Sustainable Prosperity in the New Economy?

Lazonick, William

Published by W.E. Upjohn Institute

Lazonick, William.
Project MUSE. muse.jhu.edu/book/17382.

For additional information about this book
https://muse.jhu.edu/book/17382

For content related to this chapter
https://muse.jhu.edu/related_content?type=book&id=558658
The Rise of the New Economy Business Model

ORIGINS OF THE MICROELECTRONICS REVOLUTION

Technologies that were discovered and developed by Old Economy corporations provided the essential foundations for the rise of the New Economy in ICT. During the post–World War II decades, AT&T, a regulated monopoly since 1913, dominated the communications industry. A U.S. government antitrust suit was launched in 1949 that sought to sever the exclusive relation between AT&T and Western Electric. The suit resulted in a 1956 consent decree that permitted AT&T to maintain exclusive control over its manufacturing company but barred the Bell System from competing in industries other than telecommunications. In addition, AT&T and Western Electric had to license their patents to other companies at reasonable fees (Lewis 1956). As a result, the R&D of Bell Labs, including the transistor invented there in 1947, supported the development of the ICT industries generally while the communications and computer industries remained organizationally distinct.

During the 1950s and 1960s, building on its overwhelming dominance of the punch-card tabulating machine industry, IBM came to dominate the computer industry. IBM introduced its first computer in 1952, and emerged as the undisputed leader of the computer industry within a decade. IBM grew from $166 million in revenues in 1950 to $1.8 billion in 1960, $7.5 billion in 1970, and $26.2 billion in 1980. By 1958 IBM was already the thirty-seventh largest industrial company by revenues in the United States, and a decade later it was the seventh largest. By 1963 IBM’s dominance was such that its U.S. revenues of $1,244 million from data-processing computers were well over eight times those of its nearest competitor, Sperry Rand. Indeed, the eight companies that followed IBM had combined U.S. revenues of $539 million, or only 43 percent of IBM’s (Chandler 2001, p. 86).
In the 1950s and 1960s, advances in computers, and in electronics more generally, came to depend critically on advances in semiconductors, the generic name for solid-state electronic devices. AT&T/Western Electric and IBM became important developers of semiconductors, but only for in-house use. Technology-rich and well-established Old Economy companies such as General Electric (GE), RCA, Raytheon, Sylvania, Philco-Ford, and Westinghouse entered the semiconductor industry. These companies were the leading manufacturers of the electronic vacuum tubes that were being replaced by the far smaller and less power-hungry semiconductor devices (Tilton 1971, chap. 4). On the face of it, GE was in a particularly strong position to dominate in microelectronics. In the early 1950s, GE’s revenues were 9 to 10 times those of IBM, and GE Labs had been in existence since the beginning of the century. GE did hold 8 to 9 percent of the semiconductor market between 1957 and 1966 (p. 66), but thereafter GE, which is still among the largest and most powerful technology companies in the world, did not become a force in the commercialization of semiconductors.

The most successful merchant semiconductor companies in the latter half of the 1950s and in the 1960s were smaller firms, most notably Texas Instruments (TI), the leader with 17 percent of the U.S. market in 1966, Motorola, with 12 percent, and Fairchild, with 13 percent. TI remained the world leader in market share through 1984, and in 2007 stood in fourth place, with 4.3 percent of the world market, behind only Intel (15.0 percent), South Korea’s Samsung (7.9 percent), and Japan’s Toshiba (4.3 percent) (Gartner 2008). Motorola was second to TI in 1979 as the microcomputer revolution was unfolding, and the two companies remained neck and neck in 1984, when both had revenues from semiconductors that were almost twice those of Intel. From 1985 through 1990, Motorola was the top U.S. chip company. In 1991, it relinquished that position to Intel, which has been the world leader since 1992. In 2004 Motorola spun off its chip division as Freescale Semiconductor, which by 2007 had captured 2.1 percent of the world market.

Motorola and TI were founded just two years apart—Motorola as the Galvin Manufacturing Company in Illinois in 1928 and TI as Geo-physical Service Inc. (GSI) in New Jersey in 1930. Over the ensuing decades, these companies became exemplars of OEBM, and employment relations at both Motorola and TI remained Old Economy in

An innovator in wireless communications technology, Galvin Manufacturing made the “Motorola” brand name of its car radios the company name in 1947, the same year it launched its television business and the transistor was invented at Bell Labs. In 1948 Motorola opened its own semiconductor research lab in Phoenix, Arizona, to develop devices for its electronic products. By 1954 the lab had evolved into a manufacturing facility that employed 800 people, and in the latter half of the 1950s, Motorola was selling not only transistorized radios, two-way radios, and pagers but also, as a distinct semiconductor business, germanium transistors. In 1958 Motorola hired Lester Hogan, a former Bell Labs researcher and at the time a Harvard applied physics professor, to head its semiconductor operations (Holbrook et al. 2000, p. 1024).

In the 1930s, GSI manufactured innovative seismic signal processing equipment for oil exploration (see Pirtle 2005, pp. 2–5). After shifting its headquarters from New Jersey to Dallas, Texas, GSI expanded during World War II as a defense contractor making submarine detection equipment. In 1951 GSI licensed the transistor from Bell Labs with a view to digitizing its seismic equipment. In the same year it changed its name to Texas Instruments. To lead the development of the semiconductors that it needed for its products, in 1953 TI lured away a prominent chemist, Gordon Teal, from Bell Labs by offering him the chance to run his own research lab in his home state of Texas (Teal 1991).

Within two years of joining TI, Teal and his team had developed the first commercializable silicon transistor. By 1957 TI had captured 20 percent of the semiconductor market. In 1958, a TI researcher, Jack Kilby, invented the integrated circuit, just ahead of Robert Noyce at Fairchild Semiconductor (Reid 1985). TI had $27 million in revenues and 2,100 employees in 1953, $233 million in revenues and 16,900 employees in 1960, and $828 million in revenues and 44,800 employees in 1970.

Given the prominence of companies such as Motorola and TI, the development of the U.S. semiconductor industry was not only a Silicon Valley phenomenon. The Silicon Valley semiconductor industry, however, gave rise to NEBM, and the key company in the evolution of Silicon Valley was Fairchild Semiconductor.
Strategic Characteristics

In September 1957 eight scientists and engineers left Shockley Semiconductor Laboratories in Palo Alto, California, to form Fairchild Semiconductor, a manufacturer of diffused silicon transistors, in nearby Mountain View. Just two years earlier, William Shockley, coinventor of the transistor, had recruited the “traitorous eight,” as he later called them, to his new enterprise from different parts of the United States. The interfirm mobility of talented people to found or join start-ups was aided by a unique California law that prohibited employers from demanding that employees sign post-employment covenants not to compete (Gilson 1999). Over the following decades, this mobility became the defining characteristic of the dynamic regional economy that Shockley Labs and Fairchild Semiconductor inadvertently helped to create.

