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The Growth and Development of the Internet in the United States

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Rarely does a new technology emerge that galvanizes a dramatic rethinking of the nature of commerce. The Internet is such a technology. At this early stage, it is difficult to appreciate fully the importance of the Internet, but some speculate it might be as momentous as the arrival of the telegraph (Cohen, Delurg, and Sysmar 2000; Standage 1999). Radically new communication technologies such as the Internet have multiple applications and often become ubiquitous. As such, the adoption, diffusion, and development of this new technology provide an especially penetrating view of how different national innovation systems have responded to and shaped the commercial possibilities inherent in the Internet. Of course, such an assessment for an economy as large as that of the United States is difficult. It is further complicated by the peculiar way in which communications technologies permeate and facilitate connections and relationships. Often the action of such technologies is imperceptible to most of the actors involved and even to aggregate statistics; for example, better information transfer between customers and suppliers is not manifested in the finished good, though it is embodied in the good in terms of lower cost and/or higher quality. Given the diffuse nature and the speed of the Internet's evolution, any analysis can only be tentative.

Government and universities played vital roles in the gestation of the Internet in the pre-commercial and early commercialization phases. The apparent ease of entry encouraged many start-ups. Many established firms were laggards in the early commercialization process, though ultimately they were counted among the greatest beneficiaries. In this

respect, the commercialization of the Internet parallels the commercialization of university-based biology research in the late 1970s and early 1980s that led to the formation of a biotechnology industry (Kenney 1986). In the biotechnology case, venture capital was the midwife for the creation of the biotechnology industry, but the large pharmaceutical firms were able to later integrate the techniques of biotechnology into their technological toolkit.

National exceptionalism is a difficult argument to advance and validate. Nevertheless, in the case of the commercialization of the Internet, certain characteristics of the U.S. political economy contributed to the head start that U.S. firms enjoyed, their ability to grow rapidly, and, after the 2000 NASDAQ decline, a large number of firm failures. With respect to commercialization, the U.S. institution of venture capital played a central role in the rapid formation of new dedicated Internet firms that were established to define and occupy the new economic space. With respect to the Internet, there were three advantageous features of the U.S. national system of innovation: a unique telecommunications infrastructure, an active government in funding university research, and a capable set of private sector institutions dedicated to funding new high-technology enterprises.

The enormity of the U.S. market and the variety of impacts and uses of the Internet dictate that this discussion must necessarily be a limited examination of the role of the National System of Innovation (NSI) and the development of the Internet. For example, the significant impacts of intranets upon firm organization, internal information flow, and human resources practices, and so on are simply ignored, though they will surely be profound. The chapter by Helper and MacDuffie (chapter 11) examines the business-to-business (B2B) area in more detail; I will focus on those issues with respect to the role of the NSI in funding B2B startups. One of the most intriguing impacts or initiatives that has emerged from the Internet is not examined, namely the effort in a wide variety of industries to standardize descriptors of all parts of the value chain, so that commerce can be transacted entirely electronically.' Despite these and numerous other omissions, the pervasive nature of the Internet as a communications medium, and the wide variety of experiments underway that are aimed at exploiting the Internet, mean that the scope of this chapter remains immense.

Setting the Stage

The commercialization of the Internet and the speed with which it became a medium for commerce depended upon the already extensive diffusion of the Internet's infrastructure and its noncommercial use. This section describes some of the organizational features that provided the preconditions for the U.S. commercialization process. Despite the formation of the European Union, the United States was (and remains) the largest single market united by common laws, a common language, a common currency, and various features of a modern nation-state. [2] A more prosaic, but nonetheless important, feature for the diffusion of the Internet was a well-developed telephone system with uniform rates and usage rules. Widespread credit card usage and the large number of U.S. consumers who were comfortable using their credit cards for telephone and catalog sales also helped ensure the rapid growth of Internet commerce.

In an entirely different vein, the United States had an enormous research university system with a number of global-class engineering and science departments that were among the largest and most lavishly funded in the world. This was complemented by a large number of global-class corporate research laboratories, led by AT&T/Lucent's Bell Laboratories, IBM's Yorktown Heights and San Jose Laboratories, and Xerox's Palo Alto Research Center, to name the most prominent. No other nation or, perhaps even group of nations possessed institutions that could rival these as sources of technology and well-trained personnel. In terms of computers, computer firms, and resources dedicated to computing, the United States was the acknowledged global leader. The United States not only trained many engineers, but also had a liberal immigration policy that permitted qualified immigrants to enter, particularly for postgraduate education. These institutions and policies created an enormous pool of engineers and scientists.

The United States was the leader in developing and using computers in government, university, and industry. The importance of military spending in this process is well known (Flamm 1988), though often exaggerated. In the adoption of computers for commercial or general use, the United States was the world's leader. [3] The rapid adoption and large installed base created positive feedback loops, reinforcing the U.S.

advantage. Though **IBM** was a global colossus, U.S. antitrust enforcement ensured a semblance of competition and fettered IBM's ability to throttle new entrants: witness Microsoft, DEC, or Sun Microsystems. In most other nations, one national champion for computing and another for telecommunications equipment were chosen and subsidized by the national government; other entrants were discouraged. The evolution of the computer sector in the United States was characterized by repeated waves of new computing and data communications industry entrants, whose innovations were more capable and/or less expensive than those of the dominant vendors. Thus, there was continuing turbulence—a feature not as prevalent in Europe or Japan.

In technical terms, the Internet is the result of an evolutionary path that has been affected by two fundamental reconceptualizations of the architecture of computing: distributed networked personal computers, and the connection of a wide variety of data processing devices. At each step of this evolution, U.S.-based start-ups were the delivery mechanism for and the beneficiaries of leaps in functionality caused by a set of technological trajectories (Dosi 1984).[4] The dominant tendency has been an evolution from centralized computing to distributed, networked computing. The distributed portion of this computing system consists of the millions of computers in workplaces and homes across the United States and the world. The networked portion refers to the various media, including radio waves, electrical pulses, and photons, which permit these computers to intercommunicate.

The adoption of the Internet and the WWW was predicated upon the earlier diffusion of personal computers at home and work in the form of local area networks (LANs) in institutional settings (von Burg 2001a) and modems on home PCs (Jimeniz and Greenstein 1998). When the WWW software was first released in 1992, the majority of adopters were in institutions, especially universities, where they utilized a desktop computer connected to a LAN. These groups were already using their computers to access files through Gopher and communicating by e-mail through systems such as Telnet. They were the early adopters that downloaded browsers to access the WWW.

Though not the initial adopters of the WWW, U.S. home users rapidly embraced the Web (see table 3.1). The earlier diffusion of online services such as AOL (which was venture capital-funded), Compuserve, Prodigy,

Table 3.1
U.S. World Wide Web Users in Millions, 1996-2000

Year	Home	Work	Total
1996	13	15	28
1997	20	20	40
1998	27	30	57
1999	35	45	80
2000*	42	60	102

Note: *Estimated
Source: Computerworld, <hap: fiwww.computerworld.com/home /emmerce .NSF/All/pop>

and the Well had created a large, relatively sophisticated population of home users that were comfortable online (Jimeniz and Greenstein 1998). For the online services, the emergence of the WWW and the privatization of the Internet initially appeared to be a challenge because their revenue was generated by per-minute access fees and further fees to use proprietary services. The no-cost Internet appeared threatening, but their response was to continue their proprietary online services that were inaccessible to nonmembers, while implementing flat monthly fees and converting themselves into Internet service providers (ISPs) that provided their home customers with e-mail addresses and Internet access points globally (e.g., AOL).

The United States had a far greater installed base of computers than any other country; moreover, many were already connected to a network. This can be seen in table 3.2, which indicates that there were more domain names registered in the United States than in the rest of the world. This massive installed base and the large number of users experienced with computer networks meant that the adoption of the Internet could advance at breakneck speed. The next section discusses the ways in which the unique U.S. regulatory regime encouraged the development of the data communications market.

Regulatory Preconditions in the Telecommunications Sector

The low-cost and open U.S. telecommunications system was the outcome of a gradual evolution of the U.S. regulatory regime. [5] As important as the contemporary regulatory environment, which is discussed in the chapter

Table 3.2
Growth of Domains in the United States and the World

	.com, .org, .net and .edu					
	U.S.	World	% in U.S.	Country code domains	Total	Percent of total in U.S.
Jul. 98	1,610,689	543,945	74.8%	1,127,483	3,282,117	49.07%
Jan. 99	3,003,950	1,033,925	74.4%	1,466,276	5,504,151	54.58%
Jul. 99	4,886,550	2,165,800	69.3%	2,045,716	9,098,066	53.71%
Jan. 00	6,673,650	3,334,825	66.7%	3,393,973	13,402,448	49.79%
Jul. 00	10,120,208	7,294,171	58.1%	6,450,232	23,864,611	42.41%

Source: Adapted from Zook 2000, <Intp://socrates.berkeley.edu/—zook/domain_names/Domain>

by Dennis Yao (chapter 13), were a series of telecommunications policies that took effect before the birth of the Internet. These policies opened the telephone system to new entrants and accelerated the pace of innovation, encouraging the private sector to increase bandwidth and lower costs. United States government policy toward AT&T differed markedly from those of European and Asian governments toward their dominant telephone company. The result was that the United States had a more dynamic and open telecommunications system earlier than did most other countries.

