expanded for other products. Amazon.com, for example, uses its integrated back office system to handle not only books but CDs, videos, and gifts. Store designs, product database and search algorithms, recommendation systems, software for shopping baskets and payments systems, security, and server implementation for book retailing have simply been reused for other products. An efficient online retailer and its IT infrastructure can be scaled for any number of products with minimum constraints added.

3.2. Contract Manufacturing

In the digital economy, the trend toward outsourcing various business functions is growing rapidly because it offers a less costly alternative to in-house manufacturing, marketing, customer service, delivery, inventorying, warehousing, and other business processes. This would be consistent with the observation that firms in the physical economy also delegate production activities to external organizations if they find it less costly than to internalize them. As long as the cost of internal production (or service provision) is higher than the cost of contracting and monitoring, firms will prefer to outsource.

Regardless of the logic of this, it appears that the type of cost savings plays a critical role in the outsourcing decision. A study by Lewis and Sappington (1991) argues that when a firm's decision to buy vs. internally produce inputs involves improvements in production technology, more in-house production and less outsourcing is preferred. Their result does not depend on whether the subcontractor's production technology was idiosyncratic (only useful to produce the buyer's inputs) or transferable (the supplier could use its production technology and facility to service other potential buyers). In the case of transferable technology, the supplier would be expected to invest more in production technology, and thus offer lower costs, which may favor more outsourcing. Nevertheless, the buyer still preferred to implement more efficient technology himself internally.

In cases where buyer's production technology is substantially inferior and monitoring costs are significantly lower, we would expect contract manufacturing to be favored. Whether this is the case or not is mostly an empirical question. However, when determining whether to outsource, one must consider not only production cost savings but also savings and other benefits in product development, marketing, and distribution. By delegating manufacturing, a firm may better utilize its resources in nonproduction functions. Because production logistics are taken care of, it may be able to consider more diverse product specifications. In fact, many Internet-based firms are focusing on customer assets and marketing value of their reputation among consumers while delegating manufacturing and distribution to third parties such as Solectron (http://www.solectron.com), who offers global manufacturing networks and integrated supply chains (see Figure 1). The prevalence of outsourcing and subcontracting goes hand in hand with the use of information technology that facilitates horizontal coordination and relationships with suppliers (Aoki 1986).

Manufacturers with a well-recognized brand name and their own manufacturing operations have used manufacturer-pushed logistics management, where manufacturers dictate terms of distribution. On the other hand, manufacturers who are concerned with product development, market competition, and other strategic issues rely on contract manufacturers for efficient bulk manufacturing and dis-

Figure 1 Global Manufacturing Networks of Contract Manufacturer Solectron. Reproduced with permission.

tributors for the ancillary tasks of moving their products to retailers. They often interact only with a few large distributors, who are expected to push assigned products down to the retail channel. Their partners are more flexible manufacturers and distributors, who have developed closer ties to end customers. For example, channel marketers in the computer industry consist of original equipment manufacturers (OEMs) who provide basic components to distributors, who build computers after orders are received. New players are now taking advantage of information technology to cut costs while delegating most functions to third parties.

Dell Computers and Gateway began a new distribution model based on direct marketing. They now rely on contract manufacturers to distribute their products. Orders received by Dell are forwarded to a third party who assembles and ships the final products directly to consumers. This built-to-order manufacturing model attains distribution objectives by outsourcing manufacturing as well as distribution functions to those who can optimize their specialized functions. Distributors, in addition to delivering products, face the task of integrating purchasing, manufacturing, and supply chain management.

For traditional in-house manufacturers and retailers, integrated distributors offer technological solutions to delegate order fulfillment and shipping tasks to outside contractors. For example, Federal Express (http://www.fedex.com) offers Internet-based logistics solutions to online retailers. FedEx introduced FedEx Ship, which evolved from its EDI-based FedEx PowerShip, in 1995. FedEx Ship is free PC software that customers can download and use to generate shipping orders. In 1996, FedEx launched its Internet version on its website, where customers can fill out pickup and shipping requests, print labels and track delivery status. As an integrated logistics operator, FedEx also offers a turnkey solution to online retailers by hosting retailer's websites or linking their servers to retailer's sites in order to manage warehouses and invoices coming from retailer's websites, then pack and ship products directly to consumers. Retailers are increasingly delegating all warehousing and shipping functions to a third party such as FedEx, while distributors expand their services into all aspects of order fulfillment.

3.3. Logistics Applications

Being ready for the digital economy means more than simply allowing customers to order via the Internet. To process orders from online customers requires seamless, integrated operation from man-

ufacturing to delivery, readiness to handle continuous feedback from and interaction with customers, and the capability of meeting the demand and offer choices by modifying product offerings and services. Clearly, being integrated goes beyond being on the Internet and offering an online shopping basket. Manufacturing, supply chain management, corporate finance and personnel management, customer service, and customer asset management processes will all be significantly different in networked than in nonnetworked firms.

Logistics management, or distribution management, aims at optimizing the movement of goods from the sources of supply to final retail locations. In the traditional distribution process, this often involves a network of warehouses to store and distribute inventoried products at many levels of the selling chain. Manufacturers maintain an in-house inventory, which is shipped out to a distributor who stores its inventory in warehouses until new outbound orders are fulfilled. At each stage the inventory is logged on separate database systems and reprocessed by new orders, adding chances for error and delayed actions. Compaq, for example, which uses an older distribution model, has to allow almost three months for its products to reach retailers, while Dell, a direct-marketing firm, fulfill the order in two to three weeks.

Wholesalers and retailers often suffer from inefficient logistics management. Distributors may have as much as 70% of their assets in inventory that is not moving fast, while retailers receive replenishments and new products long after sales opportunities have disappeared. Optimizing distribution cycles and lowering incurred costs are a common concern for manufacturers, distributors, and retailers.

A conventional logistics management model built around warehouses and distribution centers is an efficient solution when products have similar demand structure and must be moved in the same manner. In this case, distribution centers minimize overall transportation costs by consolidating freight and taking advantage of the scale economy. This practice closely mirrors the hub-and-spoke model of airline transportation. By consolidating passenger traffic around a few regional hubs, airlines can employ larger airplanes on major legs and save on the number of flights and associated costs. Nevertheless, passengers often find that they must endure extra flying time and distance because flights between small but adjacent cities have been eliminated. While the hub-and-spoke system provides many advantages, it is too inflexible to respond to individual flying patterns and preferences.

Similarly, warehousing and distribution centers fail to function when products must move speedily through the pipeline. When market prices change as rapidly as computer components, Compaq's computers, which sit in distribution centers for several months, lose their value by the time they reach consumers. Dell's more responsive pricing is made possible by its fast-moving distribution channel.

More responsive distribution management cannot be achieved by simply removing several layers of warehouses and distribution centers. Rather, distributors in the United States are being integrated into the whole value chain of order taking, supply chain, and retailing. In the traditional logistics management model, distributors remained a disjointed intermediary between manufacturers and retailers. In an integrated logistics model that depends heavily on information technology and Web-based information sharing, distributors are fully integrated, having access to manufacturing and sales data and their partners' decision making process.