As shown in Figure 2.1, from 1959 through 1970, 42 new semiconductor firms—21 in 1968 and 1969 alone—were launched in the vicinity of Fairchild in what became known by the beginning of the 1970s as Silicon Valley.¹ By 1985 the number of Silicon Valley semiconductor start-ups since the founding of Fairchild totaled 125. Of these 125 firms, 32 were founded by at least one person who had left employment at Fairchild for that purpose, while another 35 companies were offspring from these “Fairchildren” (especially from National Semiconductor, Intel, Signetics, and Synertek). Fairchild was so important to the emergence of Silicon Valley because it not only drew people and knowledge from the established R&D labs of the electronic tube companies such as GE, RCA, Westinghouse, and Sylvania, but it also invested heavily in research, especially related to manufacturing processes for the mass production of diffused silicon transistors (Berlin 2005, chaps. 5–6; Lécuyer 2006, chaps. 5–6; Tilton 1971, p. 4).

Following the founding of Fairchild, the first wave of Silicon Valley semiconductor start-ups consisted of 10 firms launched between 1959 and 1964 oriented toward military markets. Between 1955 and 1963, the annual value of total U.S. semiconductor production rose from $40 million to $610 million, and the proportion that was for the U.S. military varied between 35 and 48 percent. In 1968, when the value of U.S.
semiconductor production stood at $1.2 billion, the value of military production was still 25 percent of the total. By that time, integrated circuits accounted for 27 percent of the value of all U.S. semiconductor production, up from less than 3 percent five years earlier. Military demand was critical to the growth of this important product category, accounting for 94 percent of integrated circuit production in 1963 and 37 percent in 1968 (Tilton 1971, pp. 90–91).

Meanwhile, the price per integrated circuit declined from $31.60 in 1963 to $2.33 in 1968, thus dramatically increasing the economic viability of using integrated circuits for cost-conscious civilian markets (Tilton 1971, pp. 90–91). The realization of these commercial opportunities precipitated the second wave of Silicon Valley start-ups. From 1968 through 1972, the region hosted 40 semiconductor start-ups, 13 of which were Fairchildren and another eight of which were offspring of Fairchildren. Among these Fairchildren were Intel, founded in 1968 by Gordon Moore and Robert Noyce with Andrew Grove as their first employee, and Advanced Micro Devices (AMD), founded in 1969 by

Figure 2.1 Three Waves of Silicon Valley Semiconductor Start-Ups, 1955–1985

Jerry Saunders, who brought with him seven other Fairchild executives (see Berlin 2005, chap. 7; Lécuyer 2006, chap. 7). When Moore and Noyce founded Intel to produce memory chips that could replace the magnetic coil memories then in use, they specifically declined to create a separate R&D lab and refused to accept government contracts for research (Bassett 2002, chap. 6).

The third wave of Silicon Valley semiconductor start-ups began in 1978, peaked in 1983, and continued to 1985. During these years there were 58 new firms created, of which seven were Fairchilds and another 26 offspring. In contrast to the dynamic random access memory (DRAM) and erasable programmable read-only memory (EPROM) chips that had underpinned the growth of the second-wave companies such as National, Intel, and AMD, third-wave firms such as VLSI Technology (1979), LSI Logic (1981), Cypress Semiconductor (1983), Cirrus Logic (1984), and Chips and Technologies (1985) focused on logic chips—microprocessors and application-specific integrated circuits (ASICs)—for which value-added lay in chip design rather than high-yield, low-defect mass production.

In pursuing this design-oriented strategy, the founders of these start-ups and their backers were taking advantage of new commercial opportunities opened up by the growth of consumer and business electronic product markets. Meanwhile during this third wave, integrated Japanese producers such as NEC, Hitachi, Toshiba, and Fujitsu that sold only a portion of the memory chips that they produced were taking command of the “commodity chip” markets that second-wave companies such as Intel and National had served (see Chase 1983; Patterson 1981, 1982). Underlying the formidable Japanese challenge were superior manufacturing methods that resulted in fewer defects and higher yields (see Burgelman 1994; Okimoto and Nishi 1994).

Around 1985 this Japanese challenge undermined the profitability of all the major memory producers, Intel included. So great was the Japanese threat in commodity chips that the most powerful U.S. semiconductor companies banded together to form SEMATECH (an acronym for Semiconductor Manufacturing Technology) with partial funding from the U.S. government, in an attempt to ensure that the United States would not lose indigenous capability in the production of semiconductor fabrication equipment as well (Browning and Shetler 2000; Grindley, Mowery, and Silverman 1994). By the beginning of the
1990s, however, Intel reemerged as the dominant U.S. competitor in the global semiconductor market, its revenues surpassing TI’s starting in 1990 and Motorola’s in 1991.

The foundation of Intel’s success was the microprocessor, the “computer on a chip” that it had invented in 1971 and that became the major source of revenues for the company with the IBM-led PC revolution of the 1980s. In 1981 IBM announced its PC, with the operating system supplied by Microsoft and the microprocessor by Intel. Both Microsoft and Intel retained the right to sell these products to other companies. In 1982 IBM accounted for almost 14 percent of Intel’s revenues (Chase 1983).

In 1982 IBM’s PC sales were $500 million, and just two years later they were 11 times that amount, more than triple the 1984 revenues of its nearest competitor, Apple, and about equal to the revenues of IBM’s top eight rivals. Subsequently, the very success of the IBM PC combined with open access to the Microsoft operating system and Intel microprocessor meant that, in the last half of the 1980s and beyond, IBM lost market share to lower-priced PC clones such as Compaq, Gateway, and Dell (Chandler 2001, pp. 118–199, 142–143).

Nevertheless IBM’s strategy for entering the microcomputer market had consolidated and reinforced the vertically specialized structure of the industry in line with what can be viewed as the Silicon Valley model (Best 2001, p. 124; Grove 1996, chap. 3; Langlois 1992). The subsequent domination by Intel and Microsoft of the product markets for microprocessors and operating software, respectively, created an immense barrier to entry to actual and potential competitors who would directly confront the New Economy giants. At the same time, however, by defining the “open systems” standards for the computer industry, Intel and Microsoft opened up countless opportunities for new entrants to develop specialized niche products that conformed to the “Wintel” architecture (Borrus and Zysman 1997; Pollack 1985a).

Yet for the major Silicon Valley semiconductor companies in the 1970s, vertical specialization in chips was a competitive outcome, not a strategic choice. A 1979 New York Times article subtitled “The Cloning of I.B.M.’s Computers” observed, “It is almost axiomatic in the electronics industry that companies in the semiconductor business want to go into end-user businesses, in other words to vertically integrate into finished products and systems” (Schuyten 1979). As part of a strategy to
integrate forward into consumer products, National Semiconductor and Fairchild started producing and marketing calculators (Sporck 2001, pp. 228–230). In 1972 Intel acquired a Silicon Valley digital watchmaker, Microma, which pioneered liquid crystal display watches. National Semiconductor and Fairchild Camera and Instruments (the parent company of Fairchild Semiconductor and by this time based in Silicon Valley) were also producing digital watches, as was TI (BusinessWeek 1976). Indeed, price competition from its semiconductor rivals led Intel to exit the watch business in 1978, taking a loss of $15 million on the venture (Manners 1997; Sporck 2001, pp. 185–187; Wharton 1990).