In nearly every other OECD nation, the telephone system was a government-operated monopoly, whereas in the United States, AT&T was a private corporation regulated by federal and various independent state regulatory commissions. The roots of the U.S. telecommunications environment can be traced to a marketplace struggle during the first two decades of the twentieth century that ended with the triumph of AT&T and the imposition of regulation. Beginning in 1893, when the central Bell patents expired, and ending about 1920, AT&T engaged in vicious competition with a large number of local (city-based) phone firms. AT&T's strategy was to offer low rates for local calls (i.e., where there was competition), while garnering its profits from the long-distance system that it alone controlled. The result was a brutal price competition, leading to a dramatic decrease in local rates, an increase in telephone penetration and usage,[6] overbuilding of the telephone infrastructure,

and rapid adoption of new cost-saving technologies such as the Strowger mechanical switch. AT&T used its long-distance income, the ability to block access to its long-distance lines, and selective purchases of local telephone companies to defeat the locals and unify the entire system under monopoly control (Lipartito 1997). In the process of this competition, a flat-rate price for local calls and "universal service" became an accepted norm and was enshrined in the U.S. regulatory structure. [?] This arrangement was stable for the next fifty years, despite the fact that telecommunications technology continually improved. The flat rate for local calls would become an important factor in the adoption of online services and Internet penetration into the home.

With AT&T's triumph, the U.S. system now outwardly resembled the government-owned European situation, with one entity controlling nearly the entire U.S. telephone system. [8] In most European countries, the government post office and telegraph monopolies quickly asserted control of the telephone system, and the cutthroat competition phase never occurred, so market penetration was retarded and there was no consideration of flat-rate local call pricing. Technology adoption also lagged, and service was the best an entrenched bureaucracy decided to deliver. [9] Moreover, the telephone service became a government revenue source and employer, so any deregulatory moves had budgetary and employment implications. Thus a different user profile, regulatory regime, and market structure distinguished the United States from other countries.

In the mid-1950s, AT&T owned and operated the entire phone system, from the consumer handsets to the network—it was a classic case of vertical integration. The U.S. government had no vested interest in the system, however, and it was committed to encouraging competition. The opening of the AT&T monopoly to competition can be understood as a disintegration of telecommunications into the following independent market layers (Moore 1996):

1. Terminal equipment (e.g., phone-sets, extension cables, and switches)
2. Long-distance services (e.g., MCI and Sprint)
3. The local loop
4. Encoding mechanisms (e.g., modems/multiplexing/protocols)
5. Value-added services (e.g., Tymnet, Telnet, and the Internet).

Each layer was gradually opened to competition. In parallel to this, though not directly related, was an inexorable increase in the volume of data versus voice transmission through telecommunications pipelines. Roberts (2001) estimated in August 2000 that the data transmitted by the Internet protocol surpassed all other telecommunications combined. AT&T's near monopoly in the voice area forced new entrants to focus on the data transmission market—a fortuitous decision, as data transmission grew exponentially, whereas voice transmission grew incrementally.

The first move toward opening the telephone network was the 1956 Hush-a-Phone decision by the U.S. Court of Appeals, which permitted mechanical devices such as receivers to be connected to the network. The 1968 Federal Communications Commission (FCC) Carterphone ruling allowed the Carter Electronic Corporation to connect its mobile radio system to the AT&T telephone network. Thus the first liberalization occurred at the edge of the network, and created a market for telephones and subsequently for telephone answering devices, fax machines, and computer modems.

The next step in deregulation occurred in the area of transmission. In 1969, MCI received FCC permission to establish microwave service between St. Louis and Chicago. This permission was soon extended to other markets, which enabled large long-distance users to bypass the AT&T network and extended competition closer to the center of the network. MCI and other specialized carriers soon undercut AT&T on the most lucrative routes, while AT&T's long-distance service was hobbled by its commitment and the regulatory requirement to serve less lucrative routes and provide highly regulated local service. [10] Moreover, the new entrants installed the newest and most up-to-date (and non-AT&T) equipment, thus providing a market for other equipment suppliers. Most important, though not recognized at the time, were FCC decisions separating data from voice communications, thereby permitting new entrants to specialize in data communications."

The 1974 challenge from MCI to AT&T's right to maintain a monopoly over long-distance service set in motion antitrust proceedings against AT&T. These were settled in 1982, with the consent decree stipulating the conditions for the dismemberment of AT&T: long distance was separated from local phone service, and six regional operating companies

were created. Retaining the long-distance profit center appeared a brilliant decision; little did AT&T suspect that long distance would become a commodity, and that "ownership" of the consumer would become a critical control nexus.

This gradual deregulation of the AT&T monopoly was driven by a desire to accelerate competition and innovation. It would be tempting to attribute the process entirely to far-sighted government regulators and legislators, but it was entrepreneurs who pressed for deregulation, which, to their credit, government regulators and the courts did not strongly resist. The relationship of the U.S. government to the dominant telephone vendor made deregulation much easier and more gradual. This progressive deregulation allowed new firms to emerge in every aspect of telecommunications. Repeatedly, the new entrants ignited cutthroat competition, rapidly decreasing costs and/or increasing functionality. The outcome of this gradual deregulation was a low-cost, comparatively open market for telecommunications services.

The relatively open U.S. telecommunications market and the rapidly changing technologies created many new market opportunities. However, the conversion of opportunities into new firms—as opposed to having them actualized in existing firms—required entrepreneurs, an encouraging environment, and a capital market willing to support these new ventures. In the decades since World War II, a set of institutions evolved in the United States that were centered on venture capital, which profits from converting such opportunities into successful firms.

Venture Capital—A Critical Component of the U.S. Innovation System

Venture capital, as an institution intimately related to clusters of high-technology start-ups, was largely confined to the United States until the mid 1980s, when Israel developed a venture capital industry. The U.S. commercialization of the Internet cannot be understood without reference to venture capital and the complex of institutions for supporting entrepreneurship that have evolved with it. As we shall see, the largest concentration of firms commercializing the Internet is in the San Francisco Bay area, which is also the center of the world's venture capital

industry (Kenney and Florida 2000). Simply put, the willingness of venture capitalists to fund Internet start-ups was responsible for the U.S. pattern whereby start-ups rapidly commercialized the Internet.

The first venture capital firms were established after World War **II** with the express purpose of assisting in and profiting from the foundation and growth of entrepreneurial firms. During the following decades, venture capital gradually became a more formal institution, as the venture capitalists profited from and concentrated on investing in high technology, where they funded many of the defining firms of the late twentieth century. The rapidity of the increase is amazing — total venture capital investments increased from $45 million in 1969 to $6 billion in 1995 and the unheard of sum of $103 billion in 2000 (NVCA 2000b). However, for the first two quarters of 2001, venture capital investments were roughly half that of the comparable quarter in 2000. Moreover, there was reason to believe that the pace would continue to slow for the remainder of 2001.

As the venture capital industry evolved in regions such as Silicon Valley and Route 128, there was also a co-evolution of a plethora of other organizations, including law firms, accountants, employment agencies, executive search firms, and investment banks; all of these services specialized in accelerating the growth of small firms (Kenney and von Burg 1999; Bahrami and Evans 2000). This ecosystem of organizations operates to lower entry barriers and accelerate a new firm's growth, thereby decreasing what Stinchcombe (1965) termed the "liability of newness." Curiously, for the constituents of the ecosystem, newness is not entirely a liability—it is also a desired attribute. Under normal conditions, usually the greatest single entry barrier for any fledgling firm is the lack of capital. Venture capital is the primary accelerant because it eliminates the need for new firms to grow slowly out of retained earnings and frees the founding team from a continual, time-consuming search for capital. The law firms are able to advise their small-firm clients on how best to structure their business, bargain with the venture capitalists, handle intellectual property issues, and assist with myriad other details necessary to establish a firm (Suchman 2000). Furthermore, there are a wide variety of consultants and firms capable of undertaking many corporate functions, allowing the small firm to postpone expenditures it otherwise would

have to make immediately upon constitution, thereby freeing it to concentrate on product development and market introduction.

Another critical institution for this innovation system was the NASDAQ stock exchange, which gradually evolved to specialize in raising capital for fast-growing young firms as well as providing an exit strategy for the investors and entrepreneurs. It would be on the NASDAQ that the Internet stock bubble would be most pronounced and, after March 2000, where the decline in Internet stocks was the greatest.

In Silicon Valley, but also in other high-technology regions, entrepreneurs began establishing firms even before the Internet was officially privatized. Figure 3.1 is an indication that as of January 1999, Silicon Valley had many more significant e-commerce and software tools-based Internet start-ups than any other U.S. region. [12] This is not surprising because the individuals making up Silicon Valley's institutions are constantly searching for new opportunities, and they were already active in data communications. The potential of the Internet quickly attracted their interest, and the funding extended by venture capitalists provided the financial wherewithal for these start-ups to grow very rapidly.