4. ELECTRONIC COMMERCE AND RETAILING

The most prominent electronic commerce application is the use of the Internet for consumer retailing that will change a firm's relationship with its customers. With the growth of online retail activities, the Internet challenges not only the survival of established retail outlets but also the very mode of transactions, which in physical markets occur through face-to-face seller–buyer interactions. Online retailers such as Amazon.com, Dell, and Garden.com (http://www.garden.com) cater to customer demands and increase revenues rapidly without opening a single retail outlet. Online shops offer consumers convenience and price advantages, critical decision factors in many retail industries.

Other observers remain skeptical about consumers abandoning their daily trips to stores and shopping malls in favor of online shopping. Physical inspections of goods, personal interactions with sales representatives, the sheer act of going to a mall with friends, and other characteristics of shopping in the physical world may limit the growth of electronic retailing. However, regardless of the future extent of electronic retailing, Internet technologies have shown that they can not only make shopping more convenient but also reorganize the retail industry to meet new demands and new desires of customers.

4.1. Web Storefronts

The Internet is the most efficient information exchange medium and interactivity tool ever to impact the retail industry. The distinguishing factors of online retailing reside in offering customers useful product information and responsive customer service in all phases of their shopping experience. Applications addressing these functions tend to be maximized by new entrants in the market. For

example, Amazon.com, having no physical retail outlets to worry about, has designed a store improving the range of product and product information to match customer needs and offering fast and efficient shopping service. In contrast, players in existing retail markets are concerned with protecting their existing channels. Most retailers open their Web stores either to keep up with competitors (28%) or to explore a new distribution channel (31%) (*Chain Store Age* 1998). About 40% of retailers use their Web stores in an effort to extend their business into the virtual market.

The exceptional growth of online retailing in the United States can be traced back to several favorable characteristics. First, U.S. consumers have long and favorable previous experience with catalog shopping. Second, credit cards and checks are widely used as a preferred payment method, making it easy to migrate into the online environment. More importantly, commercial infrastructure and environment of the U.S. markets are transparent in terms of taxation, regulation, and consumer protection rules. Consumers also have access to efficient delivery networks of Federal Express and United Parcel Service in order to receive purchased products on time and in good condition. These auxiliary market factors have been essential in the initial acceptance of Web-based commerce.

4.2. E-Retailing of Physical Products

Online retailing often refers to a subcategory of business that sells "physical" products such as computers (Dell online store), automobiles (Auto-by-tel), clothing (Lands' End online), sports equipment (Golfweb), and flowers and garden tools (Garden.com). Currently, books and music CDs fall into this category, although retailers are becoming increasingly aware of their digital characteristics.

Electronic commerce in physical goods is an extension of catalog selling where the Internet functions as an alternative marketing channel. In this regard, online shops compete directly with physical retail outlets, leaving manufacturers to juggle between established and newly emerging distribution channels.

4.3. E-Retailing of Digital Products

Retailers of digital products have a distinct advantage over other sectors in that they deliver their goods via the Internet. Sellers of news (e.g., *The New York Times* [http://www.nytimes.com]), magazines (*BusinessWeek* [http://www.businessweek.com]), textbooks (SmartEcon [http://www.smartecon.com]), information, databases, and software can provide products online with no need for distribution and delivery by physical means. This sector also includes such search services as Yahoo, Excite, and other portals, although these firms currently rely on advertising revenues rather than pricing their digital products.

A number of online retailers are selling physical products that are essentially digital products but currently packaged in physical format. For example, Amazon.com sells printed books, which are in essence digital information products. Likewise, audio CDs and videos sold by Amazon.com and CDNow (http://www.cdnow.com) are digital products. Because digital products can be transferred via the network and are highly customizable, online retailing of these products will bring about fundamental changes that cannot be duplicated in physical markets.

For example, instead of being an alternative distribution channel for books and CDs, online stores can offer sampling through excerpts and RealAudio files. Books and CDs are beginning to be customized and sold to customers in individualized configurations (see Figure 2), downloadable to customer's digital book readers or recordable CDs. Digitized goods can often be delivered in real time on demand. These functions add value by providing consumers more choices and satisfaction. The primary retail function is no longer getting products to customers at the lowest cost but satisfying demand while maximizing revenues by charging what customers are willing to pay.

4.4. E-Retailing of Services

A growing subcategory of electronic retailing deals with intangible services such as online gaming, consulting, remote education, and legal services and such personal services as travel scheduling, investment, tax, and accounting. Online service providers are similar to digital product sellers because their service is delivered via the Internet. Nevertheless, transactions consist of communications and interactions between sellers and buyers, often without an exchange of any final product other than a receipt or confirmation of the transaction.

A much anticipated aspect of online service delivery involves remote services, such as telemedicine, remote education, or teleconsulting. The future of remote services is critically dependent on the maturity of technologies such as 3D and virtual reality software, video conferencing on broader bandwidth, and speech and handwriting recognition. Advances in these technologies are necessary to replicate an environment where physical contact and interaction are essential for providing personal services.

Despite a low representation of remote services on today's Internet, several types of service retailing are currently practiced. For example, 2 of the top 10 online retailing activities—travel and financial services—sell services rather than products. Airline tickets are digital products that simply

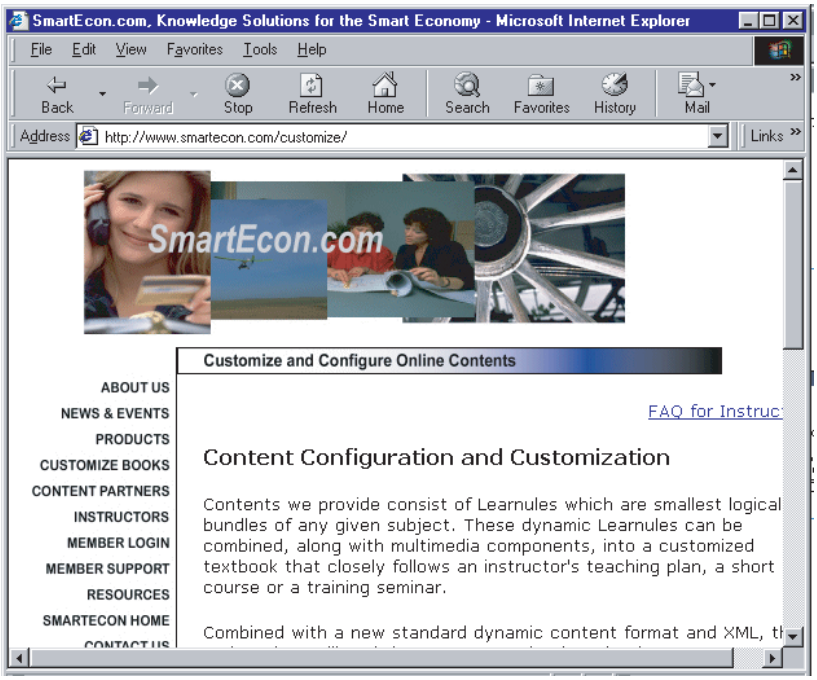

Figure 2 Online Textbooks Are Customized at SmartEcon.com. Reproduced with permission.

represent future uses of airline services. An airline ticket, therefore, signifies a service to schedule one's trips. Likewise, products in online stock markets and financial services are entitlements to company assets and notational currencies. Online service providers in these markets include those in investment, banking, and payment services.

5. PRICING IN THE INTERNET ECONOMY

In this section, we review some issues in pricing and payment in the Internet economy. In the physical market, prices are fixed for a certain period of time and displayed to potential customers. Such fixed and posted prices are commonly observed for mass-produced industrial goods such as books, music CDs, products sold through catalogs, and other consumer goods—products that are standardized and sold in mass quantity. Posted prices, in turn, allow both sellers and buyers to compare prices and often lead to highly competitive and uniform prices.

