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FRANÇOIS BAR

The Construction of Marketplace Architecture

An agent is at hand to bring everything into harmonious cooperation, triumphing over space and time, to subdue prejudice and unite every part of our land in rapid and friendly communication . . . and that great motive agent is steam.

CHARLES FRASER (1880)

AT THE END OF 1994, the commercial release of the first-version *Netscape* browser and *Netsite* server signaled the transformation of the Internet from an elite network reserved for advanced research and academics into a mass medium. As the number of dot-com sites quickly outpaced the dot-mil and dot-edu pioneers, users began to see the Internet's tremendous potential for transforming commercial interactions. Sweeping predictions accompanied this transition. The Internet was going to transform economic activity, yielding significant increases in efficiency and productivity. Fueling this confident optimism was the expectation that the Internet would usher in perfect markets that would in turn replace traditional, inefficient corporate hierarchies and supply chains. Internet-based

market processes would yield flatter organizations, disintermediate economic relationships, and give equal power to all market participants.

To a large extent, these hopes were rooted in the characteristics of Internet technology and of the innovation process that saw its emergence. The Internet's development was user-driven and bottom-up. This resulted in a decentralized network, where any node can become part of the inter-network as soon as it speaks "Internet protocol" (IP), the common language. Governance of the Internet was itself decentralized, largely outside the hands of traditional government institutions, and carefully watched by a wide array of private individuals and institutions. Unlike previous communication networks, the Internet seemed largely self-governing and allowed any individual or organization to participate on an equal footing. The hopes were that these characteristics of the technology would simply carry over to the economic processes that make use of the Internet—that decentralized technology would naturally lead to decentralized outcomes in the use of the technology. The Internet's liberating technology would drive market structure: the low cost of adoption and the endless range of new applications would lower barriers to entry, decentralize economic power, and thereby democratize society and empower individuals.¹

With the benefit of hindsight, we know today that previous infrastructures, such as the railroad, fundamentally transformed the structure and efficiency of our economies. Indeed, "steam-commerce," as the economic transformation brought on by the railroads might have been called, saw profound reorganization of productive activities within integrated multidivisional corporations. It led to sweeping restructuring of supply chains, markets for raw materials, and finished products. It allowed firms to draw on vastly broader labor markets and sources of inputs. This resulted in the reorganization of marketplaces around the possibilities created by the railroad.²

The real dimensions of such change are always difficult to gauge while the transformation is under way. Several years after the onset of the commercial Internet, as some dot-com pioneers stumble, we began to see how some early predictions missed the mark. The true economic impact of the

1. This tendency to assume that a decentralized technology naturally leads to decentralized and democratic uses is what we have described as "the Jeffersonian Syndrome." François Bar, John Richards, and Christian Sandvig, "The Jeffersonian Syndrome: The Predictable Misperception of the Internet's Boon to Commerce, Politics, and Community" (www.stanford.edu/~fbar/Publications/jeffersonian-syndrome.PDF [March 2000]).

2. Chandler (1977).

Internet still remains to be seen, but, with some initial Internet history to draw from, it is worth critically revisiting the early hopes.

Promises and Reality

Viewing optimistically the inherently decentralized and democratic characteristics of early Internet technology, analysts predicted that, applied to commercial endeavors, it would transform marketplace communication and bring us closer to the ideal of a “perfect market”: multiple buyers, multiple sellers, many interchangeable products, all smoothly and swiftly converging toward equilibrium thanks to perfect information. With the Internet, it was argued, market participants can know everything there is to know about the prices, characteristics, and quantities of goods in the market and make instantaneous, perfect, rational decisions.

The result was to be “a new world of low-friction low-overhead capitalism, in which market information will be plentiful and transaction costs low.”³ Easy entry and easy exit afforded by cheap, flexible Internet technologies would keep incumbent players constantly on their toes, in the best interest of economic efficiency. “Any product that resembles a commodity—and most do—will be driven down in price by the efficiency of the Internet as a marketplace.”⁴ At the end of the day, analysts promised that we could now get very close to Adam Smith’s ideal, perfect market. “There is a fundamental shift in power, and it’s shifting to the consumer.”⁵

Today, however, an economic reality has emerged that diverges substantially from these predictions. Far from a multitude of interchangeable participants, concentration seems the rule in many segments of e-commerce, where only the largest actors seem able to succeed. While the Internet has reduced overhead and transaction costs, e-commerce players have required considerable investment to survive. Far from a “friction-free” environment, e-commerce sites strive to create “stickiness” that will keep their customers from clicking on to their competitors. Overall, while the Internet has had significant impact on commerce, the resulting economic landscape reveals

3. Gates (1995, p. 158).

4. Bill Gates, “Friction-free Capitalism and the Price of the Future,” May 20, 1998 (www.microsoft.com/billgates/columns/1998Essay/5-20col.asp [December 1999]).