The importance of Silicon Valley-like institutions is the rapidity with which they responded to the opportunities that the Internet and WWW presented. Figure 3.1, perhaps, in some measure, over-represents the percentage of firms because of the dominance of Silicon Valley venture capitalists among the top 20 venture capitalists and the aggressiveness of firms funded by venture capitalists in undertaking public offerings. Having said that, all evidence suggests that Silicon Valley was the center of the explosion of Internet start-ups and, more recently, as a recent report by Webmergers (2001) of Internet firm closures indicates, California is massively over-represented, having experienced 32 percent of all closures they catalogued. Notice that in California the number of Internet-focused start-ups is evenly divided between e-commerce sites and software tools for the Internet. This differs from the two other major start-up concentrations. It is interesting to note that Boston's start-ups are concentrated in the software tools area, whereas New York is more e-commerce oriented. These results fit very well with the high-technology character of the Boston area and the more creative and commercial New York area. These three clusters account for over 50 percent of total

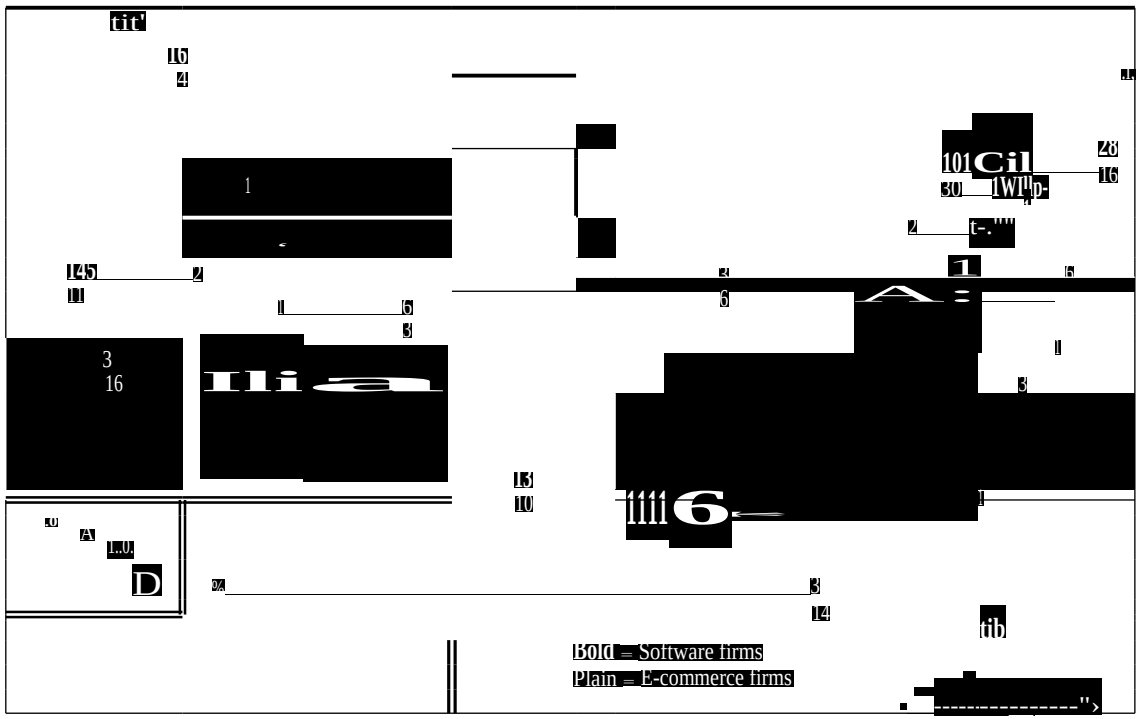

Figure 3.1
Significant venture capital-funded Internet start-ups as of January 1999
Note: Compiled from initial public offerings and investments by first-tier venture capitalists. This likely overestimates Silicon Valley firms. However, it is indicative of where the main firm concentrations are and the regions with greater technology or e-commerce emphasis. Most important, Silicon Valley indicates high concentrations of both.
Source: Author's own compilation.

venture capital disbursements in the United States, and, not surprisingly, the highest visibility Internet start-ups were formed in these three regions.

The University—An Important Initial Repository of Capabilities

At the dawn of commercialization of the Internet, the single largest concentration of users (i.e., expertise) was to be found among university faculty, particularly computer science faculty, and their students. In the initial commercialization phase, students were as important or more important than faculty. Given this expertise, it is not surprising that universities were the source of several early start-ups. Firms tracing their origins to university computer science departments include the three major portals, Yahoo!, Excite, and Lycos, and the first important commercial browser firm, Netscape. Two of the most-used search engine firms, Inktomi and Google, had university roots (UC Berkeley and Stanford, respectively). An MIT faculty member established the Web-caching firm Akamai. The university was not only a source of knowledge and expertise; it was also a source of entrepreneurs.

Computer science students and faculty formed the vanguard, but soon students in other departments, particularly business school students, began launching e-commerce start-ups. The ensuing "dot.com" fever would make entrepreneurship an important career goal for students and faculty, and many ventures were first conceived and then launched from campus. During 1997-1999, the enthusiasm was infectious. Career goals for MBA students changed from joining an investment bank or consulting firm to establishing or joining a start-up. Whether the changed goals are merely a short-term response to the increase of dot.com stock prices, or will persist for the longer term, is not clear.

From the Internet to E-commerce

The Internet began as a U.S. Department of Defense project for interlinking defense researchers at various universities and military research establishments (Abbate 1999). The first Internet server was installed at UCLA in September 1969. The next server computer went to the Stanford Research Institute, soon to be followed by servers at UC Santa

Barbara and the University of Utah. After this initial burst, further nodes proliferated slowly because only research sites funded by the Department of Defense were allowed to connect to the ARPANET, so, by 1979, there were only 61 servers. On the network, e-mail quickly became the compelling application, and soon other academic research groups clamored for e-mail access. In the mid 1970s, the U.S. Department of Energy (DOE) inaugurated MFENET for its magnetic fusion energy researchers, and then DOE'S high-energy physicists built HEPNET. NASA's space physicists established their own network. In 1981, non-DARPA-funded computer scientists launched CSNET with funding from the National Science Foundation (NSF), and this spread quickly to more than seventy sites (Haffner and Lyon 1996, 244). Contemporaneously, AT&T's dissemination of the UNIX computer operating system spawned USENET, and then in 1981, BITNET was introduced to link academic mainframe computers; it also offered a simple e-mail program (Rogers 1998). [13] In 1985, DARPA transferred the ARPANET to the NSF. In an effort to increase usage, the NSFNET was open to all universities with the requirement that they must make a connection "available to all qualified users on campus" (quoted in Leiner et al. 2000). The NSFNET diffused e-mail and file-sharing to the rest of academe, thereby enlarging the installed base and providing students with experience in using the Internet. In 1985, NSF also decreed that all NSF-related sites should use the TCP/IP protocol, and it became the dominant data transmission protocol. In the late 1980s, a lack of interest among AT&T and the other established firms in operating the NSF Internet backbones created market opportunities for startup Internet Service Providers such as UUNET and PSINET, both of which were funded by venture capitalists.

In March 1991, certain restrictions on commercial use of the NSFNET were loosened, providing an early indication that eventually the Internet would be privatized and opened fully to commercial use. In September 1994, NSF announced its intention to end subsidies for the Internet backbone by May 1995 (Ferguson 1999; Howe 2000). Even as NSF was moving in this direction, a national commercial online service began offering Internet access to its subscribers by opening an e-mail service in July 1992, followed by full Internet service in November 1992.

In 1992, the dominant program for using the Internet was Gopher, which had been written and released by University of Minnesota pro-

fessors, but graphical browsers based on the WWW specifications would soon displace it. The technological breakthrough that dramatically increased the functionality of the Internet was the development and the 1991 release by Timothy Berners-Lee at the CERN high-energy physics laboratory in Switzerland of the software and specifications that would form the basis of the WWW. In May 1991, the first Web server was introduced at the Stanford Linear Accelerator. By the beginning of 1992, there were 26 servers, and the number began increasing exponentially. Berners-Lee released a UNIX browser, but use of the WWW was still confined to a small number of academic and corporate researchers.

In February 1993, Marc Andreessen and Eric Bina, working at the University of Illinois National Center for Supercomputer Applications, wrote the Mosaic Web browser for the Microsoft Windows platform. Their user-friendly graphical browser simplified use of the WWW. Moreover, they made it freely available by posting it on the WWW, and as a result millions of copies were downloaded in a few months. This browser began the process of bringing the commercial potential of the Internet and WWW into focus. Moving to capitalize on the software, the University of Illinois licensed the Mosaic browser technology to the venture capital-funded firm Spyglass, and then later Microsoft. The creation of Mosaic, the connection of commercially operated networks to the old NSF Internet, and the withdrawal of NSF, signaled the end of the pre-commercialization phase.

The rapidity with which the terms "Internet" and "WWW" merged in the public mind is remarkable. For example, the 1994 book *The Internet Unleashed* contained 62 chapters devoted to various issues surrounding the Internet, but only one chapter was devoted to the WWW and another to Mosaic. The other chapters largely ignored the WWW. In the index, there were 42 headings for Gopher, 25 for Telnet, and only 21 for the WWW (Sams Publishing 1994).

The commercialization of the WWW bears a certain resemblance to the Oklahoma Land Rush memorialized in the 1934 movie *Cimmaron* (Kenney and Curry 1999). [14] The Web created a new, rich interactive experience and a spatial-like feeling for cyberspace. A new universe of fast and inexpensive "virtual" applications promised to allow commercial transactions that would be far less costly and/or more convenient than those in the physical world. Because this new economic space is simply

software constructions, there would be enormous opportunities to experiment and create novel applications. Many processes conducted in physical space could be modeled in software and manipulated in cyberspace.

The WWW transmits information not only through sound or words, but also through graphics, thereby creating enormous flexibility and bandwidth. The old adage "a picture is worth a thousand words" applies well. Like a phone conversation, the WWW is interactive: it allows a form of dialogue to occur between the user and the Web site. Because the interaction is digitized, it can be informated (Zuboff 1988). The removal of humans from the interaction means that if the demand for a product or service increases, then the site can be rapidly scaled up or turned off. The intense pace of WWW developments is the result of an interaction between the telephone-like speed, the ease of reproduction and transmission, and omniaccessibility (Curry and Kenney 1999). All of this is facilitated by the Internet's ease of use. In combination, this made the Internet an attractive medium for commerce.