In the Internet economy, the menu cost of changing prices is relatively low, allowing sellers to change prices according to fluctuating demand conditions. Per-transaction costs of clearing payments also decline significantly with the use of online payment systems (see Choi et al. [1997, chap. 10] for an overview of online payment systems). In addition, sellers have access to an increasing amount of customer information as Web logs and network service databases are mined and analyzed to yield detailed information about buyers. Such developments raise serious questions about the use of identifiable customer information and how such information is used in setting prices.

5.1. Security and Privacy in Transaction

Complete and absolute anonymity is very rare in commercial transactions because the very nature of trade often requires some form of identification to verify payments or any legally required qualifications. The only transactions that come close to being completely anonymous are cash-based. Even with these, repeat business will convey some information about the buyer to the seller, not to speak of serial numbers of bills, fingerprints, security cameras, and so on. In many cases, anonymity means customer privacy is guaranteed by the seller. Technically, a Web vendor may assign a random number to each customer without linking the information gathered around that number to a physically identifiable consumer. If customer information is fully disclosed for personalization, the vendor may guarantee not to use it for any other purposes or sell it to outsiders. Whether we are concerned with

anonymity or privacy, the gist of the matter is the degree to which customer information is conveyed to the seller.

5.1.1. Types of Anonymity

In general, anonymity is an extreme form of privacy in that no information is transferred. But even anonymity comes in a few varieties.

- *Complete anonymity:* With complete anonymity, sellers do not know anything about customers except that a transaction has occurred. Products are not personalized, and payments are made in cash or in an untraceable form of payment. The market operates as if sellers have no means to identify customers or learn about them in any way.
- *Incomplete anonymity:* Some anonymous customers can be traced to an identifiable person. When identities are traceable, customers have incomplete anonymity. For reasons of security and criminal justice, digital files and communications have digital fingerprints that enable authorities to trace them back to their originators, albeit with difficulty. One rationale for such a compromise is that the nature of digital products and their reproducibility threaten the very viability of intellectual property on the Internet unless unauthorized copies can be identified and traced to the culprits. Microsoft has for unknown reasons surreptitiously incorporated such measures in any document created by its Word program. Some computer manufacturers have also proposed implanting serial numbers in microprocessors so as to endow each computer with its own digital identity. This sort of information does not relate directly to any identifiable persons, although they may be traceable through usage and ownership data.
- *Pseudonymity:* A pseudonym is an alias that represents a person or persons without revealing their identity. Pseudonymity operates exactly the same way as anonymity: it can be untraceable and complete or traceable and incomplete. Pseudonymity has particular significance in the electronic marketplace because a pseudonym may have the persistency to become an online persona. In some cases, an online person known only for his or her pseudonym has become a legendary figure with a complete personality profile, knowledge base, and other personal characteristics recognized by everyone within an online community. Persistent pseudonyms are also useful in providing promotional services and discounts such as frequent flyer miles and membership discounts without disclosing identity.

Privacy is concerned with an unauthorized transfer (or collection) of customer information as well as unauthorized uses of that information. Anonymity prevents such abuses by removing identity and is therefore the most effective and extreme example of privacy. Privacy can be maintained while identifiable information is being transferred to the seller, which presents no problem in and of itself. Concerns arise when that information is used without the consent of its owner (the consumer) to affect him or her negatively (e.g., junk e-mails, unwanted advertisements, and marketing messages). What a seller can and cannot do with collected information is often decided by business convention but could ultimately be determined by law.

5.1.2. Tools for Privacy

In a marketplace, whenever a consumer need or concern arises, the market attempts to address it. Here, too, the market has created technologies that address consumers' concerns about lack of privacy. The most effective way to preserve privacy is to remove information that identifies a person by physical or electronic address, telephone number, name, website, or server address. Several models are available on the Internet.

- *Anonymity services:* Anonymity systems have devised a number of ways to strip a user's identity from an online connection. In one system, an anonymous remailer receives an encrypted message from a user. The message shows only the address to which the message should be forwarded. The remailer sends the message without knowing its content or originator. This process may continue a few times until the last remailer in the chain delivers the message to the intended destination—a person, bulletin board, or newsgroup.
- *Proxy server:* A proxy server acts as an intermediary. For example, Anonymizer.com operates a server that receives a user's request for a web page and fetches it using its own site as the originator. Websites providing the content will not be able to identify original users who requested their content.
- *Relying on numbers:* Expanding on this proxy model, a group of consumers may act as a shared computer requesting a web page. Crowds, developed by AT&T Laboratories, relies on the concept that individuals cannot be distinguished in a large crowd. Here, individual requests are randomly forwarded through a shared proxy server, which masks all identifiable information

about the users. It is interesting to note that the system tries to maintain privacy by relying on crowds when the word ''privacy'' suggests being apart from a crowd.

- *Pseudonyms:* Lucent's Personalized Web Assistant and Zero Knowledge Systems' Freedom rely on pseudonyms. This approach has the advantage of providing persistent online personas or identities. Persistent personas, on the other hand, can be targeted for advertisements based on historical data, just like any real person.

These and other currently available anonymity services are effective in most cases. But whether they are secure for all occasions will depend on the business's technical and operational integrity. For example, the anonymous remailer system requires that at least one of the remailers in the chain discard the sender and destination information. If all remailers cooperate, any message can be traced back to its originator. In addition, software bugs and other unanticipated contingencies may compromise the integrity of any anonymity service. Because technologies create anonymity, they can also be broken by other technologies.

Commercial transactions conducted by anonymous or pseudonymous users still have the advantage of allowing sellers to observe and collect much more refined demand data than in physical markets. For conventional market research, identifiable information is not necessary as long as it results in better demand estimation and forecast. Even without knowing who their customers are or at what address they reside, sellers can obtain enough useful data about purchasing behaviors, product preferences, price sensitivity, and other demand characteristics.

In other cases, identifiable information may be necessary for users to receive the benefits from using online technologies. Customization and online payment and delivery clearly require users' personal information. To some extent, these activities may be handled through online pseudoidentities. However, when a reasonable level of privacy is assured, customers may be willing to reveal their identity just as they do by giving out credit card information over the phone.

Current industry-led measures to protect online privacy are aimed at reducing consumers' unwillingness to come online and mitigate any effort to seek legal solutions. Essentially, these measures require the sellers to disclose clearly to consumers what type of data they collect and what they do with it. Secondly, they also encourage sellers to offer consumers a means to specify what they are willing to agree to. In a sense, sellers and consumers negotiate the terms of information collection and uses. Some websites display logos indicating that they follow these guidelines. P3P (Platform for Privacy Preferences) by the World Wide Web Consortium (W3C; http://www.w3.org) and TRUSTe from CommerceNet (http://www.commercenet.org) are the two main industry-wide efforts toward privacy in this regard.

As the trend toward privacy disclosure indicates, consumers seem to be concerned about selling personal information to third parties. Unsolicited, unrelated junk e-mails from unknown sellers are soundly rejected. They are, however, less upset about receiving advertisements, in the form of product news, from the sellers they visit. This is largely because consumers recognize the need for information in ordinary commerce and the benefit from customization. Privacy is largely an issue of avoiding unwanted marketing messages, as collecting and selling information about consumers has long been standard practice in many industries.