The semiconductor companies had somewhat more, but nevertheless limited, success integrating forward into capital goods. During the 1970s National manufactured checkout scanners and made money in that business before being outcompeted by IBM and NCR (Sporck 2001, pp. 230–231). Following the lead of Silicon Valley-based Amdahl, National had also entered the plug-compatible mainframe (PCM) market, producing clones of IBM’s machines. By the early 1980s, however, all of National’s PCMs were manufactured by Hitachi (BusinessWeek 1983), and in 1989, Hitachi and Electronic Data Systems bought National’s mainframe business (Molloy 1989).

In addition, leading Silicon Valley semiconductor companies, including Intel, National, and Intel-spinoff Zilog, entered the minicomputer industry in the late 1970s and early 1980s, but they were outcompeted by not only the Japanese but also by firms in the Route 128 high-tech corridor to the north and west of Boston in Massachusetts, such as Digital Equipment Corporation (DEC) and Data General, as well as by IBM and HP. In 1981 Intel entered the microcomputer industry, one in which National was already engaged using Intel’s 8086 microprocessor. Intel’s director of corporate planning, Les Vadasz, argued that Intel’s forward integration into microcomputers was strategic: “We develop products because they fit into our overall architecture of things” (BusinessWeek 1981a). But 1981 was also the year that IBM launched its PC, using Intel’s microprocessor. IBM’s success pushed Intel out of the microcomputer business and helped to ensure that the leading producer of microprocessors would grow to world dominance as a specialized semiconductor company.

The Silicon Valley semiconductor companies, therefore, had tried to integrate forward into final products, but competition from integrated
Japanese and U.S. rivals forced them to specialize in chips. Vertical specialization, however, did not stop there. A number of Silicon Valley design-oriented chip companies that entered the industry in the 1980s, and even more so in the 1990s, did so without investing in the manufacture of semiconductors. For example, many producers of programmable logic devices and graphics processors such as Altera, NVIDIA, and Xilinx turned to foundries to manufacture their chips. The Taiwanese in particular took advantage of the opportunity, as the Taiwan Semiconductor Manufacturing Company (TSMC) and United Microelectronics Corporation (UMC) became the largest semiconductor contract manufacturers in the world (Brown and Linden 2005, pp. 288–293; Leachman and Leachman 2004; Taiwan Industry Semiconductor Association 2007; Zerega 1999).

If a layer of vertical specialization emerged in the manufacture of chips, so too did it emerge in the assembly of chip sets, printed circuit boards, and, increasingly, even finished products (Sturgeon 2002). In the 1980s and early 1990s contract manufacturers, also known as electronic manufacturing service (EMS) providers, operated as job shops that took on extra work from integrated original equipment manufacturers (OEMs) in periods of peak demand. Then, during the mid-1990s, a few Old Economy companies—particularly IBM, HP, and Ericsson (in Sweden)—took the lead in selling existing plants to EMS providers (see Chapter 3). Meanwhile the newest New Economy companies, such as Cisco and 3Com, which engaged in internetworking, outsourced almost all of their manufacturing from the outset.

In the Internet boom of the late 1990s, the demand for EMS capacity soared. New Economy companies that did no manufacturing relied on EMS providers for not only assembly but also an increasing array of services including testing, design, documentation, and shipping (Curran 1997). Old Economy telecommunications equipment companies such as Motorola, Lucent, Nortel, and Alcatel also undertook major outsourcing programs to EMS providers; by 2000 there was a rush by these companies to offload manufacturing plants.

In the process, five dominant EMS providers emerged: Celestica, Flextronics, Jabil Circuit, Solectron, and Sanmina-SCI (Carbone 2000, 2002, 2004). From 1993 to 2003, the revenues of the largest EMS provider, Flextronics, increased from $93 million to $13.4 billion, and employment increased from 2,000 to 95,000. During the same period,
Solectron, the second largest EMS provider, saw an increase in revenues from $836 million to $11.0 billion and in employment from 4,500 to 66,000. Flextronics acquired Solectron in 2007. In 2007 dollars, the top five had combined revenues of $5.7 billion in 1994, $23.3 billion in 1999, $58.7 billion in 2004, and (including the combined operations of Flextronics and Solectron) $50.0 billion in 2007. Total employment at these companies was 90,000 people in 1999, 268,000 in 2004, and 356,000 in 2007.

Organizational Characteristics

These changes in industrial organization had far-reaching implications for the employment of labor. The start-up phenomenon and vertical specialization depended upon, and over time reinforced, the existence of industry-wide standards as distinct from the in-house proprietary standards that had characterized OEBM with its vertically integrated enterprises such as AT&T/Western Electric and IBM. The existence of industry-wide standards facilitated the movement of high-tech labor from one company to another over the course of a career. New Economy executives valued the industry-wide experience, including knowledge of the latest developments in technology and product markets, that new employees often brought with them to their company. The regional concentration of ICT firms in Silicon Valley further facilitated this movement of labor from one firm to another—one could change employer without relocating—while the networks created by regional concentration and interfirm mobility generated new learning to which participants in the regional labor force had privileged access relative to high-tech labor outside the region (Saxenian 1994).

The interfirm mobility of high-tech labor brought with it a new form of compensation—nonexecutive stock options—for attracting, retaining, and motivating a broad base of employees. The executive stock option had its origins in the United States from the late 1930s as high-level salaried corporate managers sought a form of compensation that would be subject to the 25 percent capital-gains tax rate rather than personal-income tax rates on the highest income brackets that reached 91 percent in the 1950s (Lazonick 2003a). The Revenue Act of 1950 transformed this possibility into reality (Pearson 1950), and over the course of the 1950s, top executives of U.S. corporations saw income
from options become an important component of their total remuneration (Lewellen 1968).

In the late 1950s and early 1960s, however, a backlash of public sentiment against this enrichment of top executives led the U.S. Congress to place restrictions on the use of stock options as a mode of compensation. In 1959, the AFL-CIO issued a pamphlet in which it warned against an erosion of the New Deal legislation that sought to prevent the opportunity for “a handful of insiders to rig the game for their own ends” (Industrial Union Department, AFL-CIO, 1959, p. 4). In a much less strident article in the Harvard Business Review, Erwin Griswold, Dean of Harvard Law School, criticized the tax rules on stock options for favoring a special class of people who did not in any case make investments that justified capital gains (Griswold 1960). He argued that option grants focused the minds of executives more on the gamble of holding publicly traded stocks than on the requirements of managing large corporations.

Griswold’s article provoked a vigorous academic debate (e.g., Baker 1963; Campbell 1961; Holland and Lewellen 1962; Lent and Menge 1962). Nonacademic participants in this discussion included Henry Ford II, CEO of Ford Motor Company; Thomas Watson, Jr., CEO of IBM; Nelson Rockefeller, governor of New York; and Albert Gore, senator from Tennessee. In a special message on tax reduction and reform delivered in January 1963, President John F. Kennedy advocated taxing executive stock options at ordinary income tax rates and thus “remove a gross inequality in the application of the income tax” (Washington Post 1963).