By early 1993, the technology was ready, and a few existing firms and several start-ups were experimenting with harnessing the technology to commercial purposes. However, for the most part, industry and entrepreneurs were more interested in the implications of interactive television delivered through the cable system. In most respects, the Internet was still a university-driven technology, and for the users it was free. From the perspective of hardheaded businesspersons, the Internet was attractive, but it was difficult to decide whether there was a valid business model for its commercialization. The first significant report to the general public about the commercial implications of the Internet was the December 8, 1993 *New York Times* article by John Markoff entitled "A Free and Simple Computer Link." Markoff described how firms were putting documentation online, preparing online magazines, and thinking about advertising applications. Online sales were not mentioned.

E-commerce

The U.S.'s advantages for an early start commercializing the Internet were substantial and multidimensional. Both U.S. start-ups and established firms moved quickly to establish an Internet presence. The strength of the U.S. firms is best illustrated in table 3.3, which indicates that Micro-

Table 3.3
Media Metrix Global Top 20 Web and Digital Media Properties for November 2001

Rank	Top Web and digital media properties	Unique visitors (000)
	All Digital Media	189,357
1	MSN-Microsoft Sites*	127,379
2	AOL Time Warner Network*	113,119
3	Yahoo!*	100,990
4	X10.COM	44,528
5	Vivendi-Universal Sites*	39,518
6	About/Primedia*	39,076
7	Google Sites*	36,541
8	Terra Lycos*	35,225
9	Amazon*	35,133
10	eBay*	33,418
11	LYCOS SITES	31,956
12	Excite Network*	27,031
13	CNET Networks*	27,005
14	Walt Disney Internet Group*	26,019
15	Infospace Network*	23,012
16	American Greetings*	20,410
17	Real.com Network*	20,237
18	Ask Jeeves*	20,216
19	eUniverse Network*	18,555
20	FortuneCity Network*	17,437

Note: *Aggregated from a variety of sites
Source: Media Metrix, <http://www.mediametrix.com>

soft, AOL, and Yahoo! were the world's leading Internet sites on the basis of unique visitors as of November 2001. The strongest European site is Lycos, which was purchased by the Spanish telecommunications firm Telefonica. Research on the Internet in Mexico found that many of the most popular "Mexican" e-commerce sites were actually hosted on computers in the United States (Curry, Contreras, and Kenney 2001). Thus, to some degree the statistics might understate the centrality of U.S. industry to the Internet. In the following sections we briefly detail the responses of established firms to the Internet. This is followed by four short subsections discussing the actions of the start-ups and the responses of the established firms in four areas: portals and other miscellaneous

sites, business-to-consumer (B2C) e-commerce, B2B e-commerce, and software tools. One salient feature of these sections is the sheer volume of entrants and rivals in each area and the proliferation of niches within those areas.

Existing Firms and the Internet

The responses by existing firms varied widely in type and rapidity. At the initial stage of commercialization, full comprehension of the impact of the Internet was not easy. For example, it was only on May 16, 1995, with the release of Bill Gates's memo entitled "The Internet Tidal Wave," that Microsoft demonstrated it grasped the implications of the Internet (Ferguson 1999). Given Microsoft's comparative tardiness, it is no surprise that in the period from 1995 to 1997 most non-technology firms had little appreciation of the possible impacts of the Internet on their businesses.

Among the first established firms to understand the Internet's potential were Silicon Valley firms such as Cisco, Sun Microsystems, and Oracle, all of which had been financed by venture capitalists in the 1980s. Cisco was particularly advantaged: it produced the routers and switches that directed much of the Internet traffic, so it became aware of the Internet's implications almost immediately. Sun, with its roots in the engineering and networking community, also saw the potential, and its servers would become the standard for large Web sites. Sun also introduced the Java programming language. Oracle's database software became the platform upon which most Web sites operated. These firms became critical Internet infrastructure firms.

Technology firms such as IBM and Hewlett Packard also responded, though they both lagged behind Sun and Oracle. Other firms such as DEC were less successful. In the case of DEC, this is particularly surprising because it was the owner of Altavista, which was one of the most successful early search engines. DEC might have been able to create a successful portal and become a rival to start-ups such as Yahoo! A comparison of the rival PC makers Dell and Compaq also illustrates that the Internet did not necessarily lead to commercial advantage. Dell rapidly transferred its build-to-order model to the Internet and was rewarded with lowered costs and increased sales. In contrast, Compaq, dependent as it was upon its retail channels, found it difficult to convert its oper-

ations to the Internet. For Dell the Internet was a competitive weapon, whereas for Compaq the Internet proved to be a difficult media to use effectively (Kenney and Curry 2001). Although the Internet was beneficial for most technology firms, it also created difficulties for firms whose business model could not easily integrate the Internet.

For existing firms, the WWW enabled the provision of new services to their customers. For example, Federal Express first provided a one-way information service that enabled customers to track the location and arrival times of shipments (Lappin 1996; Grant 1997). The positive customer response to this experiment spurred Federal Express to develop yet other Internet services. Based on its experience with the tracking service, an application was developed to permit customers to use the Internet for all their shipping functions. The features now available include scheduling pick-ups and obtaining detailed maps for all their drop-off locations, rate charts, and other information such as international customs regulations. FedEx also provided free downloadable software capable of automating shipment by allowing the user to create an address book, maintain a shipping history log, and create and print labels (FedEx 2001). In other words, FedEx and other package shippers quickly integrated the WWW into their business.

For every FedEx and Dell, there were many established firms that initially were oblivious to the possible impact of the WWW. Of course, many firms, including General Motors, Ford, and Wal-Mart, operated sophisticated EDI (electronic data interchange) systems, not only internally, but also with a core group of suppliers or customers; however, they were not the first to switch to the Internet. Whereas FedEx and Dell began integrating the Internet into their operations in 1995, most firms only recognized the possibilities and dangers posed by the Internet in late 1996 and 1997. The store-based retail industry was especially slow in responding, and established Web sites after 1998. Catalog-based firms such as **AEI,** Eddie Bauer, and Land's End moved more rapidly. The response of manufacturers was more variable. For example, Cisco and Intel began online customer service in 1995 and 1996, respectively. From these beginnings, the early adopters gradually deepened the functionality of their site. In 2000, Cisco had online sales of over $12 billion and resolved over 70 percent of its support requests over the Internet (Cisco Systems, Inc. 2000).

The safest generalizations about the established firms is that the more technologically sophisticated they were, the closer they were to computer networking, and the more entrepreneurial they were, the more likely they were to begin experimenting with the Internet and the WWW. However, many established firms were largely oblivious to the Internet's possibilities until start-ups actually entered their market with the threat of disintermediating them (if they were retail operations) or reorganizing the value chain (if they were manufacturers). Either way, the strategic threats from the start-ups soon forced every established firm to consider the implications of the Internet for business.

The Start-ups

The role of start-ups in the commercialization of the Internet did not begin with the WWW. As mentioned earlier, the Internet data communications firms PSINET and UUNET were funded by venture capitalists in the late 1980s. [15] It is accurate to say that outside of these firms, there were only a few start-ups and fewer investments until 1994. This was a function of the time it took for entrepreneurs to comprehend the opportunities that the WWW represented, and the slightly greater time for venture capitalists to be convinced that the Internet presented a valuable investment opportunity; however, the lag was not long, particularly in Silicon Valley. By early 1994, venture capitalists began receiving business plans from entrepreneurs with ideas about how to exploit the WWW. Given the greater venture capital resources and large numbers of entrepreneurs, Silicon Valley quickly became the center for Internet start-ups.

With the release of Mosaic, a few existing small firms and some start-ups began developing browsers. A few of these were funded by venture capitalists, but most were self-financed. The first major start-up to attract venture capital and become a firm dedicated to exploiting the WWW was Netscape. It was established in April 1994, by Jim Clark, an ex-Stanford professor and founder of Silicon Graphics Inc., and Marc Andreessen, a former student at the University of Illinois and leader of the team that created Mosaic. After hiring the others on the Mosaic team, they rewrote Mosaic and rapidly captured the browser market (Cusumano and Yoffie 1998). Netscape went public in August 1995 at a price that gave it a valuation of nearly $1 billion. This alerted every venture capitalist to

the capital gains one might reap in the Internet field. By March 9, 2000, more than 370 self-identified Internet firms had gone public; their total valuation was $1.5 trillion, though they had only $40 billion in sales (Perkins 2000).

As the number of users grew rapidly and new business ideas proliferated, the Internet became an economic space that continually expanded, providing yet further commercial opportunities. The greater the number of users, the more reason there was to create Web pages, which meant there was more content. The result was a virtuous circle of increasing returns. This provided opportunities for still other start-ups to develop new software and Web-based services. There was an explosion of software tools firms, Web-hosting services, and so on. For example, businesses could be built on searching and cataloging the other sites. The earliest examples of these catalogues and search engines were created in universities, but they were soon transformed into for-profit firms, such as Yahoo!, Excite, and Lycos. Each success attracted still more entrepreneurs experimenting with other business models.

The chaotic but rapidly growing user base, reinforced by the high valuations that Internet-related start-ups commanded in the stock market, unleashed a frenzy of venture investing. Naturally, this willingness to fund experiments encouraged ever greater experimentation. Moreover, during the stock market boom, all of these experiments could be listed on the stock market for massive capital gains. One example of a failure was "push" technology, which enabled WWW content providers to automatically send information to users. In 1997, pundits hailed push as a killer application, but by 1999, it became clear that it was only a niche market, at best. Venture capitalists had funded many firms to exploit push technology, but with only a limited market, the firms either limped along, were acquired, or ceased operations.