5.2. Real-Time Pricing

Prices change almost instantly in auctions, but posted prices may also change, albeit at a slower pace. Any price that clears the market is determined by demand and supply conditions, which fluctuate. For example, when there is an excess demand (supply), price goes up (down) until buyers and sellers agree to make a transaction. Posted prices may be fixed during a given period, but unless a seller possesses perfect information about consumer valuations, he must rely on his information about costs and the market signal received from previous sales to decide prices. To increase sales, prices must be lowered; when there is a shortage, prices can be raised. Through this trial-and-error process, prices converge on a market clearing level until changes in demand or supply conditions necessitate further price changes.

In this vein, posted price selling is a long-term version of real-time pricing. If we consider sales trends as bids made by market participants, there is little qualitative difference between posted-price selling and auctions in terms of price movements, or how market clearing prices are attained. Nevertheless, fundamental differences exist in terms of the number of market participants, the speed at which prices are determined, or in the transactional aspects of a trade, such as menu costs.

The Web is ideal for personalized product and service delivery that employs flexible, real-time changes in pricing. Vending machines and toll collectors operating on a network may charge different prices based on outdoor temperatures or the availability of parking spaces. A soda may be sold at different prices depending on location or time of day. User-identified smart cards, which also provide relevant consumer characteristics, may be required for payment so that prices can be further differentiated in real time based on their identity.

5.3. Digital Product Pricing

Pricing strategies in the digital economy undergo significant transformation from conventional cost-based pricing. Because pricing strategies are an integral part of the overall production process, it would be folly to assume that existing economic modeling and reasoning can simply be reinterpreted and applied to the digital economy. For instance, digital products are assumed to have zero or nearly zero marginal costs relative to their high initial costs needed to produce the first copy. This implies that competitive (based on the marginal cost) prices will be zero and that all types of knowledge-based products will have to be given away for free. But no firm can survive by giving out its products for free.

For example, a firm invests $1000 to produce a digital picture of the Statue of Liberty. Suppose that it costs additional $1 (marginal cost) to make a copy of the file on a floppy disk. Because of the overwhelming proportion of the fixed cost, the average cost continues to decline as we increase the level of production (see Figure 3). Its average cost will converge toward $1, its marginal cost. If the variable cost is zero, its average cost, along with its market price, will also be zero.

This ever-declining average cost poses serious problems in devising profitable pricing strategies. A leading concern is how to recover fixed cost. For example, suppose that Microsoft spends $10 million dollars for one of its software upgrades. If it finds only 10 takers, Microsoft will lose money unless it sells it at $1 million each. At $100, its break-even sales must be no less than 100,000. Microsoft, with significant market power, will find little difficulty in exceeding this sales figure. On the other hand, many digital product producers face the possibility of not recovering their initial investment in the marketplace.

For digital products or any other products whose cost curves are declining continuously, the average cost or the marginal cost has little meaning in determining market prices. No firm will be able to operate without charging customers for their products and services. Traditional price theory, which relies heavily on finding average or marginal cost, is nearly useless in the digital economy.

As a result, we must consider two possibilities. The first is that the cost structure of a digital product may be as U-shaped as that of any other physical product. In this case, the pricing dilemma is solved. For example, the variable cost of a digital product may also increase as a firm increases its production. At the very least, the marginal cost of a digital product, for example, consists of a per-copy copyright payment. In addition, as Microsoft tries to increase its sales, it may face rapidly increasing costs associated with increased production, marketing and advertising, distribution, and customer service. In this case, traditional price theory may be sufficient to guide e-business firms for pricing.

Secondly, the possibility of extreme product customization implies that each digital product has unique features that have different cost schedules. In this case, the relevant cost schedule cannot be

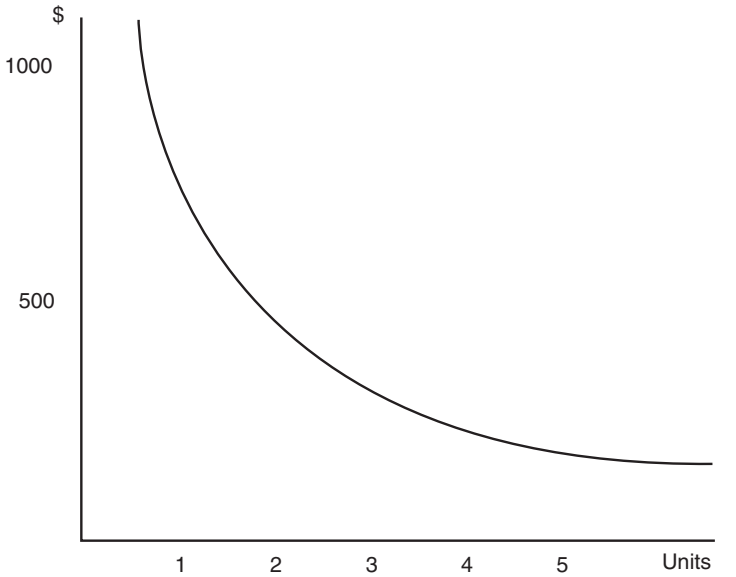

Figure 3 Decreasing Average Cost of a Digital Product Firm.

tabulated on the basis of the number of units reproduced. The marginal cost to consider is not that of reproduction, but that of production quality of a unique, personalized copy. Conventional price theory based on competitive sellers and buyers would be inadequate to deal with customized products, whether digital or physical, because of the heterogeneity of products. In such a market, cost factors have little meaning because the seller has some market power and the buyer has limited capability to substitute vendors. Instead, demand-side factors such as consumers' willingness to pay and relative positions in bargaining and negotiation determine the level of price.

6. INTERMEDIARIES AND MARKETS

The term *digital economy* makes it clear that digital technologies are more than tools that offer an alternative to conventional catalog, TV, and mall shopping activities. Digital technologies provide incentives to reorganize firms, reconfigure products and marketing strategies, and explore novel ways to make transactions. In this section, we review new forms of market mechanisms that are based on networked markets.

6.1. Types of Intermediation

Economic activities revolve around markets where sellers, buyers, and other agents must meet and interact. Therefore, the structure of the electronic marketplace plays an important role in achieving ultimate economic efficiency. How the marketplace is organized is a question that deals with the problem of matching sellers with buyers in the most efficient manner, providing complete and reliable product and vendor information and facilitating transactions at the lowest possible cost.

The three models—portals, cybermediaries, and auction markets—represent different solutions to tackling these problems:

- *Portals:* In portals, the objective is to maximize the number of visitors and to present content in a controlled environment, as in physical malls. Internet portals generate revenues from advertising or from payments by firms whose hypertext links are strategically placed on the portal's web page. Corporate portals, an extended form of intranet, do not produce advertising revenues but offer employees and customers an organized focal point for their business with the firm.
- *Cybermediaries:* Cybermediaries focus on managing traffic and providing accounting and payment services in the increasingly complex Web environment. Their revenues depend on actual sales, although the number of visitors remains an important variable. Many of them provide tertiary functions that sellers and buyers do not always carry out, such as quality guarantees, marketing, recommendation, negotiation, and other services.
- *Electronic auctions:* Electronic auction markets are organized for face-to-face transactions between sellers and buyers. The market maker, although it is a form of intermediary service, plays a limited role in negotiation and transaction between agents. Conceptually, electronic markets are a throwback to medieval markets where most buyers and sellers knew about each other's character and their goods and services. This familiarity is provided by the market maker through information, quality assessment, or guarantee. In this market, negotiations for terms of sales become the most important aspect of trade.