5. Ferguson, cited in R. Quick, “The Attack of the Robots: Comparison-Shopping Technology Is Here—Whether Retailers Like It or Not,” *Wall Street Journal*, December 7, 1998, p. R14.

many unanticipated features. The early expectations rested on three key assumptions: low entry barriers, decreased roles for intermediaries, and lower transaction costs. It is worth examining where they stopped short before moving on to an analysis of the new landscape.

First, the Internet was expected to shatter entry barriers. New players, able to marshal virtual resources in place of real ones, were expected to compete on par with incumbents. With the Internet, no need to build stores or hire a sales force—a cleverly designed website would suffice. No need to keep costly inventory—orders would simply be passed on to suppliers for just-in-time delivery. Technology was to abolish entrenched positions as competitive advantage. Small players could be as powerful as large ones.

In many sectors, however, the barriers to successful and credible entry remained high. It quickly became apparent that if entering was easy, staying would be more difficult. Anyone could open a bookstore on the Internet. Yet only the best-capitalized bookstores would manage to survive (and even for these, survival still remains an open question). Entrants have discovered that it takes significant resources and skills to maintain an effective web presence, to guarantee that orders received will be filled. Traditional businesses still have the relationships and the marketing expertise that create substantial obstacles to new players' entry. Entrants had their chance, but over time it turned out that experience, long-standing business relationships, and domain expertise still matter. In fact, concentration seems pervasive throughout the Internet world. Whether you look at portals, ISPs, exchanges, or the makers of the underlying network infrastructure, tremendous economies of scale, scope, and network seem to favor the largest players and reinforce concentration. Because of network externalities and economics (large fixed costs, low marginal costs), we are seeing increasing concentration and large players, rather than a multitude of small players.

Second, the Internet was to bring disintermediation.⁶ In the old economy, intermediaries of all kinds performed important functions as information brokers. They aggregated demand for suppliers, giving them a better sense of what the market wanted, and offered buyers a convenient one-stop picture of supply. In the Internet economy, however, a world

6. Malone, Yates, and Benjamin, (1987).

where everyone supposedly has access to complete information, intermediaries simply add cost and delay. They could be eliminated now that technology allowed direct connections between buyers and sellers, without need for brokers, market makers, consolidators, and other middlemen.

In fact, new intermediaries emerged, old intermediaries adapted. Homebuyers and sellers did not simply bypass realtors but began to use the services of online brokers, some new, but mostly traditional realtors with a new web presence.⁷ Stockbrokers did not disappear: new brokers like e-trade emerged while traditional brokers adapted. There may even be more intermediaries today than before: business-to-business transactions once directly negotiated between two parties now often take place within online marketplaces. Rather than disintermediation, we are witnessing the transformation of intermediation.⁸

Third, the Internet economy was to be friction-free. In the old economy, communication activities account for a large portion of the costs of transactions. They reflect the trouble and expense of searching for products, identifying the right buyers and sellers, negotiating contracts, invoicing purchasers, billing and collecting. All create market friction and make it burdensome to switch from established commercial relationships. Hierarchical relationships among commercial partners, embodied in long-term contracts or organizational integration, were the old economy's way to reduce transaction costs.⁹ The Internet, offering cheap and efficient ways to set up and execute transactions, was expected to reduce that friction, making markets more perfect. In turn, this would lead to greater reliance on markets than hierarchies for the organization of economic activities.

But if the Internet could reduce friction, the same technology can also be deployed to create more of it. Start-ups discovered that friction (or "stickiness," as their business plans prefer to call it) often is the key to profits.¹⁰ Friction, and the resulting market imperfections, creates seller or buyer advantage as well as arbitrage opportunities for traders. Embedding friction within their web offerings, they were able to create switching costs for their customers, either through standards (for example, incompatible instant messaging), or particular implementation (for example, web-based

7. Buxmann and Gebauer (1998).

8. Sarkar, Butler, and Steinfield (1995).

9. Williamson (1975).

10. Smith, Bailey, and Brynjolfsson (2000).

e-mail that cannot be forwarded).¹¹ Friction-free may be a macroeconomic ideal but makes less sense from the point of view of individual business players. Indeed, friction is where business opportunities are to be found. Instead of friction-free commerce, what emerged was the design of exchange spaces with differential friction.

Through this all, a common theme starts to emerge. At the core of the transition toward e-commerce is the emergence of multiple virtual spaces for exchange. These are not trivial to build and to back up with real-world ability to deliver on the agreements they help to negotiate. As a result, there are real barriers to credible and sustainable entry. Far from disintermediation, they constitute the emergence of new intermediaries or the reinvention of old ones. And far from providing friction-free interaction, they represent the careful arrangement of intentional friction. As firms deploy electronic technology to create commercial advantage for themselves, they are striving to alter the terms and dynamics of competition. They are, in the process, re-creating the marketplace.