Despite the scattered failures, overall the Internet sector burgeoned and more firms entered the space. The investments in the pioneers returned excellent results as firms went public. From 1995 through March 2000, the willingness of public markets to purchase the shares of newly formed Internet firms fluctuated, but in general the market was very positive and small firms were able to raise large amounts of capital. For example, eBay went public at a split-adjusted price of $7.64 per share in September 1999 and rose as high as $121 per share before falling to

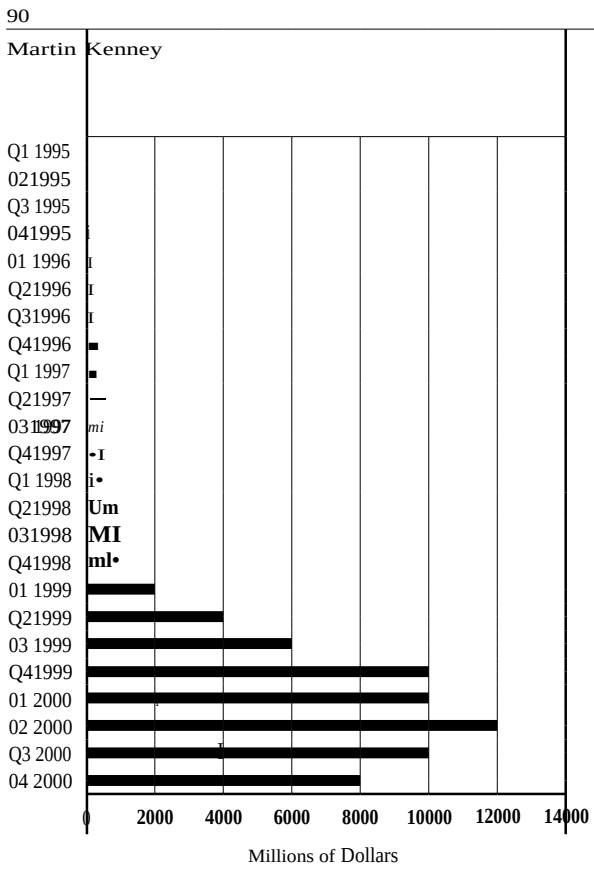

Figure 3.2
Internet-related investments by venture capitalists by quarter, 1995—Q4, 2000

about $45 per share in February 2001. This illustrates how by mid-1999 there was what might be termed a full-scale investment frenzy as public investors drove the price of new issues skyward. As a result, some venture capital funds reported annualized returns of one hundred percent or greater. In 1999, the *average* return for early stage funds was 91.2 percent, the highest in history (NVCA 2000a). [16] As figure 3.2 indicates, the amount of venture capital invested in Internet-related firms grew from a nearly negligible $12 million in the first quarter of 1995 to nearly $12 billion in the second quarter of 2000 (NVCA 2000b). In percentage terms, the increase was equally dramatic, growing from a negligible percentage in 1995 to nearly 40 percent of total investment in 1999.

The money going to first-round financing clearly can be seen in the estimated figures (NVCA, 2001). In 1994, only 15 firms in the Internet-related sector received such funding (including spin-offs from existing firms); by 1999 and 2000, these figures rose to 1,044 and 1,546, respectively. Similarly, IPOs increased from four in 1994 to 134 and 56 by 1999 and 2000; these figures exclude the communication equipment market and a small number of buyouts.

In this bubble, massive sums were committed to multiple firms intent on entering the same business segment, even when it was likely that only one firm could survive. However, if these investments are thought of as being experiments, it means that the United States launched an enormous number of experiments. This large number, even if accompanied by foolishness and even stupidity, increased the probability of having made a correct investment; indeed, some of the start-ups have become global leaders. As important, this feverish investment alerted established firms to the potential of the WWW and forced them to react. In effect, these investments both created new firms and changed the environmental conditions for established firms. Finally, the concentration of these firms in Silicon Valley meant that they were able to benefit from the knowledge gained from previous start-up attempts and from access to advanced users providing insight into other opportunities to create new firms (von Hippel 1988).

An intense emphasis on speed is a central attribute of the U.S. venture capital-driven commercialization process. Speed is vital because usually there are other start-ups seeking to occupy the same space, and because it is necessary to reach critical mass before larger, established firms enter the market. The fuel for this growth is sufficient capital and the ability to offer new employees equity that might quickly appreciate in value. Combined with the head start, this emphasis on rapid execution meant that the United States would repeatedly have the earliest and then the largest firms in nearly every Internet segment. Moreover, because a number of these sectors exhibit winner-take-all characteristics, the earliest entrants to grow to substantial size often acquire an insurmountable first-mover advantage.

The genesis of the Internet in the United States, the large number of U.S. and English-language users, and the preponderance of English-

language content were all advantages for U.S. firms establishing Internet firms. United States firms quickly established dominance in English-language Web sites, and foreign Web sites had to cede their own national English-language market. Moreover, they were soon faced with established U.S. firms trying to capture their local language market.

The success of U.S. firms in other countries was not assured, however, for a variety of reasons. Customization for a local market was not so simple. Different cultures might appreciate different layouts, designs, and logics. Beyond this are the individual national idiosyncrasies and legal regimes. Thus the English-language Yahoo! auction site was sued in French courts for allowing Nazi paraphernalia to be offered to the French. (See Yao's discussion of this case in chapter 13.) The technology opens the world to the user, but national governments continue to enforce their local laws. Examples such as the Yahoo! case indicate that the emergence of dominant global players is not a foregone conclusion.

The transformation of cyberspace into an economic space was characterized by a construction process in which commercial entities were formed at various levels." The uppermost level is the location of actual sites, such as Amazon, Yahoo!, Chemdex, and eBay, which the user visits. At this level, the diversity of sites is almost infinite. The level below encompasses the various software toolmakers and services. At this level, there are established firms, such as **IBM,** Oracle, and SAP, and also a large number of start-ups, such as Viant, Scient, Ariba, CommerceOne, and Microstrategy, to name only a few. The firms at the next level provide services much closer to the network, including Web-hosting firms such as Exodus and those providing network software such as Inktomi and Akamai. At the infrastructural level are the firms actually owning the data pipelines of all types. Then there are the firms providing the infrastructure equipment, including routers, fiber optics-related components, DSL equipment, cable modems, and so on. In the infrastructure sector both established firms and start-ups competed, and in most of these areas the competition was between established U.S. firms such as Cisco, Lucent, and 3Com; established non-U.S. firms such as Ericsson (Sweden), Nortel (Canada), Alcatel (France), Siemens (Germany), and NEC (Japan); and many start-ups.

Deciding the boundaries for a discussion of the Internet is complicated indeed. In fact, when Hunt and Aldrich (1998) described the organiza-

tional ecology of the Internet, they included firms ranging from AT&T to the newest start-up. For the purposes of this chapter, such a definition would be too inclusive. Therefore, my discussion concentrates upon only two levels: the Web sites and the software and services directly related to creating and delivering those sites. To accomplish this, the sites are parsed into general commercial Web sites and software and services. Among the general Web sites, two genres, the B2C and B2B sites, are described in separate subsections. This division is somewhat artificial, but given the number of sites and the proliferation of activities on the Web, it provides a certain order and structure.

Portals, Communities, Auctions, and More

The sheer diversity of WWW-based commercial activities is remarkable. Many of these businesses simply would not exist if it were not for the WWW. For example, portals and search engines such as Yahoo! and Google are only possible because of the WWW. It is impossible to even categorize all the experiments in creating new businesses that the Internet has sparked. One way to think about this is that cyberspace is being "settled" and people are building economic activities in the space. Some of these activities are directly analogous to those in physical space, such as B2C and B2B commerce (discussed below), but others are unique to cyberspace.

Portals are important because they have established themselves as central destinations for Web users. The dominant portals were established during the earliest days of commercialization. Due to the U.S. head start, nearly all of the dominant global portals such as Yahoo!, Excite, Altavista, and Infoseek were U.S.-based." These U.S. portals have successfully penetrated foreign markets. In November 2000, Yahoo! operated 23 overseas properties (Yahoo's term). In the most important markets, such as France, Germany, the United Kingdom, and Japan, Yahoo! is either the first or second most-visited site. In France and Germany, it is second only to the sites established by the dominant telecom providers, Deutsche Telecom and France Telecom. The strength of the U.S.-based portals is predicated on a number of advantages. The precocity of the U.S. market and its large size meant that the vast preponderance of sites continue to be in English. Not surprisingly, this is an advantage to the U.S. portals, not only in terms of content, but also in terms of an ability

to increase content and services that could be distributed over more users. They also had an advantage because they had more technological and marketing experience. Their early growth allowed them to establish global brand names, before other sites could compete in the English-language market. In other countries, indigenous portals were forced to defend their language market from the U.S. portals, which had already captured their English-language traffic. However, the U.S. portals also translated their sites into foreign languages, while leveraging their underlying architecture, software, server farms, and technical talent.

Another group of sites are those involved in consumer-to-consumer (C2C) e-commerce. This category refers to Web sites that connect consumers. Because C2C sites are not based on direct sales, their profits come from other revenue sources such as advertising, commissions, referral fees, and so on. The premier example is the auction site eBay, which was established in September 1995 and grew rapidly to be the largest C2C auction site on the Internet, with revenues of $431 million in 2000, with a profit of $48 million. In 1998, it expanded overseas by establishing a subsidiary in the United Kingdom. In June 1999, it purchased Alando.de, the largest C2C German auction site. In February 2000, it launched a joint venture with NEC for the Japanese market. EBay claims that it is the leading C2C auction site in Australia, Canada, Germany, and the United Kingdom (figure 3.3). It expects to operate in 10 countries by the end of 2001 and plans to expand to 25 countries by 2006 (eBay 2001). Whether eBay can successively translate its model for each of these national markets is difficult to predict; however, it now has critical mass, brand awareness, significant technical advantages, and a strong financial base.