We find that the reason why more intermediaries are needed in electronic commerce is that the complex web of suppliers and customers—and real-time interactions with them—poses a serious challenge to fulfilling transactional requirements. Business relationships in physical markets are often hierarchical, organized along the value chain, and dominated by static arrangements in long-term contracts. Retailers typically rely on distributors and manufacturers, who in turn prefer to maintain steady and reliable relationships with suppliers. In the networked economy, however, the number of potential business partners virtually equals that of all firms and consumers. More importantly, their relationships, with no hierarchical structure, change dynamically. A simple business process such as a payment settlement between a seller and a buyer often involves several agents. For these reasons, matching sellers with buyers requires more than an advertiser-supported portal and a hypertext link. To support interactive purchases on the Internet, the electronic marketplace requires more innovative mechanisms, which we review below.

6.2. Managing Distributed Commerce

The simple act of buying an online news article may involve numerous agents who provide search information, local and out-of-state newspaper publishers who have contractual obligations, reporters and columnists (who actually produce contents), payment service providers, banks, copyright clearing houses and so on. If Yahoo or Microsoft owned most Internet firms (publishers, payment services, search sites, etc.), a customer could possibly buy (or sell) products on the company's website and necessary transactions and payments could be handled by one firm. A retailer in a physical market

provides a similar service. In a grocery store, the customer collects all necessary items and makes one payment to the owner.

To enable such a convenient buying experience, a Web store must carry all items that customers need. Otherwise a list of items in a shopping basket may come from a number of different vendors, the customer having collected the items after visiting the vendors' individual websites. Options left to stores and buyers are to:

- Process multiple transactions separately
- Choose one seller, who then arranges payment clearance among the many sellers
- Use an intermediary

In a distributed commerce model, multiple customers deal with multiple sellers. An efficient market will allow a buyer to pay for these products in one lump sum. Such an arrangement is natural if a website happens to carry all those items. Otherwise, this distributed commerce requires an equally flexible and manageable mechanism to provide buyers the convenience of paying once, settling amounts due among various vendors. The intermediary Clickshare relies on a framework for distributed user management.

For example, the Clickshare (http://www.clickshare.com) model (see Figure 4) gives certain control to member sites that operate independently while Clickshare, as the behind-the-scenes agent, takes care of accounting and billing. Going beyond payment settlement, an intermediary or ''cybermediary'' not only provides member firms with accounting and billing functions but also undertakes joint marketing and advertising campaigns and exercises some control over product selection and positioning. In this regard, a cybermediary resembles a retailer or a giant discount store. It differs from an online shopping mall, which offers location and links but little else. Unlike a portal, which is inclined to own component services, this intermediation model allows members to maintain and operate independent businesses—thus it is a distributed commerce—while at the same time trying to solve management issues by utilizing an intermediary.

Amazon.com is a well-known intermediary for publishing firms. As Amazon.com expands its product offerings, it has become an intermediary or a distributor/retailer for other products and services as well. A vertical portal such as Amazon.com or a corporate portal such as Dell is well positioned to expand horizontally and become a cybermediary dealing with their own as well as others' businesses.

It must be pointed out that Yahoo, a portal, may expand in the same way. However, portals focus on either owning a share of other businesses or arranging advertising fees for the referrals. In contrast, a cybermediary's main function is to manage commercial transactions of individuals in the distributed environment in addition to providing users with a convenient shopping location.

6.3. Association and Alliance

Conventional web portals such as Yahoo and Excite try to maximize advertising revenues by increasing the number of visitors to their sites and enticing them to stay longer to view advertisements. But advertisements as a form of marketing pose the age-old question, do the viewers really buy advertised

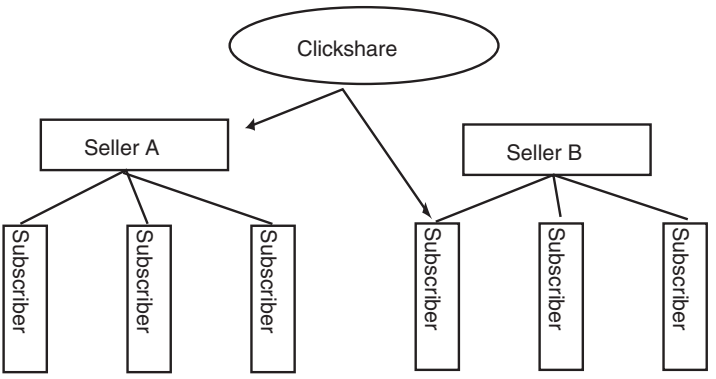

Figure 4 An Intermediary Mediates Cross-market Transactions.

products? To ensure that the message presented on visitors' web pages is producing an effect, some advertisers require click-through responses from viewers. Instead of relying on passive imprints, click-through advertisements are paid only if the viewer clicks on the ad and connects to the advertiser's website. Like hypertext links referring customers to other sites, these click-through ads are aimed at managing visitor traffic. In this way, portals become a customer referral service.

The possibility to refer and manage traffic on the Web is fully realized at Web ventures specifically designed to generate revenues from referrals. For example, Amazon.com has over 100,000 associates on the World Wide Web, who maintain their own websites where visitors may click on hypertext links that directly transport them to the Amazon.com site. Associates—that is, intermediaries—in return receive referral fees based on actual purchase by those referred by their sites. Through the Associates Program, Amazon.com has effectively opened more than 100,000 retail outlets in a couple of years. Referral fees paid to associates have replaced advertising expenses and the costs to open and manage retail stores.

Referral fees can be shared by consumers as well. SmartFrog,* for example, functions as a referrer to various online shops such as Amazon.com and eToys. After becoming a member, a Smart Frog customer visits vendor sites and, when he or she is ready to buy, goes to Smart Frog's website and clicks on the listed vendors, who pay 10% of the purchase price to Smart Frog. Out of this 10%, Smart Frog currently rebates half to its customers and keeps the remaining half.

In this way, Smart Frog, not the vendors, pays for the advertising and marketing efforts needed to generate visitors. In this cybermediated economy, the costs to advertise and attract customers are paid to entrepreneurs and consumers instead of marketing firms and the media who carry advertisements. The intermediary's profit and the benefit for consumers—in the form of lowered prices—both originate from the transaction costs previously marked for advertising and marketing. This new business opportunity and enterprise model is enabled by the distinctive nature of the networked economy.

7. ONLINE TRADING MARKETS AND AUCTIONS

Virtually all types of products are being sold through online auctions such as Onsale.com or eBay (see Figure 5). Firms and governments can implement sophisticated bidding and auction procedures for buying supplies and selling their products. Consumers can search and negotiate for best prices through auctions. By eliminating physical distance and simply increasing the number of products and trading partners available to individual bidders, online auctions offer opportunities unrealized in physical markets. Such a market arrangement, however, may produce price levels—and thus competitiveness and profit levels—that may be fundamentally different from physical markets. In this section, we present an overview of various types of auctions being implemented on the Internet and evaluate their effects on price levels, market competition, and overall economic gains and losses.

7.1. Types of Auctions

Auctions may be for a single object or a package of nonidentical items. Alternatively, auctions may be for multiple units where many units of a homogeneous, standardized good are to be sold, such as gold bullion in the auctions conducted by the International Monetary Fund and the U.S. Treasury in the 1970s and the weekly auctioning of securities by the Treasury.