Mapping a Way through the Transformation

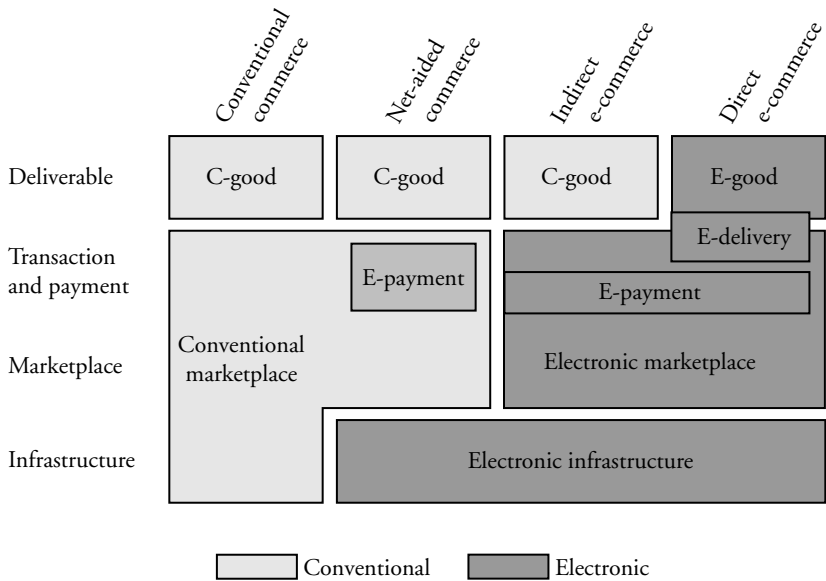
The Internet-based reinvention of markets comes in varied degrees and flavors. As a result, the single label of “e-commerce” covers a wide variety of ways to organize production and exchange activities. Commercial interactions are organized differently in different sectors, often reflecting the pre-existing ways of doing business and the position of incumbents. To discern what is really new and analyze the implications, we need to start with a map (see figure 2-1). Commercial activities, whether conventional or electronic, involve four basic levels.¹²

COMMUNICATION INFRASTRUCTURE. Commerce requires communication: buyers and sellers must exchange information about the characteristics of goods and services, about quantities, availability, and prices; firms must coordinate their activities with those of partners and subcontractors. In the most primitive markets, such as farmers’ markets on the central square of medieval towns, communication was interpersonal and unmediated as buyers and sellers negotiated directly with each other. All communication technologies and media have influenced commercial

11. Shapiro and Varian (1998).

12. Bar and Murase (1999). See also Picot and others (1997).

Figure 2-1. *Mapping E-Commerce*



activities. Carrier pigeons and the mails have increased the reach of old marketplaces; telegraph and telephone have helped accelerate the pace of exchange. New communication media will continue to influence the conduct of economic activities as they transform the way in which various economic actors communicate.

MARKETPLACE. Commercial communications do not take place in a vacuum, but in the context of structured coordination environments within which buyers interact with sellers, negotiate, and agree on the terms of a transaction. These marketplaces come in many shapes and forms, from the vast network of fairs in medieval Europe¹³ to the modern NASDAQ. They share the fact that they are embedded within communication infrastructures that shape and constrain their mechanisms: the characteristics of what is traded, the process for matching demand and supply depend on the communication infrastructure.

13. Braudel (1979, pp. 63–74).

TRANSACTION MECHANISMS. These come into play to send, execute, and settle orders (including payments) that have been agreed to in the marketplace. They rely on the features of the communication infrastructure, either to physically transfer a payment or to transmit information about credits and debits to the accounts of buyers and sellers.

DELIVERABLES. Finally, the system's goal is to supply deliverables, the service or merchandise being exchanged. Here again, the underlying communication infrastructure constrains what goods can be shipped (or transmitted), what services require proximity or can be performed at a distance.

Different degrees of reliance on electronic technologies at these four levels result in four broad categories of commerce (figure 2-1). In pure conventional commerce, nothing electronic is involved. Buyers and sellers physically meet in a market, communicate face-to-face, conduct transactions directly, and settle them with physical currency. The buyer physically takes delivery of the good or service. Since their inception however, electronic technologies have assisted in the entire range of commercial activities. A first level of electronic commerce, network-aided commerce, relies on electronic communication technologies to assist traditional commercial activities. The telephone made it possible to conduct traditional transactions at a distance rather than in person, and electronic data interchange (EDI) allowed companies to automate the exchange of orders and invoices. These, however, do not fundamentally change the commercial process, they simply make existing processes faster, cheaper, and more efficient. When a company lets customers pick a product from a website rather than a printed catalog, or takes their orders over e-mail, it uses the Internet as an aid to existing commerce rather than to transform it, continuing that trend.

The next level, indirect e-commerce,¹⁴ corresponds to the creation of an electronic marketplace on the network, within which demand and supply are matched, even though the goods and services traded are ultimately delivered physically to a customer. This matching process often differs significantly from what goes on in the physical marketplaces it replaces (or competes with). Airlines' computerized reservation systems (CRS), such as American Airlines' SABRE, effectively created an electronic marketplace for airplane trips and ancillary travel services that functioned quite differently from the network of travel agents interacting with airlines over the

14. Committee on Economic and Monetary Affairs and Industrial Policy (1998).

phone it replaced.¹⁵ Similarly, E-Bay's electronic marketplace is much more than the automation of newspaper classified ads and provides a new process for pairing up buyers and sellers.