There are many other examples of C2C sites. For example, a number of sites allow users to engage each other in games. There are community sites such as Geocities, which was purchased by Yahoo! for more than $4 billion. Firms such as Napster provide software downloads that allow registered users to trade various digital content such as MP3 files. There are online services that provide notification, registration, and verification through the Internet for meetings. These are only examples of the enormous variety of services created to exploit the Internet.

For students of technology, the development of C2C business is fascinating because it did not simply translate existing commerce online;

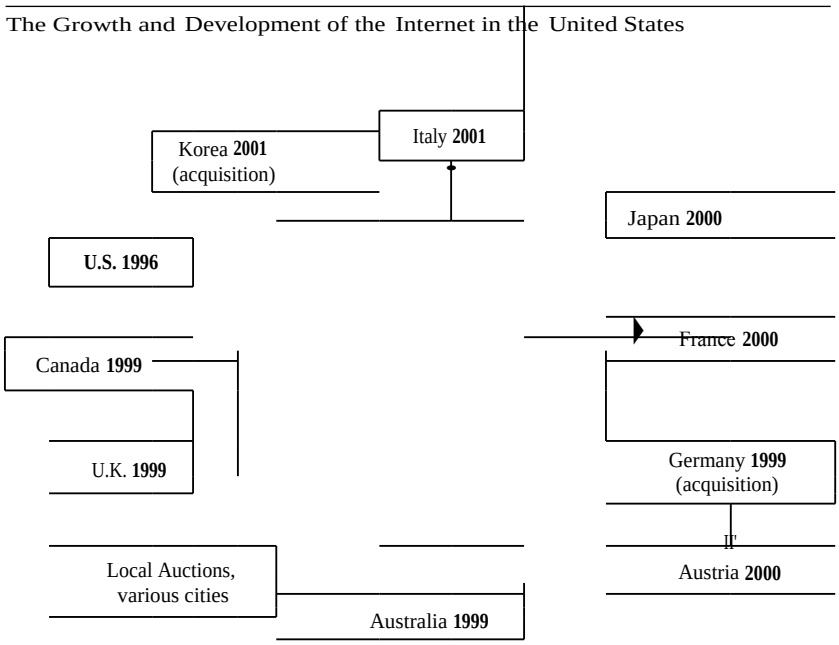

Figure 3.3
EBay's global auctions

rather, it was a field for experimentation with extremely wide parameters of possibility. Of course, such experimentation was under way in other countries, but there can be little doubt that the United States undertook a far greater number of experiments than any other single country."

Business-to-Consumer E-commerce

From late 1995 through late 1998, great attention was focused on the proliferation of start-ups in the B2C sector. These start-ups meant to replace physical stores (bricks and mortar) with online sales. Put differently, the online operations would disintermediate the traditional retailers, because virtual storefronts on the Internet would substitute for physical storefronts. One idea was to create e-malls, retail sites that, like physical-world shopping malls, would be where retailers would "locate" their various shops. The proposition was that these B2C sites would attract consumers because of the convenience of having a centralized "shopping center" online. This was a flawed vision and these malls failed, though interestingly the portals and other heavily visited sites then set up shop-

ping sites that resembled the mall idea. They have played, however, a role in the development of the Internet in Korea, as analyzed by the chapter by Chang.

The theory underlying B2C e-commerce was that the elimination of the costs of stores and sales employees and the use of a more efficient supply chain due to taking customers' orders directly should allow online retailers to sell at a discount. The proponents of online retailing were predicting nothing short of revolution—there would be a massive shift of purchasing to the Internet. There is precedent for such shifts in retailing. For example, the "category killers" such Wal-Mart, Home Depot, Borders, Barnes & Noble, Office Depot, Rite Aid, and so on transformed retailing and thereby devastated both small independent stores and the department stores. The Internet appeared to be an opportunity to galvanize a shift in consumer purchasing habits that could have transformative consequences for retailing.

With any new technology there are two ideal-typical possibilities. New entrants displace the existing firms, or the incumbents fend off the threat either by adopting the entrant's model or by reinforcing their own advantages, thereby undercutting the entrant's advantages. In B2C e-commerce, the incumbents were caught unaware by the start-ups, which mushroomed seemingly overnight. Moreover, many, but certainly not all, of the early efforts by the incumbents to develop Web-based businesses failed. For example, both Wal-Mart and Levi's created Web sites that proved to be disasters, though later their efforts would improve. Retailers that had substantial mail order businesses were generally far more successful in switching to Web-based operations.2°

In July 1994, only a few months after the establishment of Netscape and Yahoo!, Amazon was established; its online bookstore opened in July 1995. Amazon's founder, Jeff Bezos, was not particularly attracted to books; rather, he was searching for a retail sector that would be easy to penetrate. Books were chosen because they are an easy-to-ship, undifferentiated product. Moreover, there was an existing set of distributors that could be used for fulfillment. But, most critical, from its inception Amazon aimed to expand from books to other items, with the eventual goal of becoming a multiproduct retailer—in other words, Wal-Mart was the real target. As indicated in figure 3.4a, by 2001, parts of Amazon's empire had gone bankrupt. Even though Amazon consistently lost money,

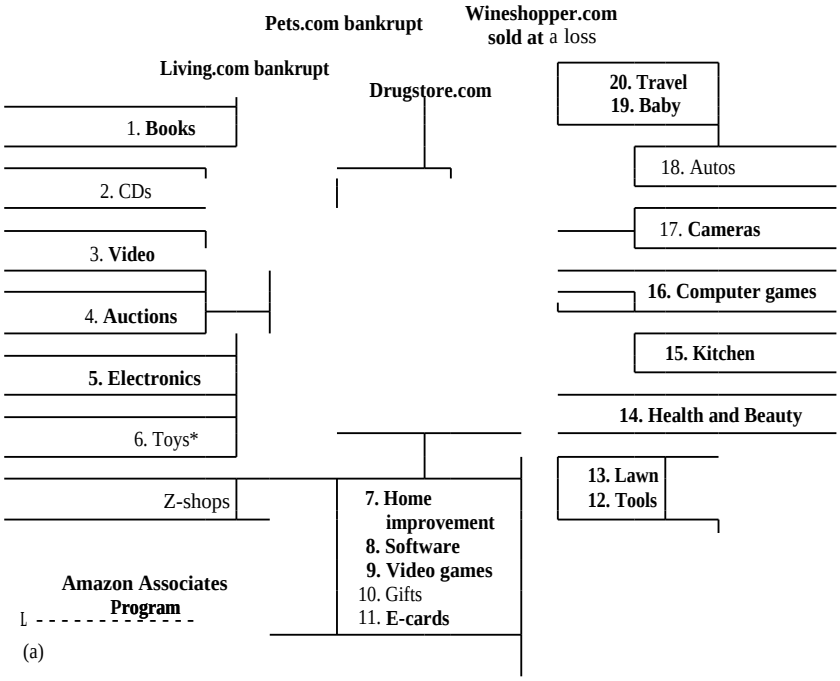

Figure 3.4a
Amazon's growing empire
Source: Author's compilation from various sources
* In 2000, became joint venture with Toys "R" Us.

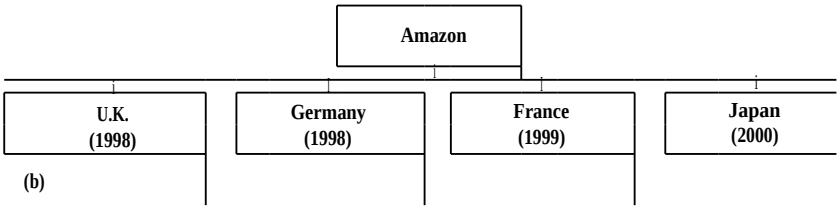

Figure 3.4b
Amazon's international operations

and it did not have the advantage of being the first online bookstore, it was able to grow rapidly because of the venture capital backing it received in June 1996. As of fall 2001, Amazon was not yet profitable, but management promised pro forma profitability in the near future.

The early investments in the B2C space by venture capitalists and the successful listing of Amazon on the NASDAQ ignited a frenzy of investment in online retail start-ups. Very soon there were specialized sites selling groceries, pet supplies, air travel, vitamins, pharmaceutical prescriptions, stocks, CDs, electronics, PCs, home improvement supplies, and nearly every other commonly consumed item. In this investment frenzy, often four or five online firms were established in each product category. At times these firms would have different business models, but for the most part they were simply clones. For example, in January 2000, *Upside* magazine listed six dedicated online cosmetic start-ups: Eve.com, Gloss.com, Sephora.com, Beauty.com, Beautyscene.com, and Beautyjungle.com (Garner 2000). Similarly, there was a plethora of online toy stores launched by start-ups and traditional players. However, by the end of 2000, all of them had failed or were consolidated (table 3.4). Many of those that had gone public were by early 2001 in the process of being delisted by the NASDAQ. Even more odd was the proliferation of high-visibility online pet stores that rapidly disappeared, taking millions of investor dollars with them. When the IPO boom ended

Table 3.4
Status of Most Important Online Toy Stores in 2000

Firm	Status	Investors
Toysmart.com	Closed 2000	Disney
Toytime	Closed 2000	Unavailable
RedRocket.com	Closed 2000	Viacom
KB Kids.com	For sale	Consolidated Stores
EToys	Since going public, down 95%	Idealab (public investors)
SmarterKids.com	Since going public, down 90%	Venture capitalists (public investors)
Toys "R" Us	Merged Web site with Amazon	Toys "R" Us
Amazon.com	Merged Web site with Toys "R" Us	Venture capitalists (public investors)

Sources: Wall Street Journal 2000; author's research

in early 2000, many of these e-retailers still had not gone public and were not profitable. With no exit opportunity, their backers rejected entreaties for more funds, sparking a wave of distress mergers and bankruptcies.