Auctions discussed in this section are single auctions where either an item is offered for sale and the market consists of multiple buyers making bids to buy or an item is wanted and the market consists of multiple sellers making offers to sell. In either case, one side of the market consists of a single buyer or seller. Most online auctions are currently single auctions. On the other hand, multiple buyers and sellers may be making bids and offers simultaneously in a double auction. An example of a double auction is a stock trading pit. Because market clearing level of price may differ substantially between double and single auctions, we discuss double auctions in Section 7.5 below.

Auctions may also be classified according to the different institutional rules governing the exchange. These rules are important because they can affect bidding incentives and thus the type of items offered and the efficiency of an exchange. There are four primary types of auctions:

1. *English auction*. An English auction, also known as an ascending bid auction, customarily begins with the auctioneer soliciting a first bid from the crowd of would-be buyers or announcing the seller's reservation price. Any bid, once recognized by the auctioneer, becomes the standing bid, which cannot be withdrawn. Any new bid is admissible if and only if it is higher than the standing bid. The auction ends when the auctioneer is unable to call forth a

*http://www.smartfrog.com—recently purchased by CyberGold (http://www.cybergold.com), who pays customers for viewing advertisements.

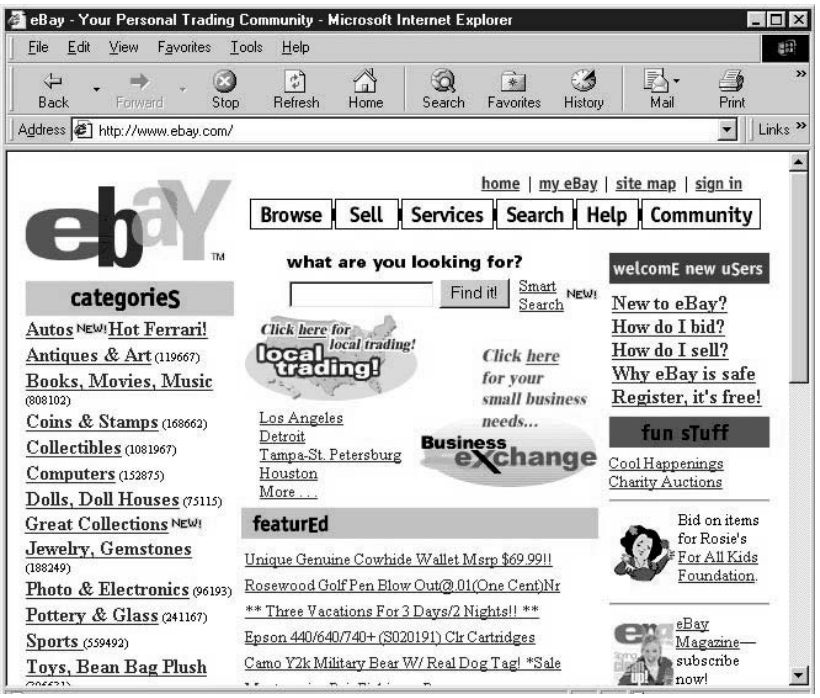

Figure 5 eBay Online Auction Site. Reproduced with permission of eBay Inc. Copyright © eBay Inc. All rights reserved.

new higher bid, and the item is ''knocked down'' to the last bidder at a price equal to that amount bid. Examples include livestock auctions in the United States and wool auctions in Australia.

2. *Dutch auction*. Under this procedure, also known as a descending bid auction, the auctioneer begins at some price level thought to be somewhat higher than any buyer is willing to pay, and the price is decreased in decrements until the first buyer accepts by shouting ''Mine!'' The item is then awarded to that buyer at the price accepted. A Dutch auction is popular for produce and cut flowers in Holland, fish auctions, and tobacco. Price markdowns in department stores or consignment stores also resemble Dutch auctions.
3. *First price auction*. This is the common form of ''sealed'' or written bid auction, in which the highest bidder is awarded the item at a price equal to the amount bid. This procedure is thus called a sealed-bid first price auction. It is commonly used to sell off multiple units, such as short-term U.S. Treasury securities.
4. *Second price auction*. This is a sealed bid auction in which the highest bidder is awarded the item at a price equal to the bid of the second highest bidder. The procedure is not common, although it is used in stamp auctions. The multiple-unit extension of this second price sealed bid auction is called a competitive or uniform price auction. If five identical items are sold through a competitive price auction, for example, the five highest bidders will each win an item but all will pay the fifth-highest price.

The distinguishing feature of an auction market is the presence of bids and offers and the competitive means by which the final price is reached. A wide variety of online markets will qualify as an auction using this definition. Less than two years after eBay appeared on the Internet, revenues from online auctions have reached billions of dollars in the United States, projected to grow into tens of billions in a few years. Major online auctions are in consumer products such as computers, airline tickets, and collectibles, but a growing segment of the market covers business markets where excess supplies and inventories are being auctioned off.

7.2. B2B Trading Markets

Online auctions for business are an extension of supply chain applications of the Internet, by which firms seek parts and supplies from a large pool of potential business partners. The real-time interaction in these auctions differs significantly from contract-based supply relationships, which may be stable but often inefficient in terms of costs. A more flexible and responsive supply chain relationship is required as the manufacturing process itself becomes more flexible to meet changing demands in real time. Especially for digital products, the business relationship between suppliers and producers may be defined by the requirement for immediate delivery of needed components.

Currently, business-to-business auctions are mainly those that sell excess or surplus inventories. For example, FastParts (http://www.fastparts.com) and FairMarket (http://www.fairmarket.com) offer online auctions for surplus industrial goods, mainly desired by corporate purchasing departments. A significant impediment to widespread B2B auctions is the fact that online auctions allow only a single item to be exchanged at a time. However, corporate purchasing managers typically deal with thousands of items. This will require them to make and monitor bids in thousands of web pages simultaneously, each handling one item. A more efficient auction will allow them to place a bid on a combination of items. Unlike auctions organized around a single item or multiple units of a single item, the new market mechanism poses serious challenge in guaranteeing market clearance because it must be able to match these combinatorial bids and offers, unbundling and rebundling them (see Section 7.5.2).

7.3. Auctions in Consumer Markets

Auctions selling consumer goods are mainly found in used merchandise and collectibles markets. Both in Onsale.com and eBay, all types of consumer goods are offered by individuals for sale. Ordinarily these items would have been sold through classified advertisements in local newspapers or in various ''for sale'' newsgroups. Online innovations stem from the size of the potential audience and the real-time and interactive bidding process.

While online markets have an inherently larger reach than physical markets in terms of the number of participants the success of eBay and onsale.com is largely due to their allowing potential buyers and sellers an easy way to interact in real time. eBay, for example, is simply an automated classified ad. The list of products offered as well as those who buy and sell at eBay site resembles those found in the classified ad market. Want and for-sale ads are largely controlled by newspapers who generate as much as 30% of their total revenues from individual advertisers. Aware of the increasing threat posed by Internet-based classified ads, several newspapers experimented with online classified advertising based on their print versions. Nevertheless, large-scale initiatives by newspapers have all but failed. Surprisingly, eBay has succeeded in the same product category.