Gore championed this position in Congress, which revised the tax code in 1964 (Albright 1964; Cohen 1964; Gore 1965; Nossiter 1961). The “restricted” stock option of the 1950 Act became a “qualified” stock option; to qualify for capital-gains treatment, the option had to be exercised within five rather than 10 years, and, upon exercise, the acquired stock had to be held for three years rather than six months. In addition, the exercise price of the option had to be 100 percent of the market price, whereas previously it could be 85 to 95 percent. The new tax law also placed restrictions on the repricing of stock options should the company’s stock price decline (Cohen 1964). Each of these changes reduced the probability that executives would realize as much in benefits from stock options as they had been receiving.
In 1969 and 1976, moreover, Congress raised the capital-gains rate and lowered the personal-income rate, thus mitigating the original purpose of options. Moreover, under the Tax Reform Act of 1976, Congress eliminated the capital-gains treatment of all future employee stock options. In 1978, Graef Crystal (1978, p. 145)—a compensation consultant who would later become a vocal critic of excessive executive pay (Crystal 1991)—stated that qualified stock options, “once the most popular of all executive compensation devices . . . have been given the last rites by Congress.”

That was not the end of executive stock options, however. Congress subsequently lowered both the personal-income and capital-gains rates, and in 1981 restored the capital-gains treatment and relaxed the rules on the granting and exercising of stock options, thus resuscitating them (BusinessWeek 1981b; Noble 1981; Rankin 1981). In the forefront of lobbying Congress to bring back capital-gains treatment for stock options were the National Venture Capital Association (NVCA) and the American Electronics Association (AeA), both of which were nationwide organizations that emanated from Silicon Valley (Bacon 1981; Reiner 1989, chap. 6). In the 1980s and 1990s, stock options for both executives and nonexecutives would become a distinctive mode of compensation under NEBM.

The 1980s and 1990s witnessed an explosion in executive pay, driven by stock options. Between 1980 and 1994, the mean value of stock option grants to CEOs of large U.S. corporations rose from $155,037 to $1,213,180, or by 683 percent, while the mean value of their salary and bonus compensation rose from $654,935 to $1,292,290, or by 95 percent. As a result, stock options accounted for 19 percent of CEO compensation in 1980 but 48 percent in 1994 (Hall and Leibman 1998, p. 661).

A study of CEO remuneration in S&P 500 companies found that average compensation in 2003 dollars rose from $3.5 million in 1992 to a peak of $14.8 million in 2000, declining to $8.7 million in 2003 (Jensen, Murphy, and Wruck 2005, p. 33). The value of stock options accounted for 28 percent of this pay in 1992, 49 percent in 2000, and 38 percent in 2003. Of the change in pay from 1992 to 2000, 10.5 percent came from salaries, 15.4 percent from bonuses, and 56.7 percent from stock options. Of the decline in pay from 2000 to 2003, 14.1 percent came from salaries, 11.2 percent from bonuses, and 65.0 percent from
stock options. It has been estimated that, largely as a result of gains from the exercise of stock options, the ratio of the pay of CEOs of major U.S. corporations to that of the average worker increased from 42:1 in 1980 to 85:1 in 1990 to 531:1 in 2000 (Dash 2006). Notwithstanding the less ebullient stock markets that prevailed in the first half of the 2000s, this ratio remained very high at 411:1 in 2005 and 364:1 in 2006 (AFL-CIO 2007).

With good reason, both academics and journalists who are critical of high executive pay have focused most of their attention on the excesses of executive stock options. Yet the vast majority of employee stock options in the United States have been issued to nonexecutive personnel as part of what became known as “broad-based” programs (Hall and Murphy 2003, pp. 51–53; Mehran and Tracy 2001; Oyer and Schaefer 2005; Sabow and Milligan 2000; Sesil et al. 2002). During the Internet boom, broad-based stock option programs diffused to many more companies, with top executives getting more of them and increasing numbers of nonexecutive employees getting them for the first time.

The significant use of stock options for nonexecutive employees originated in the 1960s when high-tech start-ups began to offer them to scientists, engineers, and managerial personnel at all levels, not just top executives, to lure them away from employment at established companies. Old Economy corporations could credibly promise secure employment to professional, technical, and administrative employees, with superior compensation taking the form of pay increases tied to promotion up the managerial hierarchy. Start-ups, their futures highly uncertain, could not realistically hold out the expectation of employment security. They could, however, use stock options, with exercise prices often at pennies a share, to attract well-educated and experienced personnel. If the start-up did an IPO or was sold to an already-listed company, these stock options would become very valuable.

The high concentration of start-ups in Silicon Valley meant that in the 1980s new ventures increasingly not only used stock options to induce high-tech labor to leave secure employment with established corporations, but they also competed among themselves for personnel, with an emphasis on stock options in their compensation packages. Besides attracting “talent” and giving these new hires a stake in getting the start-up to an IPO, ample stock options could substitute to some extent for cash salaries (e.g., see Uchitelle 1990).
At the same time, a company could also grant its employees non-qualified stock options on which ordinary taxes had to be paid at the time of exercise, but on which the company could claim a dollar-for-dollar tax credit without having to show the cost of stock options as an expense that would in turn reduce reported earnings (and as a result presumably place downward pressure on its stock price). In 2000, at the peak of the boom, this tax benefit from nonqualified employee stock options was worth $887 million to Intel, $5,535 million to Microsoft, and $2,495 million to Cisco.

Given the lowering of ordinary tax rates in the early 1980s, non-qualified options became a favored form of stock-based compensation, especially in Silicon Valley, where new ventures abounded. No longer were stock options viewed as an exclusive privilege of top executives. Rather, in the New Economy, stock options could be seen as necessary to attract “talent” to supply their expertise and effort to innovative new ventures that could drive the growth of the U.S. economy.

The growing importance of stock options to attract new employees placed pressure on high-tech firms to use options to retain them as well. For this reason, the practice evolved in New Economy firms of making annual option grants, with the vesting period for any annual block of option grants being 25 percent of the grants at the end of each of the first four years after the grant date. Once the options were vested, they could typically be exercised for a period of 10 years from the grant date, so long as one remained with the company. Without creating the Old Economy expectation among employees of “lifelong careers” with the company, the perpetual pipeline of unvested options functions as a tangible retention mechanism. Indeed, for most employees, the amount of options that an individual can expect to receive is tied to his or her position in the firm’s hierarchical and functional division of labor, so that the retention function of stock options is integrally related to the employee’s career progress within the particular company.

There is a widespread consensus among ICT firms that the prime function of stock options is to manage interfirm mobility on the labor market by attracting and retaining labor. As displayed in Figure 2.2, the importance that ICT compensation executives ascribed to the “attract” and “retain” objectives (along with the integrally related objective to “provide competitive total compensation”) in the late 1990s and early 2000s is evident in their responses to the annual survey, conducted
The objectives were ranked in any given year by the percentage of companies listing an objective as “most important” for their ongoing stock options plans. Companies gave multiple “most important” objectives, ranging from an average of 2.2 in 1996 to 3.6 in 2000. The ICT companies included in the survey changed from year to year. Number of companies surveyed: 1996, 68; 1997, 68; 1998, 82; 1999, 81; 2000, 180; 2001, 166; 2002, 174; and 2003, 136. In 1996, “Rewarding past contributions” was a frequent response in the “Other” category.


by the consulting firm iQuantic, on the “most important” objectives of ongoing high-tech stock option programs. Note the stability of the relative rankings between 1996 and 2003, notwithstanding the fact, as noted in Figure 2.2, that the number of companies that responded to the survey varied markedly over this period, as did their average number of “most important” responses.
In their early years, some Silicon Valley start-ups like Intel, Oracle, Sun Microsystems, and Cisco Systems granted stock options to substantial proportions of their employees. Many New Economy companies located outside Silicon Valley—for example, Microsoft, based in Washington State, and Dell, based in Texas—did so as well (Lazonick 2007b). During the 1980s and 1990s, New Economy companies maintained, and in some cases enlarged, their broad-based stock option programs even as they grew to employ tens of thousands of people.