After establishing a Web site, these e-tailers discovered that simply posting an image of an item online and booking an order did not remove the need to deliver the purchases to the customer. Managing the delivery logistics would be as important as booking a sale. In Christmas 1999, many e-tailers were simply not prepared for the volume of Internet purchases, and their systems were overwhelmed. As a result, many purchases were not delivered in time for Christmas. Finally, the online retailers discovered what offline retailers had always known: predicting demand is one of the most difficult skills in retailing. For example, Amazon discovered that it had purchased the wrong toys and after Christmas had to write-off $35 million in unsold inventory. In response to these problems, in August 2000, Amazon.com came to an arrangement with Toys "R" Us.com in which Toys "R" Us would be responsible for buying and managing the inventory, while Amazon would operate the Web site development, order fulfillment, and customer service for a new joint site. The inventory for both companies would be housed in Amazon's warehouses (Farmer and Junnarkar 2000). In effect, Amazon conceded that it did not have the expertise to predict toy demand effectively, while Toys "R" Us conceded that it was not so successful in interfacing with Internet buyers and handling fulfillment.

Traditional retailers such as Macy's and J. C. Penney found it difficult to establish online operations. The world's largest retailer, Wal-Mart, launched its first Web site in late 1996, but it generated minimal sales. Simultaneously, Amazon extended its product offerings beyond books and CDs, presaging a possible competitive threat. In 1999, Amazon hired 15 of Wal-Mart's logistics and retailing executives to strengthen its logistics operations, making the threat more palpable. In January 2000, believing that its own site operating from corporate headquarters in Bentonville, Arkansas, was not successful, Wal-Mart established a joint-venture agreement with a venture capital firm to re-establish Wal-Mart.com, with headquarters in Palo Alto. Effectively, Wal-Mart decided that it had to develop an organization entirely separate from its Arkansas headquarters (Waxer 2000). This is not surprising, as selling in the online world is very different from selling from stores.

Without venture capital, there could not have been such a proliferation of B2C startups. Although creating possible competitors, it also alerted U.S. retailers to the threats and opportunities this new method of interacting with customers posed. The start-ups discovered the difficulties of fulfillment, inventory control, and handling of returns. In general, the firms most successful in launching online operations were those that had strong order fulfillment operations already in place. These firms already fulfilled remote orders, so for them it was a matter of switching their incoming order stream from voice and catalog to the Internet.

It is too early to judge the ultimate result of the willingness to risk hundreds of millions of dollars in e-tailing. What is certain, even if most of these investments are lost, is that the U.S. retail system will have been forced to become more efficient than ever. Further, there is the possibility that a number of the start-ups such as Amazon will survive and create an entirely new channel that has a global reach. Given the estimate that as much as one-quarter of Amazon's sales originate from outside the United States, Amazon has already become a global brand. As of 2001, there were mixed signals about the ability of U.S. firms to compete globally: firms such as eToys closed their overseas subsidiaries prior to closing themselves, whereas eBay and others continued to compete globally.

Business-to-Business E-commerce

Only six months to one year after the establishment of the first B2C firms, venture capitalists began funding entrepreneurs to establish Web sites aimed at becoming online marketplaces where businesses could buy and sell, business-to business (B2B) sites. The B2B market quickly outstripped B2C in sales, though it is interesting to note that the first B2B operations that were successful were those of firms such as Dell, Cisco, and Intel that sold through their dedicated sites to other businesses. These were neither sites developed by newly established firms nor the consortia sites established by oligopolistic groups of firms. Helper and MacDuffie examine the B2B sector, especially in regards to the auto industry in greater detail (chpater 11). This section limits its focus to the aspects of B2B e-commerce that directly relate to the responses of the U.S. economy to the opportunities for harnessing the Internet and especially the role of venture capitalists in funding the establishment of firms

to exploit what were perceived to be new business opportunities that resulted from the commercialization of the Internet.

By mid 1998, independent marketplaces had been established for nearly every business imaginable. A 1999 report by a Robertson Coleman analyst listed 253 separate B2B sites (Upin 1999). VerticalNet was one of the first independent B2B sites. In October 1995, it established the first vertical trading community, and by November 2000, VerticalNet operated over sixty separate industry sites (VerticalNet 2001). The Plastics Network, which was launched in September 1995 and relaunched in 1999 with funding from Internet Capital Group (ICG), was another early site. In fact, ICG was a publicly listed firm established in 1996 with the express purpose of investing in fledgling B2B startups. ICG's investments were an indicator of the growth in interest in B2B e-commerce. In 1996, ICG committed only $14 million, but by 1999, this had increased to $572 million. Moreover, it expected to commit in excess of $1 billion in 2000, though this has been dramatically reduced due to the collapse of ICG's stock price. ICG was not alone. Beginning in 1997, there was a rising tide of investment in B2B startups (Internet Capital Group 2001). For example, Chemdex Corporation was funded by several venture capital funds in September 1997. The receptivity of the public market to B2B stock offerings in 1998 and 1999 led to a plethora of new firms funded by both traditional venture capital and the new publicly held venture capital firms such as ICG and CMGI.

The establishment of B2B sites was initially uncontested by existing firms and industries. In this respect, the B2B marketplace resembled that of the B2C sector, because the first movers were start-ups funded by venture capital. These start-ups aimed to attract established firms to their sites. This was easiest when there was no dominant firm or set of firms in the value chain. However, as Helper and Macduffie so ably indicate, if the value chain contained oligopolists, be they suppliers or purchasers, often they exerted significant power over adjacent segments at the least and perhaps even over the entire chain. In such markets, success in moving the chain onto the start-up's platform was predicated upon attracting these oligopolists. For the oligopolists there was no compelling reason to join any specific platform. Though the potential efficiencies were substantial and could not be ignored indefinitely, joining a marketplace

controlled by another firm would create vulnerability and permit the other firm to reap the benefits.

Hesitant to join marketplaces owned by others, larger firms soon decided to create their own Web sites. The problem was that each oligopolist created his or her own unique site. This reintroduced an inefficiency because it divided the market, forcing suppliers to adapt to different sites, and thereby limited any efficiency gains. Thus, if the oligopolists all created their own sites, then the threat of a market organized by an independent firm remained. The independent could divide and conquer the market, because the independent could offer incentives, such as a preferential position, equity, or lower trading costs, to a few oligopolists that were willing to break ranks and join the independent site. Then the late movers would be the losers, because after the site gained momentum they would be compelled to join the site under unfavorable bargaining conditions. The oligopolists responded to this threat by creating consortia to own the platforms they joined.

In terms of commercialization, the B2B space also exhibited characteristics similar to those in the B2C area. Entrepreneurs quickly entered the field, and there was a proliferation of sites in each category as venture capitalists funded many "me-too" firms. After a significant lag, the established firms reacted by creating their own Web sites. As Helper and MacDuffie indicate, by the end of 2001, many of the venture capital-funded B2B sites had been closed and others were in great difficulty, whereas some of the consortia sites did appear to be gaining traction. At the close of 2001, what seemed most certain is that key firms such as Intel, Cisco, and Dell have had significant success with their B2B operations.

Software Tools and Internet Services

The early and rapid development of e-commerce, the large number of leading-edge users, and an already strong position in software provided significant advantages to US firms intent upon developing software tools for Internet users. As von Hippel (1999) pointed out, the needs of cutting-edge users can alert toolmakers to marketable improvements, or what could be termed "learning from lead customers." Further, the needs of customers such as Yahoo!, Amazon, and/or eBay meant that software

and services would be severely tested, thereby exposing limitations and problems. The intense competition among the users as they sought technological advantages meant that software innovators had a ready market. A symbiosis between software designers and leading-edge users developed. This created a virtuous circle in which improved tools accelerated the development of the Web sites and vice versa.

For established software firms such as Microsoft, Oracle, and Seibel Systems, the start-ups were both competitors and potential acquisition targets. United States firms quickly grasped the importance of the WWW and rewrote their software to operate on the Internet. The German firm SAP did not grasp the movement to the WWW as quickly, and by the time it became conscious of its significance it had lost ground to aggressive U.S. competitors. In contrast, Oracle rapidly reengineered its database software to be WWW compatible and captured market share from its competitors.

Rationalizing and transferring business processes and B2B e-commerce to the Web-based protocols created significant new demand for software, and many start-ups were funded by venture capitalists to meet this new demand. Venture capital-funded startups such as CommerceOne, Ariba, E.phiphany, and Kana Communications, to name only a few, became global competitors, and very often the U.S. firms (and, most often, these had roots in Silicon Valley) were competing globally against each other. In the Internet services arena, U.S. start-ups such as Exodus Communications became global leaders in corporate web-hosting. Other firms offered to manage corporate Web sites, e-mail, and a wide variety of other Internet-related functions. Software firms such as Inktomi and Akamai developed software used for Internet infrastructure.

United States firms have occupied nearly every important Internet-related software niche. These firms have rapidly expanded their businesses into other countries, either by establishing offices or using their stock to purchase the much smaller national competitors. Whether American or foreign, most Web sites operate on U.S. software and hardware. Regardless of the outcome of international competition concerning portals or e-commerce, or the different privacy issues and government policies, it will be U.S. software toolmakers and service providers that will become the dominant vendors. Judging from the current situation, there

will be fewer significant European and Asian firms. The exception will be if mobile phones become a dominant Internet access device—an unclear proposition.