While online classified ads offered by newspapers are nothing more than online versions of their print ads, eBay offers features that consumers find convenient. Classified ads provide buyers only with contact information for purchasing a product. The buyers must make telephone calls and negotiate with the sellers. On eBay's website, all these necessary processes are automated and made convenient. Sometimes the formula of successful online business is simply to maximize the interactivity and real-time capabilities of the online medium itself.

Besides successful online versions of classified ads, another type of online auction deals with perishable goods, which need to be sold quickly. Excess airline tickets and surplus manufacturing products comprise the second type of products sold in online auction markets. For these products, the electronic marketplace offers the necessary global market reach and responsiveness.

Despite the growing interest in online auctions, the majority of consumer goods, except those discussed above, are not suitable for auctions. For these items, conventional selling such as posted price retailing will be more than adequate. Nevertheless, the flexibility offered by online trading may offer innovative market processes. For example, instead of searching for products and vendors by visiting sellers' websites, a buyer may solicit offers from all potential sellers. This is a reverse auction, discussed below. Such a buying mechanism is so innovative that it has the potential to be used for almost all types of consumer goods.

7.4. Reverse Auctions

A reverse auction is where a buyer solicits offers from sellers by specifying terms of trade that include product specification, price, delivery schedule and so on. Once interested sellers are notified and assembled, they may compete by lowering their offers until one is accepted by the buyer. Alternatively, offers may be accepted as sealed bids until one is chosen. In this regard, a reverse auction is more akin to a buyer auction, commonly found in business procurement and government contracting.

But an online implementation of a reverse auction—e.g., Priceline.com—deals with more mundane varieties of consumer goods and services. At Priceline.com website (http://www.priceline.com),

consumers can specify the maximum price they are willing to pay for airline tickets, hotel rooms, automobiles and home mortgage (see Figure 6). Then Priceline.com acts as a reverse auction market as it searches and finds a seller who has the good that matches the buyer's requirements and is willing to provide the good or service at the specified terms.

Like classified ads, the reverse auction mechanism is commonly found in physical markets. For example, it is used to determine suppliers and contractors in large-scale projects. In some seller's markets where products are perishable, sellers compete to unload their products before they become spoiled or unserviceable. Not surprisingly, Priceline.com's main source of revenues is the airline industry, where unsold seats are perishable products that cannot be saved and resold at a later date.

As in the case of building contractors and bidders, the advantage of reverse auction hinges on the limited time span of certain products and services and the existence of competition among sellers. However, it is seldom used for manufactured consumption goods. An obvious logistical problem is that there are many more buyers than sellers. This will render reverse auctions almost impossible to handle. On the other hand, online markets may offer an opportunity for reverse auctions to be used more frequently, even for most consumer goods. In a sense, reverse auctions are a form of customer-pulled marketing and an ideal selling mechanism for the digital age.

Consumer-initiated, or pulled, searches may produce some potential vendors who have matching products for sale, but contacts have to be made separately from the search result. Online reverse auctions combine search process with direct contact and negotiation with the sellers. The prospect of using a reverse auction as an online business model depends on its ability to enable consumers to specify various aspects of the good or service they intend to purchase because individual preferences may not be matched by existing products and services. In such cases, interested sellers may engage in ex post manufacturing to satisfy customer requirements. Online searches, reverse auctions, and ex post manufacturing represent the continuing innovation of the digital economy to satisfy personalized needs.

7.5. Emerging Market Mechanisms

Auctions are typically used when sellers are uncertain about market demand but want to maximize selling prices. Conversely, buyers use auctions to obtain lowest prices for contracts and supplies. If this is the case, why would sellers use online auctions when they can obtain higher prices through posed-price selling? Revenues are maximized, because since traditional auctions usually involve one seller with multiple buyers or one buyer with multiple sellers. In each of these cases, the individual who sells an object or awards a contract is always better off as the number of bidders increases

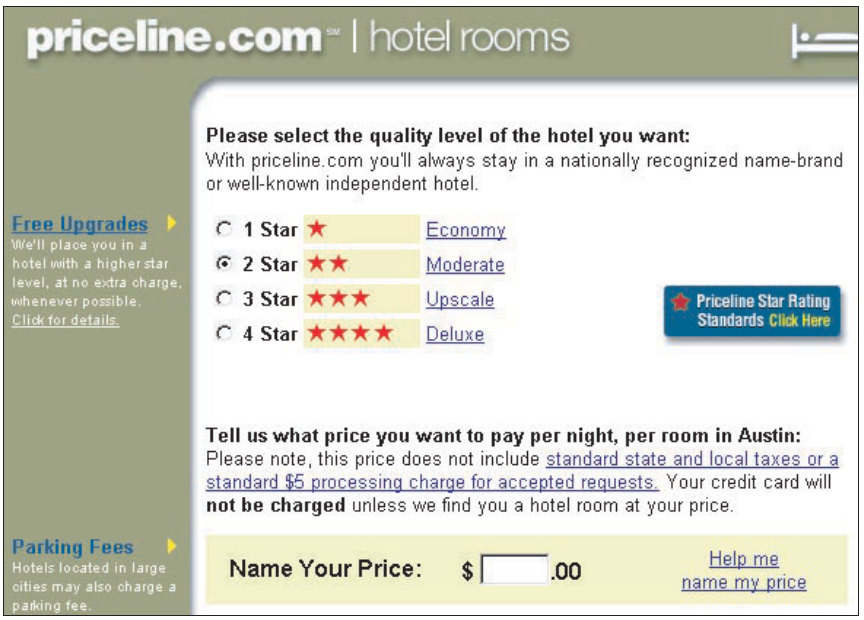

Figure 6 Customers Name Their Prices at Priceline.com. Reproduced with permission.

(Wang 1993; Bulow and Klemperer 1996). However, if the auction consists of many sellers and buyers simultaneously, the result changes dramatically. Such an auction is called a double auction market.

7.5.1. Double Auction

In a typical auction, a single seller receives bids from multiple buyers or one buyer collects offers from multiple sellers. In a double auction, both multiple sellers and buyers submit bids and offers simultaneously, similar to trading in security markets. Multiple units of different products may be auctioned off at the same time.

A double auction closely resembles supply-and-demand interactions in physical markets. Because of this simple fact, a double auction results in a very different price level from single auctions, described above. In a single auction, the selling price may be far above the competitive level due to competition among the buyers. With many sellers and buyers, however, double auction markets tend to generate competitive outcomes. A double auction is simply an interactive form of market where both buyers and sellers are competitive.

Ideally, any effort to promote competitiveness should include expanding double auctions and similar market mechanisms in the digital economy because they offer an opportunity to raise economic efficiencies unsurpassed by any physical market organizations. For auctioneers, however, single auctions generate substantially more revenues than double auctions. Where will the incentives be for them to participate in such a competitive market? Both sellers and buyers will prefer single auctions. On the other hand, a variant type of double auction may present a unique opportunity in the digital marketplace. For example, when buyers are looking for a bundle of products and services, a double auction with many sellers and buyers is necessary to clear the market.

7.5.2. Bundle Trading

Bundle trading is an essential market mechanism when products are customized and buyer's needs must be satisfied by many sellers. Customized and personalized products often consist of a collection of complementary goods and services. For example, a combination of airline tickets, hotel rooms, a rental car, meals, and amusement park admission tickets can be bundled as a packaged leisure product. Some products that are vertically related, such as a computer operating system and a web browser, may be provided by different vendors, requiring buyers to deal with multiple sellers.