By the 2000s, stock option awards outstanding accounted for a substantial proportion of the total common stock outstanding of the leading ICT companies (Table 2.1). Compensation professionals call this ratio the “overhang.” The numerator in the overhang depends on the number of options awarded over the past decade (assuming that is the exercise period), changes in stock prices that make it worthwhile for employees to exercise these options, and cancellation of outstanding options when employees leave the company. The denominator in the overhang depends on the extent to which a company issues new common stock or retires outstanding common stock. In the 2000s the widespread practice of massive stock repurchases (as will be discussed in Chapter 6) tended to increase the overhang.

Microsoft, for example, started giving its 200 employees stock options in 1982, and four years later, with about 1,000 employees and $200 million in revenues, went public to provide liquidity to the shares that employees purchased when they exercised their vested options (see Lazonick 2003a). As the company grew to employ over 20,000 people in 1996 and almost 40,000 four years later, virtually all Microsoft employees got options. In May 2001, with stock prices tumbling, Microsoft doubled the option grants of all employees. Just over two years later, however, with 55,000 employees, the company announced that it would no longer award stock options. Since then, as Table 2.1 shows, Microsoft’s overhang has been on the decline, despite its large-scale stock repurchases.

Until 1997 Intel awarded stock options to only about half of its employees. As the Internet boom heated up, and as the word spread among Intel’s almost 50,000 employees that CEO Andrew Grove had raked in some $98 million from exercising stock options in 1996, the company expanded the program to include almost all of its employees. In contrast, Intel’s main Silicon Valley rival, AMD, gave options to only
<table>
<thead>
<tr>
<th></th>
<th>2000</th>
<th>2001</th>
<th>2002</th>
<th>2003</th>
<th>2004</th>
<th>2005</th>
<th>2006</th>
<th>2007</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cisco Systems</td>
<td>12.94</td>
<td>13.89</td>
<td>15.53</td>
<td>17.60</td>
<td>19.50</td>
<td>21.56</td>
<td>23.35</td>
<td>22.49</td>
</tr>
<tr>
<td>Dell</td>
<td>13.33</td>
<td>12.77</td>
<td>13.33</td>
<td>14.27</td>
<td>15.00</td>
<td>14.97</td>
<td>13.79</td>
<td>13.29</td>
</tr>
<tr>
<td>Hewlett-Packard</td>
<td>7.04</td>
<td>9.79</td>
<td>13.58</td>
<td>15.76</td>
<td>17.63</td>
<td>18.81</td>
<td>17.58</td>
<td>15.36</td>
</tr>
<tr>
<td>IBM</td>
<td>8.70</td>
<td>9.77</td>
<td>11.64</td>
<td>13.65</td>
<td>14.80</td>
<td>15.11</td>
<td>14.44</td>
<td>11.88</td>
</tr>
<tr>
<td>Lucent Technologies&lt;sup&gt;a&lt;/sup&gt;</td>
<td>11.53</td>
<td>16.78</td>
<td>14.05</td>
<td>8.81</td>
<td>9.24</td>
<td>9.27</td>
<td>6.47</td>
<td>na</td>
</tr>
<tr>
<td>Microsoft</td>
<td>15.38</td>
<td>16.22</td>
<td>15.83</td>
<td>14.67</td>
<td>11.56</td>
<td>8.40</td>
<td>7.45</td>
<td>5.59</td>
</tr>
<tr>
<td>Motorola</td>
<td>6.14</td>
<td>8.37</td>
<td>11.02</td>
<td>12.73</td>
<td>13.40</td>
<td>12.20</td>
<td>10.20</td>
<td>9.90</td>
</tr>
<tr>
<td>Oracle</td>
<td>9.45</td>
<td>9.23</td>
<td>8.13</td>
<td>8.52</td>
<td>8.60</td>
<td>8.81</td>
<td>9.07</td>
<td>8.44</td>
</tr>
<tr>
<td>Sun Microsystems</td>
<td>13.87</td>
<td>14.86</td>
<td>16.29</td>
<td>17.67</td>
<td>18.09</td>
<td>17.18</td>
<td>15.61</td>
<td>13.33</td>
</tr>
</tbody>
</table>

**NOTE:** Fiscal years ending: January, Dell; May, Oracle; June, Microsoft and Sun Microsystems; July, Cisco Systems; September, Lucent Technologies; October, Hewlett-Packard; December, AMD, IBM, Intel, Motorola, and Texas Instruments.

<sup>a</sup>On December 1, 2006, Lucent ceased to exist when it was merged into the France-based company Alcatel to form Alcatel-Lucent.

**SOURCE:** Company 10-K filings.
11 percent of its 13,000 employees in 1983 and has never given options to more than 25 percent of its labor force, reaching that proportion in 1998, when it employed 12,800 people. Through the first half of the 1980s, AMD stood out in Silicon Valley as a company that had a “no-layoff” policy (Gutchess 1985b, pp. 24–27; see also McEnaney 1985).² Even in Silicon Valley, under certain conditions and for certain firms, the offer of employment security may have been more important than the offer of stock options in performing the retention function.

Cisco Systems, which had 10 employees as a start-up in 1984 and some 200 employees when it did its IPO in 1990, extended annual stock option grants on a systematic basis to virtually all of its employees over the course of the 1990s, even as its payroll reached 40,000 in 2000. With 66,129 employees at the end of fiscal 2008, Cisco still gives almost everyone options. Its overhang soared to almost 24 percent in 2006, but then, notwithstanding ongoing stock repurchases, declined in 2007 and then again in 2008 (to 20.16 percent) as the result of the exercise and cancellation of options. Like Cisco, Dell, Oracle, and Sun have historically given options to all employees.

HP, an Old Economy company located in the heart of Silicon Valley, awarded stock options only to upper-level employees in the early 1980s, but then gradually extended stock options to a larger proportion of the labor force from the mid 1980s to 1998. In 1985 the proportion of HP employees holding options was only 8 percent, but it increased to 18 percent in 1990, 25 percent in 1995, and 30 percent in 1998. At the height of the Internet boom, this proportion jumped sharply, first to 57 percent in 1999 and then 98 percent in 2000. At the end of fiscal 2007, the proportion of HP employees holding options had declined to 58 percent, or 99,000 employees, but all regular HP employees have been eligible to receive options since 2000.