Finally, direct e-commerce is purely electronic, where the goods or services traded are themselves electronic and delivered over a network. This includes the commerce of software in its many forms, from music to computer programs, as well as online stock exchanges. Insurance and services such as aircraft engine maintenance are now traded that way as well. In this purest form, the electronic infrastructure supports the marketplace and transaction and payment mechanisms as well as the transmission of the traded objects themselves.

This mapping of e-commerce makes two important points. First, the broad category of electronic commerce covers in fact a wide diversity of commercial arrangements, with different degrees of "electronic-ness." As a consequence, the impact can range from a mere enhancement of traditional commercial activities to fundamentally new ways to structure and implement them. The nature and magnitude of the economic implications will be equally diverse. This makes it crucial to look at real cases in individual sectors in order to understand the diverse implications of the transitioning to electronic commerce. Second, the map highlights what is the most transformative aspect of this transition: the emergence of electronic marketplaces. While communication networks have always been an important *aid* to the market and to market activities, the network itself is now increasingly becoming a *marketplace*, that is, the place where buyers meet sellers, negotiate prices and quantities, agree on delivery terms, and exchange goods and payments.

Thus it is useful to distinguish two categories of economic implications of e-commerce, broadly described by the headings of efficiency and structure. The quest for enhanced efficiency within existing commercial practices has important economic benefits but is not fundamentally new. It was the goal in the application of previous communication innovations to commercial practices: the world has seen previous rounds of mail-commerce, telegraph-commerce, phone-commerce. Each entailed substantial economic benefits, making existing market processes faster and cheaper. But this is still network-aided commerce. The second category is less obvious but more fundamental. The implementation of electronic

15. Hopper (1990). See also chapter 5 by Klein and Loebbecke in this volume.

marketplaces within the network infrastructure shapes the structure of economic relationships between companies and the operation of market processes. The next sections look at these two in turn.

Not So New: Pursuing Efficiency through Network-Aided Commerce

A first dimension of electronic commerce, and the most visible, simply constitutes the continuation of existing trends: it is the application of electronic communication technologies to existing commercial practices and marketplaces. Like the diffusion of previous communication technologies through commercial activities of the past, it does not in itself represent a fundamental transformation but rather incremental improvement of existing processes. Communication technologies are key to market processes because markets mechanisms are information processing activities. Markets are structured information exchange environments, where actors convey information about the characteristics of goods and services, their prices and availability. Market mechanisms such as negotiation, matching, and agreement similarly are communication processes. Naturally, every time a new communication technology comes along, it is typically applied to the automation of existing market communication, further enhancing the flow of market-related information.¹⁶

Thus before the Internet, couriers, the telegraph, the telephone, or electronic data interchange (EDI) have served to enhance market-related communication—to allow faster, better, broader, cheaper matching of buyers and sellers and the settlement of transactions and payments.¹⁷ Time and again, the first step in the application of new technologies has led to further automation of existing marketplaces—designed to improve their operation along existing processes rather than transform these processes.

This is also the case with the Internet. Exchanging information about product and services becomes faster and cheaper. The Internet allows sellers to reach new potential customers, increasing their range, and conversely enables buyers to compare the offerings of a greater set of suppliers. As a result, sellers have developed better ways to gauge demand for their products, to adjust prices accordingly, and to relay these adjustments to the

16. Beniger (1986).

17. Brousseau (1994).

marketplace, leading to more dynamic pricing mechanisms. Internet technologies permit faster and more cost-effective matching of demand and supply, yielding improved market clearing mechanisms. They support better negotiation mechanisms and faster transaction settlement. Sellers have harnessed the features of the network to offer more responsive and more personalized customer service.¹⁸

These are all significant improvements. However, similar claims can also be made for any of the previous communication technologies, from the postal network to the telephone. The result, in this round as in the previous rounds, is network-aided commerce, a move toward more efficiency in market processes rather than fundamentally new market processes. Two characteristics of this transition deserve particular notice.

First, these improvements need be neither uniform nor symmetrical. In fact, they are typically implemented strategically. Individual market participants hope to get a leg up on their competitors by deploying information systems that give them faster, better market information or that help them close a transaction faster. Sellers try to make it less attractive for their customers to switch to competing suppliers because of the superior service they can provide thanks to improved communication technology. Buyers try to exert greater pressure on their suppliers by deploying network systems that give them a more accurate vision of their alternatives. In all cases, as with earlier information systems, the purpose is precisely to create advantage over competitors, greater leverage over buyers or suppliers.¹⁹ As a result, especially in the early stages, communication technology deployment may improve the efficiency of certain market operations, but this does not in itself make the market more perfect. Improvements will, more likely than not, be unevenly distributed and asymmetrical in the benefits they yield. This obviously calls for a response from those who lost out in the first round of technology deployment. As time passes and the technology matures, marketplace improvements will diffuse and technology-based advantages will tend to cancel out, leaving the benefits of greater efficiency to be shared by all market participants.²⁰ However, we should not expect that transition to be instantaneous.