While a purchase that involves multiple sellers may be carried out through a series of transactions or auctions, bundle trading offers a simplified and efficient solution. In addition, products and services are increasingly bundled and integrated rather than being sold as separate units. As a result, a different kind of problem arises, namely how to facilitate markets that allow convenient buying and selling of a wide range of products and services in one basket or transaction.

A technological solution to bundle trading is to provide an auction that allows buyers and sellers to trade any number of goods in any combination. For example, stock trading markets such as NYSE or Nasdaq are double auctions that clear individual assets one by one. On the other hand, investors usually hold their assets in a portfolio that consists of diverse assets, consistent with their investment objectives on the overall returns and values. Nevertheless, physical markets are unable to carry out unbundling and rebundling of assets offered and demanded in the market.

The networked environment on the Internet offers a possibility of allowing such portfolio-based transactions. In essence, the desired auction mechanism must unbundle and rebundle offers and bids presented by both sellers and buyers. A prototype of such a mechanism is a portfolio trading algorithm developed for the investment community (Fan et al. 1999; Srinivasan et al. 1999). Its basic setup, however, can extend into procurement process in manufacturing as well as bundle trading in physical products and personal services.

Alternatively, third-party intermediaries may provide an agent-based solution to trading bundles. Like a travel agent, an intermediary can assemble a package of products and services to match a customer's need. Because of the increasing trend toward integrated products, intermediaries or agent-based service providers will play a greater role in the Internet economy.

8. OUTLOOK AND CHALLENGES

New technologies and applications are continually developed and applied to business processes on the Internet. The basic infrastructure of the digital economy clearly consists of computers and networking technologies. However, underlying component technologies and applications are evolving rapidly, allowing us to make only a haphazard guess as to which will turn out to be most critical or most widely accepted in the marketplace.

But not all technologies are created equal: those that aid commerce in a smart way will become critical in meeting the increasing demand for more flexibility and responsiveness in a networked commercial environment. The drive toward interoperable and distributed computing extends the very advantage of the Internet and World Wide Web technologies. Broadband networking, smart cards,

and mobile network applications bring convenience and manageability in the network-centered environment. New technologies and computing models such as XML and multitier distributed computing help firms to implement more efficient management solutions. These technologies, when combined, improve and reinvent existing business processes so as to meet flexibility and responsiveness demanded by customers.

Nevertheless, regulatory as well as technical variables may become an important factor that hinders future growth of the Internet economy. Despite a high level of efficiency enabled by technologies, free markets are sometimes unable to produce efficient results when:

- Lack of information and uncertainty about products and vendors results in market failures.
- Goods and services have characteristics of public goods that private economies do not produce sufficiently.
- An industry is dominated by a monopoly or a few oligopolistic firms where outputs are reduced and prices are higher than competitive markets.
- Market players do not enjoy a transparent and universal commercial environment.

In such cases, a third party such as a government needs to intervene to provide information, promote goods production, and regulate and provide legal and commercial infrastructure. Even in the free-spirited Internet, governments play many essential roles as policy-making bodies. Business and regulatory policies as well as taxation influence firm organization and behaviors, competition, and profit levels, which ultimately determine the level of consumer welfare. (For more in-depth discussion on policies toward electronic commerce, see Choi et al. [1997] and Choi and Whinston [2000]).

Should governments regulate online markets? Various types of inefficient markets can be made efficient through regulation. A primary example is regulation of monopolies, lowering prices and increasing outputs. Health and safety regulations protect consumers. At the same time, however, regulators may be ''captured'' by those who are being regulated and protect firms' interests against consumer welfare and market efficiency. Regulation of online commerce may have similarly controversial results. It may protect consumers' interests and ensure efficiency. On the other hand, it may hinder the growth of online business. Regardless of its final effects, there is a growing list of online business activities that receive increasing attention from government agencies that want to regulate them.

In addition to still-evolving government policies toward e-commerce, technological factors continue to pose challenges to those doing business on the Internet. Recent episodes of distributed denial of service (DDoS) attacks on major e-commerce sites, where web servers are flooded with bogus service requests to the degree that normal customers become unable to connect, show how vulnerable Internet-based commerce can be. Despite heavy interest and large investments in security measures and technologies, DDoS attackers take advantage of the open infrastructure that lies at the bottom of the Internet telecommunications networking and are able to interrupt its normal performance through various types of requests, often using a host of third-party servers who become unwitting partners of the attack.

Technologies alone are unable to provide a sure firewall to prevent such attacks as long as the basic TCP/IP network of the Internet cannot distinguish the type of traffic that runs through or there exist some insecure servers on the network who become free riders on such attacks (Geng and Whinston 2000). Increasingly, economic analysis and tools are becoming an essential ingredient in solving technological problems.

Despite policy and technical barriers, the number of business applications based on the Internet is growing rapidly into teleconferencing, logistics support, online services in banking and medicine, customer service through chat lines, online publishing, distance learning, and broadband/mobile content delivery. In essence, the Internet has become the information infrastructure necessary to carry out various types of business operations, market processes, and transactional requirements in the fully digital economy. Any effort to reengineer business and industrial processes in the 21st century will necessarily involve the use of the Internet and its associated applications. Understanding the economic aspects of the Internet will become the final challenge in promoting and selecting a winning combination of technologies and business models.

REFERENCES

Aoki, M. (1986), ''Horizontal vs. Vertical Information Structure of the Firm,'' *American Economic Review,* Vol. 76, No. 5, pp. 971–983.

Barua, A., Pinnell, J., Shutter, J., and Whinston, A. B. (1999), ''Measuring the Internet Economy: An Exploratory Study,'' CREC/Cisco Working Paper, Center for Research in Electronic Commerce, University of Texas at Austin, Austin, TX. Available at http://crec.bus.utexas.edu/works/articles/internet_economy.pdf.

Bulow, J., and Klemperer, P. (1996), ''Auctions Versus Negotiations,'' *American Economic Review,* Vol. 86, No. 1, pp. 180–194.

Chain Store Age (1998), ''Sticking to the Web,'' June 1998, pp. 153–155.

Choi, S.-Y., and Whinston, A. B. (2000), *The Internet Economy: Technology and Practice,* SmartEcon Publishing, Austin, TX.

Choi, S.-Y., Stahl, D. O., and Whinston, A. B. (1997), *The Economics of Electronic Commerce,* Macmillan Technical, Publishing, Indianapolis.

Fan, M., Stallaert, J., and Whinston, A. B. (1999), ''A Web-Based Financial Trading System,'' *IEEE Computer,* April 1999, pp. 64–70.

Geng, X., and Whinston, A. B. (2000), ''Dynamic Pricing with Micropayment: Using Economic Incentive to Solve Distributed Denial of Service Attack,'' Center for Research in Electronic Commerce, University of Texas at Austin, Austin, TX.

Lewis, T. R., and Sappington, D. E. (1991), ''Technological Change and the Boundaries of the Firm,'' *American Economic Review,* Vol. 81, No. 4, pp. 887–900.

Srinivasan, S., Stallaert, J., and Whinston, A. B. (1999), ''Portfolio Trading and Electronic Networks,'' Center for Research in Electronic Commerce, University of Texas at Austin, Austin, TX.

Wang, R. (1993), ''Auctions versus Posted-price Selling,'' *American Economic Review,* Vol. 83, No. 4, pp. 838–851.