At the beginning of the 1990s, IBM, like most Old Economy companies, reserved stock options for top executives, but in making the transition to the NEBM (see Chapter 3), the company increasingly and substantially broadened the base of recipients. As can be seen in Table 2.1, the overhangs of HP, IBM, Intel, Motorola, and TI were on the rise in the first half of the 2000s, in large part because these companies have spent billions of dollars annually buying back shares in the 2000s, hence reducing the number of shares outstanding.
For NEBM employees, stock options are not only a potential form of remuneration for work but also, hopefully, a source of retirement savings. As will be shown in Chapter 4, almost all New Economy companies have defined-contribution rather than defined-benefit pension plans, often with a low level of contribution by the company. The expectation is that the accumulation of wealth through the exercise of stock options will form a much more significant financial foundation for retirement than the company pension plan per se.

During the Internet boom, at companies like Microsoft, Cisco, and Intel, income from broad-based stock options soared with speculative stock prices. Since 2001 a new reality has set in that includes lower levels of high-tech employment and wages that are based mostly on salaries. Using County Business Pattern (CBP) data, Figures 2.3 and 2.4 show the changes in full-time employment levels, and Figures 2.5 and 2.6 show the levels of real wages for two key ICT sectors—semicon-

![Figure 2.3 Full-Time Employees in the Semiconductor Industry, Silicon Valley, Route 128, Dallas, and Oregon, 1994–2006](image_url)

SOURCE: U.S. Census Bureau (2008a).
ductors and software publishing—from 1994 through 2006 for districts in the United States that have high concentrations of ICT workers.\(^3\)

In the case of semiconductors, I have included data for Silicon Valley, Route 128, the Dallas area (home of TI), and the state of Oregon, which is Intel’s main location for microprocessor fabrication. With 15,500 employees in Oregon in 2008 (down from 16,000 in 2005), Intel is the state’s largest business employer, and the area around Portland has Intel’s largest concentration of employees worldwide. In the case of software publishing, I have included data for Silicon Valley, Route 128, the Dallas area, and Washington State, which is the home of Microsoft. In Figures 2.5 and 2.6, I have included series of real wages for these industries for the United States in addition to the district/state data.

U.S. semiconductor employment peaked at 225,000 in 2001, but it was 39 percent lower in 2005 before increasing by 4 percent in 2006. Figure 2.3 shows that Silicon Valley dominated semiconductor employment in the United States from 1994 through 2006, but with a smaller

---

**Figure 2.4 Full-Time Employees in Software Publishing, Silicon Valley, Route 128, Dallas, and Washington State, 1994–2006**

![Chart showing employment trends in software publishing from 1994 to 2006 for Silicon Valley, Route 128, Dallas, and Washington State.]

SOURCE: U.S. Census Bureau (2008a).
share of declining total numbers in the mid-2000s. Dallas increased its share to almost 10 percent in 2000 and maintained that share through 2006. Oregon’s share was also higher in the first half of the 2000s than in the second half of the 1990s, largely because Intel kept its most advanced microprocessor design and fabrication in the United States while offshoring to other countries much of the less sophisticated semiconductor work that Intel had been doing at other locations in the United States.

U.S. software publishing employment increased dramatically in the second half of the 1990s, and, like semiconductor employment, reached a peak in 2001. The number of software publishing employees dropped by 41 percent in 2002, but subsequently recovered so that it was at 93 to 97 percent of its 2001 level from 2003 through 2006. Figure 2.4 shows that Silicon Valley dominated software publishing employment in the latter half of the 1990s, but that Washington was catching up because

Figure 2.5  Real Wages (in 2000 dollars) in the Semiconductor Industry, United States, Silicon Valley, Route 128, Dallas, and Oregon, 1994–2006

SOURCE: U.S. Census Bureau (2008a).
of the growth of Microsoft. Indeed, in 2006, the number of software publishing employees in Washington surpassed the number in Silicon Valley for the first time. Route 128 had a larger share of software publishing employees in the second half of the 1990s than in the first half of the 2000s, with a recovery of share in 2005 and 2006 compared with 2001–2004.

As was shown in Figure 1.5, the largest numbers of ICT employees are in the computer programming and computer system design industries. Of the 506,321 people employed in computer programming in 2006, 9.1 percent were located in Silicon Valley and 3.6 percent along Route 128. Of the 486,523 people in computer system design in 2006, 5.0 percent were in Silicon Valley and 3.3 percent along Route 128.

Figure 2.5 shows that Silicon Valley led other areas in semiconductor wages by a considerable margin throughout the period. This differential probably reflects a combination of competition for labor among

![Figure 2.6 Real Wages (in 2000 dollars) in Software Publishing, United States, Silicon Valley, Route 128, Dallas, and Washington State, 1994–2006](image)

SOURCE: U.S. Census Bureau (2008a).
the large number of semiconductor companies in Silicon Valley and the high cost of living there. Note also the sharp spike in average real wages in Silicon Valley, Oregon, and Route 128 at the peak of the Internet boom. Indeed from 1996 to 2000, real wages in semiconductor employment in Silicon Valley almost doubled, from $79,600 to $156,300.

Even more dramatically, as shown in Figure 2.6, average real wages of software publishing employees in Washington more than tripled, from $112,600 in 1996 (already almost double 1994 real wages) to $380,038 in 2000. The reason—employees at companies such as Intel and Microsoft were cashing in on stock options at inflated stock market prices. In computer programming as well as computer system design employment, Silicon Valley wages were also higher than in other districts, and average real wages also moved up sharply in the boom.

The importance of the gains from the exercise of stock options indicated by the CBP data is confirmed when we calculate the gains from the exercise of stock options at the company level, using data from company filings to the Securities and Exchange Commission (SEC). In their proxy statements, companies provide data on the gains from the exercise of stock options of the CEO and the four other highest paid executives (the “top five”). Table 2.2 shows the average annual income per top five executive from the exercise of stock options from 1995 to 2007 at the same 12 ICT companies that are listed in Table 2.1.

In general, the gains peaked in fiscal 2000 or 2001, although Intel’s top five experienced their peak in 1998. At Oracle each of the top five averaged almost $170 million from exercising stock options in 2001, although they reaped no gains in 2002, which was a relatively bad year for stock option gains at all of the companies. (Dell’s fiscal year ends on January 31, and its 2002 average of $28.6 million primarily reflects options exercised in calendar year 2001.) Even before Microsoft ceased to award stock options, neither William Gates, its current chairman, nor Steven Ballmer, its current CEO, derived any earnings from the exercise of stock options, although in 2007 their stakes in Microsoft placed them at numbers 1 and 31, respectively, among the richest people in the world (Forbes 2007). Unlike most of the other companies, whose top five did very well from exercising options, Microsoft’s top five averaged a paltry $5,180 in 2005 and zero in 2006, in sharp contrast to the $22.0 million (2005) and the $13.0 million (2006) that the top five received on average at Oracle, one of Microsoft’s most important software rivals.
Table 2.2  Average Gains (thousand U.S. dollars) per Top Five Executive from the Exercise of Stock Options, Selected U.S. ICT Companies, 1995–2007