Second, the unfolding of these improvements represents the first step in a cyclical, evolutionary pattern. This initial implementation of market

18. Hanson (2000).

19. Clemons (1986).

20. Brynjolfsson and Hitt (1996).

automation technology requires the deployment of a new network infrastructure, sometimes within individual organizations, sometimes between market players. Initially, the motivation for this deployment may be strictly aligned with its automation goals and the investment justified on that basis. However, once this new infrastructure is in place, it allows market participants to experiment with possibilities beyond this initial intent, tinkering with other ways to use this network and its applications. This in turn will suggest and enable deeper transformation of market processes, beyond the strict automation that motivated the technology's initial deployment.²¹ History has shown how this process ushers in a virtuous innovation cycle, leading to fundamental economic change, and there is no reason to expect this round to be any different. The next section explores the emergence of new market structures, an important step in that direction.

What, Then, Is Really New? Structuring the Electronic Marketplace

The most fundamental transformation of commercial activities through the application of electronic technologies is not primarily about efficiency; it has to do with market and industry structure. It is about architecture.

The architecture of conventional marketplaces, the physical arrangement of their “bricks and mortar,” is never neutral. Ludovic Piette's depiction of Pontoise's *place du marché* in 1876 shows this clearly. The buildings surrounding the square limit the area available for trading, and therefore the number of sellers and buyers who are allowed to take part in market activities. The physical arrangement of stalls constrains the discovery paths buyers can follow, and thus has an impact on what they buy. Sellers occupy different physical positions, display their wares on the ground or in carts, thus affecting their negotiating situation. A physical barrier stops buyers from entering the marketplace until the market is officially open for business.

The specific constraints resulting from this architectural arrangement were somewhat arbitrary. Pontoise's *place du marché* could have been organized differently, and indeed, one could find many different physical marketplace designs around the world, from the covered markets of Covent

21. Bar, Kane, and Simard (2000).



Ludovic Piette, *Le marché de la place de l'Hôtel de Ville, à Pontoise* (1876). Musées de Pontoise.

Garden to the *souk* of Istanbul. However, while different architectural choices could be made, none was neutral. Each entailed physical constraints that structured the market activities harbored in these spaces. Architecture shaped commerce.

Set against the old brick and mortar marketplaces, communication technologies promised freedom from physical constraints. Telegraph and telephone began to allow distant buyers and sellers to participate in markets without being physically present. The Internet promised to liberate marketplaces from the constraints of physical space. There would be no limit to how many buyers and sellers could “fit” in the marketplace, since it was no longer physically bound. Sellers could dream up all kinds of ways to display their wares and design imaginative virtual stands within the software of the electronic marketplace. The market would no longer be held in a specific time zone and nothing demanded that it shut down after dark.

With the Internet, the network *is* the marketplace.²² Not simply a lubricant for the wheels of traditional commerce, the Internet becomes the very place where buyers and sellers meet and transact business. The network, or more precisely the combination of network-based applications and network

22. Gordon (1989).

control software, is the environment within which the various stages of commercial exchange unfold. The network determines market access, since only those who are connected can participate in the market process. It supports discovery, as market players use the network to learn what goods and services are available, at what price, with what characteristics. Buyers and sellers also use the network to find out more about each other, from reputation to credit worthiness and service follow-through. Network-based software carries out the matching of demand and supply, connecting buyers with sellers. Once paired, buyers and sellers use the network to negotiate the precise terms of the transaction they wish to enter into. The network then supports the closing of a transaction and transfer of payment. For electronic products, the network also serves as delivery channel, completing the chain.

For this reason, the transition to e-commerce is more profoundly transformative of economic processes than past transitions such as “steam-commerce”: the information infrastructure and the software that determines its configuration become the foundation for a full set of basic market processes. Market mechanisms then become embedded in the network’s software, and network configuration defines market operations. When the network becomes the marketplace, the information communicated over the infrastructure, the market mechanisms, and the functioning of transaction settlement and payments are all embedded in the software infrastructure that supports the network marketplace and determines its operating parameters. As software, they can adapt flexibly to changing market processes and coevolve with changing economic relationships and organizational forms.

Furthermore, control over the configuration of digital networks—the software definition of who can communicate with whom, under which conditions, to do what—is separable from ownership of the underlying physical infrastructure.²³ As a result, electronic marketplaces can potentially be designed and modified by a variety of parties, ranging from infrastructure owners, providers of marketplace environments, and market players—buyers, sellers, or third parties. Ability to control network configuration then becomes the key to defining the marketplace’s architecture. The architecture of the network marketplace and the software that supports it are the domain of the private actors that provide the network marketplaces—whether these are online auction or spot markets, online retail

23. Bar (1990).

sales sites, portals for e-commerce transactions, or business-to-business supply chain transactions.