Regardless of what happens to the e-commerce start-ups, in the arena of WWW software tools, the U.S. firms have important first-mover advantages. Whether the bulk of the sector will be captured by existing firms such as Oracle or Seibel or by the start-ups such as Ariba and Kana is not as important as the fact that most of the tools will be provided by U.S. firms. The one significant exception is the German enterprise resource planning software firm SAP, whose software is used by firms around the world (see Casper, chapter 7 in this book). SAP seems to have made the transition to the Internet world. With a few other exceptions, such as the German firm Intershop, the Internet software tools industry, which is centered in Silicon Valley, makes it likely that U.S. firms will be able to benefit from the further evolution of the Internet infrastructure. The one possible exception to this scenario would be if wireless applications were to become dominant, requiring a set of competencies that U.S. firms lack, but as Sako and Glimstedt and Zander show are more prevalent in Japan and Scandinavia.

Conclusion

In summary, the speed with which the U.S. NSI reacted to the commercial possibilities inherent in the Internet was remarkable and, perhaps, unprecedented. In nearly every facet of the Internet, from the infrastructure and equipment to e-commerce, U.S. firms became global leaders, with the possible exception of two fields: wireless Internet and optical switching. It would be simplistic to attribute the achievement of such dominance to any single variable; rather, it was the result of a confluence of factors.

The first bundle of factors that favored U.S. industry was the unique political economy of the telecommunications system. Early and gradual (though thoroughgoing) deregulation made the United States the leading economy for innovation. In sharp contrast, in most of Europe and Asia the dominant government-owned monopolist (even in 2000) exerted undue influence. The flat-rate tariff structure for local phone calls was remarkably important for the diffusion of online services and the uptake of the Internet in the home market. The macro-level deregulation created a

powerful competition that drove bandwidth costs down, encouraging ever-greater use of the telecommunications system and the Internet.

A second bundle of factors involved the willingness of Americans to order remotely. United States consumers already had ample experience using credit cards to purchase through catalogs or over the phone. Thus they were comfortable purchasing from a Web site. Similarly, U.S. firms were already using Electronic Data Interchange (EDI) systems, so they were a receptive audience for Internet-based trading systems, particularly because they believed such systems would be less expensive and easier to use. Moreover, U.S. firms were under intense price competition from foreign and domestic producers, so the idea of a potentially more convenient, easier to operate, and cost-effective system was attractive. Many leading firms such as Intel, Cisco, and Dell quickly moved to implement Web-based systems because of these advantages.

The third and probably the most unusual bundle of factors centered upon a unique feature of the U.S. economy, the infrastructure centered upon venture capital meant to support high-technology entrepreneurship. Earlier this infrastructure had supported the establishment of critical e-commerce and Internet infrastructure firms such as Sun Microsystems, Oracle, and Cisco Systems. With the successful public offerings of Netscape, Yahoo!, and Amazon, venture capitalists were eager to fund Internet-related investments of all types. From one perspective, the massive outpouring of capital was spectacularly wasteful, but from another perspective, it created a large number of experiments to be winnowed out by a Darwinian selection process. This infrastructure not only funded these experiments, it also attracted many of the society's best managers and technologists.

When the preparation of this chapter began, Internet firms were still the toast of Wall Street, and there was a perception that the venture capital-funded Internet boom was contributing to a fundamental transformation of the economy. By the end of 2001, the situation appeared very different. A powerful shakeout struck public and private start-ups as firms were delisted and venture capitalists refused to provide further support for many of these firms. Undoubtedly, billions of dollars have disappeared, and firms are rapidly writing down their investments. Many firms, such as Lucent in January 2002, are selling their venture funds to outside brokers at substantial reductions of their value a year ago.

Nevertheless, the Internet has become an almost taken-for-granted utility. Entrepreneurs and established firms alike are deploying the Internet to reorganize the way commerce is conducted. In retail commerce, it is an important new sales and information channel. There are innumerable small enterprises that never received venture capital that now use the WWW as their sales channel. Similarly, as MacDuffie and Helper (chapter 11) will show for B2B commerce, the use of the Internet is becoming an accepted medium for handling mundane interfirm transactions and various co-design processes. An observation made on other technological changes will likely be proven true again: in the short run, the impact was overhyped, but in the long run, the changes set in motion were much greater than anyone imagined.

The heights of the Internet gold rush not only affected the United States, but as the other papers in this book show, spread around the globe. Nations that previously had had low levels of technology-related entrepreneurship and minimal or nonexistent venture capital resources experienced an explosion of venture capital investing, much of it targeted at Internet start-ups. To encourage this efflorescence, many of these nations created new markets with looser listing requirements, thereby encouraging even greater investment and start-up activity. However, the bursting of the U.S. NASDAQ bubble in early 2000 led to a stock price collapse and closing of public markets as an exit strategy for technology and especially Internet firms globally. The outcome of this reversal of fortunes is as yet uncertain; however, in a number of nations it may result in a vicious cycle of decline that destroys these fledgling institutions that had just been introduced to encourage new firm formation.

The Internet investment craze of the second half of the 1990s was wasteful in the extreme. Wild ideas of all sorts received funding. And yet, even after the evisceration of large amounts of this speculative capital, U.S. firms remain dominant in nearly every area related to the Internet, except in mobile telephony, where European and North Asian firms have been most successful. From a systemic perspective, it is likely that in a decade hence we will reflect upon the Internet investment bubble and conclude that the willingness of investors to experiment resulted in U.S. firms capturing a leadership role, and that the survivors gained the

resources, experience, and market share that only a few firms in other nations were able to achieve.

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Notes

1. For developments in the personal computer industry value chain, see Kenney and Curry 2001.

2. It is worth noting that in the United States, many different entities including state, county, and city governments can affect e-commerce. These jurisdictions have different taxation schemes and laws pertaining to retail sales, particularly with respect to tobacco, firearms, alcohol, and pornography. Despite these differences, it is accurate to call the United States a unified market.

3. The U.S. lead was not always at the invention stage. Frequently, there was simultaneous invention in several nations, but nearly always the United States triumphed in the commercialization of the idea.

4. Four "technological trajectories" contributed to the rapid growth of these industries (Dosi 1984). The first is Moore's Law (named after one of the founders of Intel). It states that the cost of a transistor on a semiconductor will be halved every 18 months. The second is Metcalfe's Law (named by George Gilder after Robert Metcalfe, co-inventor of Ethernet and founder of 3Com), which postulates that the functionality of a network will increase exponentially with the addition of each user. The third law is Shugart's Law (coined by me for Al Shugart, founder of the hard disk drive firm Seagate Technology), and is based upon the observation that the price per bit of magnetic storage halves every 18 months. The importance of this law is ignored, but Web sites such as Yahoo!, Amazon, etc. require enormous amounts of data storage. The final law, which Gilder (2000) terms the Law of the Telecosm, observes that the price of transmitting a bit of data over the communications network is halved every 12 months.

5. See, for example, Davies 1994.

6. In 1900, there was one telephone per 60 Americans, one for every 115 Swedes, and one for every 1,216 Frenchmen (de Sola Pool 1977, 30).

7. The term "universal service," when first coined by Theodore Vail, did not refer to every American having access to a telephone. It referred to the ability for anyone having an AT&T-provided phone being able to contact any other phone in the system (Dordick 1990, 230).

8. In rural areas and some towns, independents survived and had interconnection agreements with AT&T.

9. Few would argue that AT&T service was the best possible, but most would agree that in the 1950s and 1960s it was superior to service in other countries.

10. The value of the local loop would only come in the late 1990s, when the Regional Bell Operating Companies would benefit from their control of the customer.

11. For AT&T, losing data communications did not appear serious in the 1970s, as it was such a small market. In fact, AT&T was uninterested in packet-switched data communications when it was first proposed. The result was that AT&T did not have the dominant role in the Internet data transmission business, and its equipment subsidiary, Western Electric, which became Lucent, fell behind in the data transmission equipment business (Hafner and Lyon 1996, 63-66).

12. The definition of a "significant" start-up was a firm that either had gone public or received funding from the top 20 venture capital firms. Thus the map is not exhaustive or necessarily complete; it is only illustrative. Not included in this map are network equipment start-ups, Internet Service Providers, and other physical network-related firms.

13. Contemporaneously, several firms introduced various networking technologies, such as DECNet and IBM's SNA, but these were all proprietary.

14. A salient expression of this was the individuals who rushed to occupy various URLs with no intention of using them. They then offered to sell the URLs. To translate this into the land rush metaphor, they "staked a claim" to an address in cyberspace. One response to this was legislation forbidding "cybersquatting," a reference to the registration by entrepreneurs of addresses that were trademarks and/or established firms' names.

15. Venture capitalists had funded AOL in the 1980s as an online service; at the time its operations were unrelated to the Internet.

16. The three-year compounded average annual return was a more modest 47.9 percent!

17. The richness of this economic space is based on a small number of universally agreed-upon open protocols. The most important are HTML, HTTP, TCP/IP, etc. A metaphor for this is the richness of life being based on the DNA molecule, which operates on the basis of quite simple protocols.

18. Microsoft and AOL are also leading destinations. AOL is successful because it has its captive audience of AOL subscribers. Microsoft attracts visitors for many reasons; for instance, it is the default option on the Internet Explorer browser, and users need software assistance, etc.

19. Entrepreneurs and venture capitalists in other countries often simply observed the experiments in the United States and then reproduced them in their own countries. This was the case for the German auction site Alando.de and numerous Asian sites. The Japanese firm Softbank adopted this as its strategy for creating Japanese sites.

20. For Dell, see Curry and Kenney 1999.