<table>
<thead>
<tr>
<th>Year</th>
<th>AMD</th>
<th>CSCO</th>
<th>DELL</th>
<th>HPQ</th>
<th>INTC</th>
<th>IBM</th>
<th>LU</th>
<th>MSFT</th>
<th>MOT</th>
<th>ORCL</th>
<th>JAVA</th>
<th>TXN</th>
</tr>
</thead>
<tbody>
<tr>
<td>1995</td>
<td>546</td>
<td>4,065</td>
<td>387</td>
<td>534</td>
<td>4,892</td>
<td>152</td>
<td>2,505</td>
<td>3,190</td>
<td>4,301</td>
<td>727</td>
<td>4,066</td>
<td></td>
</tr>
<tr>
<td>1996</td>
<td>2,011</td>
<td>15,790</td>
<td>820</td>
<td>1,074</td>
<td>24,585</td>
<td>5,383</td>
<td>—</td>
<td>0</td>
<td>1,038</td>
<td>8,302</td>
<td>2,786</td>
<td>0</td>
</tr>
<tr>
<td>1997</td>
<td>4,549</td>
<td>3,124</td>
<td>1,977</td>
<td>2,161</td>
<td>12,516</td>
<td>3,764</td>
<td>248</td>
<td>4,127</td>
<td>180</td>
<td>3,620</td>
<td>4,425</td>
<td>1,265</td>
</tr>
<tr>
<td>1998</td>
<td>190</td>
<td>5,972</td>
<td>14,417</td>
<td>1,114</td>
<td>40,137</td>
<td>10,239</td>
<td>15,597</td>
<td>3,271</td>
<td>0</td>
<td>3,752</td>
<td>11,515</td>
<td>1,492</td>
</tr>
<tr>
<td>1999</td>
<td>139</td>
<td>60,586</td>
<td>36,937</td>
<td>8,732</td>
<td>4,796</td>
<td>24,457</td>
<td>165</td>
<td>30,178</td>
<td>2,297</td>
<td>6,754</td>
<td>5,619</td>
<td>5,037</td>
</tr>
<tr>
<td>2000</td>
<td>20,080</td>
<td>51,302</td>
<td>98,791</td>
<td>4,360</td>
<td>32,063</td>
<td>13,293</td>
<td>6,100</td>
<td>50,653</td>
<td>607</td>
<td>83,504</td>
<td>25,180</td>
<td>15,048</td>
</tr>
<tr>
<td>2001</td>
<td>3,517</td>
<td>11,884</td>
<td>75,151</td>
<td>0</td>
<td>4,117</td>
<td>29,296</td>
<td>0</td>
<td>31,531</td>
<td>546</td>
<td>169,674</td>
<td>18,441</td>
<td>992</td>
</tr>
<tr>
<td>2002</td>
<td>16</td>
<td>805</td>
<td>28,612</td>
<td>127</td>
<td>3,514</td>
<td>943</td>
<td>1</td>
<td>1,405</td>
<td>114</td>
<td>0</td>
<td>5,406</td>
<td>0</td>
</tr>
<tr>
<td>2003</td>
<td>81</td>
<td>1,291</td>
<td>2,103</td>
<td>502</td>
<td>6,298</td>
<td>2,139</td>
<td>0</td>
<td>6,870</td>
<td>0</td>
<td>13,001</td>
<td>1,323</td>
<td>9,178</td>
</tr>
<tr>
<td>2004</td>
<td>115</td>
<td>14,207</td>
<td>14,019</td>
<td>182</td>
<td>6,338</td>
<td>2,876</td>
<td>0</td>
<td>8,564</td>
<td>808</td>
<td>8,633</td>
<td>1,432</td>
<td>493</td>
</tr>
<tr>
<td>2005</td>
<td>1,649</td>
<td>15,804</td>
<td>9,364</td>
<td>2,319</td>
<td>4,208</td>
<td>3,550</td>
<td>183</td>
<td>5</td>
<td>2,913</td>
<td>21,953</td>
<td>2,397</td>
<td>2,220</td>
</tr>
<tr>
<td>2006</td>
<td>4,746</td>
<td>17,614</td>
<td>31,466</td>
<td>4,903</td>
<td>2,929</td>
<td>3,210</td>
<td>—</td>
<td>0</td>
<td>8,178</td>
<td>12,998</td>
<td>564</td>
<td>7,286</td>
</tr>
<tr>
<td>2007</td>
<td>1</td>
<td>22,517</td>
<td>6,692</td>
<td>8,837</td>
<td>4,339</td>
<td>2,454</td>
<td>0</td>
<td>554</td>
<td>46,865</td>
<td>666</td>
<td>1,302</td>
<td></td>
</tr>
</tbody>
</table>

NOTE: AMD, Advanced Micro Devices; CSCO, Cisco Systems; DELL, Dell; HPQ, Hewlett-Packard; INTC, Intel; IBM, International Business Machines; LU, Lucent Technologies; MSFT, Microsoft; MOT, Motorola; ORCL, Oracle; JAVA, Sun Microsystems; and TXN, Texas Instruments. — = not available.

SOURCE: Company proxy statements.
In addition to the information on top five compensation, the notes to company 10-K financial statements provide data that permit an estimate of the average gains per company employee (including those who may not have received options) from the exercise of stock options. Hence, the ratio of the average gains of the top five to those of the average employee can be calculated.\textsuperscript{4} Table 2.3 shows the average gains per employee (excluding the top five) from exercising options for the same 12 companies listed in Table 2.2. Very significant average gains were made by employees at these companies at the peak of the Internet boom, especially at Cisco, Dell, Intel, Microsoft, Oracle, and Sun, all of which awarded options to virtually all of their employees in the second half of the 1990s.

The gains that have been reaped more recently from the exercise of stock options pale in comparison to those achieved during the boom, even at Cisco, where a 60 percent increase in its stock price over the course of fiscal 2007 enabled its 55,700 employees to average $73,000 in stock-option gains. The cessation of new option grants at Microsoft from 2003 accounts for its sharp decline in average employee gains from 2005 to 2007.

At IBM the average gains from the exercise of stock options for the decade 1996–2005 were $95.9 million for the top five and $29,000 for the average employee. In the mid-1990s, IBM was beginning to transition from the Old Economy practice of awarding stock options only to upper-level executives to the New Economy practice of distributing options to a broader base of nonexecutive employees. The relatively low average gains per employee at IBM compared with the average gains at most of the other companies listed throughout the period 1995–2007 reflect the facts that 1) a smaller proportion of IBM employees received options; 2) with 386,558 employees at the end of 2007, IBM’s headcount was more than three times that of Intel, the next largest employer among the 12 ICT companies; and 3) the movement of IBM’s stock price was much more damped than those of most of the other companies during the Internet boom. At the height of the Internet boom, HP also substantially broadened the base of those who received stock options. The spike in average gains per employee to almost $18,000 in 2000 reflects the spike in HP’s stock price as well as substantial increases in the number of stock options granted per option holder in the late 1990s.
Table 2.3  Average Gains (in U.S. dollars) per Employee (excluding the top five) from the Exercise of Stock Options, Selected U.S. ICT Companies, 1995–2007