The promise of this newfound freedom led to a pervasive myth about the Internet: No longer bound by real-world constraints, the virtual marketplace would become a “perfect market” where all the inherent biases of the physical world could be overcome. In fact, architectural bias returned with a vengeance. Because the architecture of virtual marketplaces is defined in software, network configuration determines marketplace architecture.²⁴ This means that those who have the power to set network configuration can decide who can participate in the market and what will be the rules of engagement within that marketplace. They can architect a virtual space with open or restricted access, decide to let in select buyers, sellers, or third parties. They can give them equal or differential access to market information. They can decide whether the market will function like an exchange, with bid-ask mechanisms, an auction, a brokerage, or simply a catalog. They can structure it so all parties get an equal shot at a transaction or embed preferential treatment for select market players within the software code that governs market clearing.

Control can reside in a variety of places within the network. The “end-to-end” principle,²⁵ which has guided Internet design, argued for implementing software functions, to the extent possible, at the edge of the network (that is, in the computers connected to the network) and in the topmost software layers²⁶ (that is, as independently as possible from the underlying network hardware). According to that model, the communication network is a neutral conduit and all the intelligence resides at the edge, in the servers controlled by the network users. In the pure end-to-end network, control over marketplace configuration therefore belongs to those who control the applications that run on these end devices and the virtual network they constitute. As the Internet matures, it experiences increasing departures from the purest end-to-end principle. Owners of various sub-networks (for example, backbone providers, broadband access providers, or Internet service providers) find it in their competitive interest to embed certain functions (such as security, caching, mirroring, etc.) within the piece of the network they control.²⁷ They do so in part to improve network

24. Just as “Code is Law” (Lessig, 1999a), we might say that “Code is Economics.”

25. Saltzer, Reed, and Clark (1984).

26. See chapter 16 by Michael Kleeman in this volume, describing the network’s layered model.

27. Clark and Blumenthal (2000).

performance, but also because these functions can serve as the building blocks of electronic marketplaces, allowing them to leverage network control into market power. Thus in this emerging network environment, software-based control over network configuration can be found both at the edge and within the network, potentially exercised by multiple parties, jointly or independently.

Modern Marketplace Architecture

The resulting combinations of software-based control open a virtually limitless array of possible arrangements, far greater than what exists in traditional markets. It allows the builders of electronic marketplaces substantial latitude to follow modern architecture's dictum—"Form follows function"²⁸—now that software building tools and materials are flexible enough to create marketplaces where design can be subordinated to the pursuit of specific market mechanisms and outcomes. This means that while Internet technology can be used to design perfect markets (or near-perfect markets), it can just as well serve to construct biased ones. And because the exact exchange mechanisms are buried deep within the code of complex network and application software, the true characteristics of these marketplaces may be much harder to divine than those of the farmers' markets of old. A simple glance at Pontoise's central square was enough to gauge the strength of a particular market position. Modern travelers would find it much harder to assess their relative position in the various possible e-marketplaces for airplane tickets.²⁹ In this new world, network control is the key to market control.

Consider the marketplaces described throughout the case studies in this volume. They show how Internet exchanges can be configured in very different ways to create many kinds of marketplaces, each aiming at distinct competitive outcomes.

The vast majority of electronic commerce today occurs in e-marketplaces deployed by their main players. Analyst Emarketer estimates that

28. Sullivan (1947).

29. In its October 2000 issue, *Consumer Reports* compared the main online travel sites and concluded: "The results: The 'lowest fare' online rates for the same destination were all over the map—sometimes hundreds of dollars apart. Rates also differed from the baseline prices on Apollo, the computer reservation system used by many brick-and-mortar travel agencies. In many cases online rates were higher; in other cases, lower."

over 93 percent of business-to-business e-commerce today takes place in what they call “private or proprietary exchanges”—that is, marketplaces controlled by the market’s dominant player.³⁰ These marketplaces, such as those set up by Dell Computer or Wal-Mart, are primarily ways to automate these companies’ existing supply chains.³¹ While they create competitive pressures among the various nondominant players, for example between competing electronics parts suppliers to Dell, the reverse is not true. They are configured as proprietary exchanges that do not allow these suppliers to compare Dell or Wal-Mart with other potential buyers.

Related to these are marketplaces sponsored by industry consortia rather than a single company. One of the most visible is Covisint, the automotive online exchange created by DaimlerChrysler, Ford Motor Co., and General Motors.³² The presence of competing buyers suggests that this marketplace might be less one-sided than Dell’s supply chain automation. The declared goal of Covisint is to cut the production cost of an average car by 10 percent. Some of these savings are expected from greater efficiency in transaction. Nevertheless, chances are that the architecture of the Covisint marketplace will lend itself to help its owners, the automakers, drive down the cost of components, rather than to help component makers set automakers against one another to bid up the price of their products. Consortia-controlled marketplaces are emerging not only on the buyer side. For example, twenty-eight airlines gathered around United, Delta, Continental, Northwest, and American Airlines have announced the creation of Orbitz, a jointly controlled e-marketplace for travel services.

A large number of marketplaces are controlled and operated by third parties—that is, by entities who do not trade within the exchange. Examples include Chemconnect (a marketplace for chemicals, plastics, and industrial gas) or Freemarkets (online auctions for industrial parts, raw materials, commodities, and services). The economic basis for these is different in the sense that their selling point precisely is to provide an unbiased trading environment for their customers and to charge a fee on the transactions they facilitate. Network control is then put to the service of creating a neutral marketplace architecture for traders.

Third-party control does not guarantee absence of bias, however. In a number of cases, marketplace operators might have economic incentives to

30. Emarketer (2000).

31. For a discussion of the Dell model, see chapter 7 by Martin Kenney and James Curry in this volume.

32. See Fine and Raff (2001).

create particular market slants, even though they do not themselves trade in the marketplace. Examples include placement fees that marketplaces like amazon.com, ebay, or yahoo can charge to list some sellers or some goods more prominently than others. These incentives relate to the marketplace owner's ability to allocate some scarce resource, like screen "real estate" in the case of placement. Screen space is at an even greater premium on the small screens of cell phones and PDAs, suggesting profitable strategies for those who control the order in which choices are displayed in their menus. In Japan, NTT DoCoMo has implemented a particular kind of bias in the marketplace it controls for mobile services, with the division of service providers in different classes: those within the "walled garden" and those outside.³³ Those inside get not only premium placement but also better access to the infrastructure's technical resources and to NTT's marketing might. They also share a greater portion of their revenues with NTT, the operator of the marketplace linking them to their customers. Other kinds of bias may be buried deep in the network's code and even harder to discern. For example, the broadband network provider Excite@Home has struck partnerships with certain content and service providers that agree to share their revenues in exchange for strategic caching and replication of their content within the network's servers. While @Home's network provides greater bandwidth for all services, it makes access to these privileged partners even better, presumably helping them along.

Yet another kind of software-defined marketplace comes with the deployment of peer-to-peer technologies. There the transmission network purely serves as a neutral conduit, and the market mechanisms—discovery, matching, negotiation, and transaction—are implemented "at the edge." Napster, and the corresponding marketplace for music built around this technology, represents the most visible deployment of such a marketplace.³⁴ Companies like Kinecta or iSyndicate have implemented a very similar system for the exchange of digital content around a concept inspired by media syndication.³⁵ The resulting marketplaces come perhaps

33. The French Minitel had pioneered a similar idea in the 1980s with the kiosque system, a tiered structure of partnerships with different service providers corresponding to different pricing structures and different levels of collaboration between the carrier and the service providers.

34. Napster's original intent was nonprofit, to facilitate the exchange of free music, and it may seem strange to describe it as a marketplace. Recent developments, in particular Napster's alliance with media giant Bertelsmann, indicate how a profitable marketplace can be built on that model.

35. Werbach (2000).

closest to a neutral marketplace. In these models each of the peers (the end-nodes at the edge of the network) publish a list of what they wish to sell or acquire, at what price. The network connecting them serves as a neutral conduit for that information.

These examples demonstrate that electronic technologies make it possible to design marketplaces with a wide variety of architectures, each serving the interests of different groups of market participants. While these technologies can indeed serve to reduce friction, level the playing field, or give all players equal access to market information, they can just as well be deployed to embed architectural features in the network marketplace in order to create strategic advantage for certain players. Ultimately, it is not technology that dictates marketplace architecture, but those who control how technology is deployed and configured.

Rearchitecting Commerce

How will the deployment of these various kinds of marketplaces transform commercial activities? The answer varies across sectors, and the studies in this volume begin to paint a series of pictures. Three themes stand out: marketplace efficiency, structure, and adaptability. First, evidence from the various sector studies indicates that e-commerce yields significant savings in the setup and execution of transactions. These savings, however, must be balanced against new expenses. The development of electronic exchanges has proven more expensive and time consuming than initially thought. The sector studies also suggest that those who control the new marketplaces primarily capture these savings.

A second dimension relates to the impact e-marketplaces will have on the distribution of market power. Will they broadly follow existing patterns or challenge them? We have seen that, contrary to early expectations, Internet technologies did not necessarily create level markets but could also serve to design biases within the e-market's architecture. These biases come in three main categories. First are information asymmetries, where the marketplace is structured so as to give some participants better or earlier market-relevant information. Second are matching asymmetries, when the market-clearing algorithms are programmed to favor some of the participants. Third are access asymmetries, when different market players have differential access to the telecommunication infrastructure.

This should not come as a surprise. Indeed, with rare exceptions, markets usually are asymmetric.³⁶ Because these asymmetries reflect the relative market power of the participants and constitute further sources of market advantage, we should expect powerful players to leverage new technologies to further their advantage, to reinforce rather than eliminate these asymmetries. In some cases, however, the technology can create opportunities for traditionally weaker market participants to challenge the dominance of incumbents. The case studies of book or music distribution offer such examples.

Perfect markets can exist only for commodities, where a product is fully described by three characteristics: identity, standardized quality (grade), and price. This is where we find the most successful electronic trading networks so far. In these cases, they have been easily justified by cost savings and information optimization in the supply chain. Most real-life transactions between businesses involve much more complex objects. They are not arm's-length dealings when competition primarily revolves around price but multifaceted interactions including exchanges of expertise, joint learning, or collaboration in product design. In the emerging production networks, firms favor longer-term relationships with fewer suppliers who become partners in generating shared innovation. Such relationships are better supported by collaborative networks than by auction and electronic trading markets.

In addition, Internet commerce appears to be penetrating business processes least where there is the greatest sunk investment in legacy information systems. Within the formal boundaries of the firm, there is resistance to displacing the legacy information systems that effectively manage mission-critical functions, often at low cost per transaction. The same appears to hold for business commerce that crosses firm boundaries where there is sunk investment in legacy systems that already similarly deliver very low transaction costs with broad reach—business-business payment systems, for example. This is not to say that Internet commerce will never make headway in these tougher applications, just that further progress awaits innovations that can deliver sufficient benefits to justify the replace-

36. On information asymmetries in particular, Scitovsky notes: "The root cause of the unequal distribution of knowledge between buyers and sellers is the division of labor, which causes everybody to know more than others about their own specialty and less about other people's specialties than others know about them. The farther the division of labor proceeds, the wider becomes the gulf between the specialist's knowledge and the nonspecialist's ignorance of each specialty." Scitovsky (1990, p. 137). Evolution to the "knowledge economy" exacerbates these asymmetries.

ment of existing systems. Outside of the obvious cost advantages of value chain trading networks, electronic marketplaces cannot yet support real innovation in areas such as collaborative product development and cooperative cross-firm work processes. They will eventually, as they spread further, but at the moment these network-based innovation processes remain at a very early stage indeed.

This raises a third dimension of the impact of e-commerce—relatively unexplored and also more interesting. Because network configuration can be reprogrammed, the corresponding marketplace architecture is adaptable. This process is neither costless nor instantaneous but nonetheless allows faster, cheaper, and more flexible marketplace adaptation than in the preelectronic world. Marketplace architecture can then change to reflect evolving business practices or to take into account new ways to organize work processes within or between firms. In turn, changes in corporate form and new patterns of interfirm collaborations create user-driven experimentation with networking technologies and foster the development of new networking technologies and applications. The resulting process of coevolution may very well be the most significant characteristic of the transition to e-commerce. In the past the relative rigidity of the underlying communication infrastructure impeded rapid reorganization of work processes and interfirm relationships. By contrast today, e-commerce technologies allow for the joint adaptation of communication infrastructure and economic superstructure. In the knowledge-based economy, this becomes a powerful innovation engine.

Conclusion: Policy Implications

As if to confirm that Internet technologies do not automatically generate perfect competition, electronic marketplaces—business-to-business marketplaces in particular—have already attracted significant antitrust scrutiny. This concern began before the current wave of Internet exchanges, most notably with the Department of Justice's 1992 investigation of airline computer reservation systems (CRS), one of the first and largest e-marketplaces.³⁷ As was the case with CRS, the exchanges attracting most

37. Department of Justice (DOJ) Antitrust Division, "*United States v. Airline Tariff Publishing Company, et al.*, Proposed Final Judgment and Competitive Impact Statement," *Federal Register* 59, no. 62 (March 31, 1994).

attention tend to be those owned by few major participants in a given marketplace, and the main concern is collusion.³⁸ So far, policymakers do not view the anticompetitive risks associated with electronic marketplaces (and B2B marketplaces in particular) differently from those related to nonelectronic markets. They identify a number of potential antitrust issues, including information sharing agreements, joint purchasing, exclusionary practices, and exclusive access. In their view, however, these are not fundamentally new and can be addressed with traditional antitrust analysis.³⁹

The above analysis suggests that there may be more to this story. Competitive biases can be built into the architecture of e-marketplaces in rather subtle ways. The danger is not so much the obvious one that online markets can be blatantly rigged to favor the market's owner—indeed, an early example of such abuse, CRS, was effectively handled by antitrust. The real danger is that much more subtle manipulations of consumer choice and market outcome become possible and are likely to escape detection because they are embedded in the network's very architecture.⁴⁰ This issue of embedded, indirect market manipulation is one with which existing systems of commercial law and policy are ill-prepared to cope effectively.⁴¹ This points to a new link between communication policy and competition policy: when network control yields market control, policies for network access have implications that go beyond the strict domain of telecom policy to affect broader economic issues. When network code curtails fair market access, it becomes crucial to guarantee open access to networks, so that competing marketplaces can be created.

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39. "Entering the 21st Century: Competition Policy in the World of B2B Electronic Marketplaces," Report by the Federal Trade Commission Staff, October 2000 (www.ftc.gov/os/2000/10/b2breport.pdf).

40. For a description of how such biases can occur in broadband cable networks, see chapter 18 in this volume.

41. Lessig (1999b).

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