| Year | AMD  | CSCO | DELL | HPQ  | INTC | IBM  | MSFT | MOT  | ORCL | JAVA | TXN  |
|------|------|------|------|------|------|------|------|------|------|------|------|------|
| 1995 | 1,086| 60,894| 3,833| 2,362| 18,746| 671  | 51,829|—    |—    |2,468 |2,136 |
| 1996 | 1,490| 93,399| 7,194| 2,213|16,010 | 1,823| 79,022|471  |7,367| 7,992 | 892  |
| 1997 | 5,075| 85,159|11,219|3,156 |25,295 | 3,615| 1,019 |154,196|1,058| 6,588 | 7,626 | 2,932|
| 1998 | 1,435| 92,947|40,547|2,676 |75,890 | 4,066| 5,449 |238,377|361  | 5,019 |10,799 | 4,473|
| 1999 | 1,687|193,476|126,639|6,613 |56,589 | 5,790| 7,505 |369,693|4,055| 5,650 |27,477 | 47,880|
| 2000 |20,113|290,870|84,818|17,987|112,018| 4,200|23,281|449,142|3,218| 60,431 |22,881 |
| 2001 | 2,115|105,865|76,122|1,498 |18,235 | 4,011|828  |143,772|415  | 46,763 | 6,767 |
| 2002 | 537  |13596 |33167 |838  |10413 | 1195 |955  |95310  |334  | 6950  | 4550  |
| 2003 | 1,163| 8,917 |10,739|936  |10,406| 1,553| 11  |80,283 | 42  | 6,193 | 1,182 | 4,803 |
| 2004 | 5,103| 32,804|12,216|638  |8,405 | 1,842|486  |50,690 |1,381| 7,908 | 1,960 | 6,144 |
| 2005 | 12,786|24,432|11,297|1,739|8,347 | 1,256| 615 |14,500 | 8,688| 6,926 | 1,187 |12,512 |
| 2006 |18,197| 25,487| 8,724|6,809| 3,396| 1,857|558  |6,208 | 3,852| 9,514 | 1,249 |11,142 |
| 2007 | 1,149| 73,004|221  |9,982| 6,915| 3,524|14,991|4,395 |14,927| 2,740 |19,209 |

NOTE: See Table 2.2 for company ticker abbreviations. — = not available.
SOURCE: Company 10-K filings.
Table 2.4  Ratios of Average Top Five Gains from the Exercise of Stock Options to Average Gains of Other Employees, Selected U.S. ICT Companies, 1995–2007

<table>
<thead>
<tr>
<th>Year</th>
<th>AMD</th>
<th>CSCO</th>
<th>DELL</th>
<th>HPQ</th>
<th>INTC</th>
<th>IBM</th>
<th>LU</th>
<th>MSFT</th>
<th>MOT</th>
<th>ORCL</th>
<th>JAVA</th>
<th>TXN</th>
</tr>
</thead>
<tbody>
<tr>
<td>1995</td>
<td>231</td>
<td>60</td>
<td>83</td>
<td>202</td>
<td>232</td>
<td>200</td>
<td>45</td>
<td>—</td>
<td>221</td>
<td>14</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1996</td>
<td>705</td>
<td>150</td>
<td>93</td>
<td>426</td>
<td>1,388</td>
<td>2,462</td>
<td>—</td>
<td>0</td>
<td>2,202</td>
<td>989</td>
<td>288</td>
<td>0</td>
</tr>
<tr>
<td>1997</td>
<td>482</td>
<td>33</td>
<td>149</td>
<td>623</td>
<td>440</td>
<td>909</td>
<td>212</td>
<td>25</td>
<td>170</td>
<td>487</td>
<td>506</td>
<td>4</td>
</tr>
<tr>
<td>1998</td>
<td>77</td>
<td>58</td>
<td>307</td>
<td>334</td>
<td>477</td>
<td>2,234</td>
<td>6,587</td>
<td>13</td>
<td>0</td>
<td>643</td>
<td>929</td>
<td>4</td>
</tr>
<tr>
<td>1999</td>
<td>48</td>
<td>202</td>
<td>252</td>
<td>1,186</td>
<td>75</td>
<td>3,755</td>
<td>19</td>
<td>74</td>
<td>566</td>
<td>949</td>
<td>175</td>
<td>1</td>
</tr>
<tr>
<td>2000</td>
<td>419</td>
<td>156</td>
<td>1,000</td>
<td>214</td>
<td>246</td>
<td>2,758</td>
<td>224</td>
<td>101</td>
<td>189</td>
<td>1,807</td>
<td>364</td>
<td>8</td>
</tr>
<tr>
<td>2001</td>
<td>651</td>
<td>94</td>
<td>835</td>
<td>0</td>
<td>194</td>
<td>6,442</td>
<td>0</td>
<td>192</td>
<td>1,316</td>
<td>1,575</td>
<td>324</td>
<td>2</td>
</tr>
<tr>
<td>2002</td>
<td>15</td>
<td>48</td>
<td>745</td>
<td>123</td>
<td>290</td>
<td>682</td>
<td>0</td>
<td>13</td>
<td>341</td>
<td>0</td>
<td>951</td>
<td>0</td>
</tr>
<tr>
<td>2003</td>
<td>43</td>
<td>119</td>
<td>175</td>
<td>452</td>
<td>531</td>
<td>1,268</td>
<td>0</td>
<td>77</td>
<td>0</td>
<td>1,728</td>
<td>834</td>
<td>22</td>
</tr>
<tr>
<td>2004</td>
<td>12</td>
<td>386</td>
<td>1,031</td>
<td>221</td>
<td>566</td>
<td>1,459</td>
<td>0</td>
<td>156</td>
<td>487</td>
<td>1,266</td>
<td>571</td>
<td>1</td>
</tr>
<tr>
<td>2005</td>
<td>72</td>
<td>585</td>
<td>745</td>
<td>1,077</td>
<td>454</td>
<td>2,557</td>
<td>298</td>
<td>0</td>
<td>335</td>
<td>2,709</td>
<td>1,527</td>
<td>2</td>
</tr>
<tr>
<td>2006</td>
<td>142</td>
<td>621</td>
<td>3,153</td>
<td>616</td>
<td>737</td>
<td>1,581</td>
<td>—</td>
<td>0</td>
<td>2,123</td>
<td>1,227</td>
<td>345</td>
<td>9</td>
</tr>
<tr>
<td>2007</td>
<td>1</td>
<td>227</td>
<td>10,475</td>
<td>504</td>
<td>366</td>
<td>439</td>
<td>0</td>
<td>78</td>
<td>2,245</td>
<td>157</td>
<td>1</td>
<td></td>
</tr>
</tbody>
</table>

NOTE: See Table 2.2 for company ticker abbreviations. — = not available.
SOURCE: Company proxy statements and 10-K filings.
Table 2.4 shows the ratios of the average top five gains from the exercise of stock options to the average gains of all other employees at each of the 12 companies in Tables 2.2 and 2.3, using the highest monthly stock prices to estimate the gains (see Note 4). As can be seen, the ratios have varied markedly not only from company to company for a given year but also from year to year for a given company. For example, in fiscal year 2006 (year ending January 31, 2006), the ratio for Dell was 3,153, as average options gains per employee fell to $8,724, the lowest level since 1996. Meanwhile, the average top five gains from exercising options stood at $31.5 million. In fiscal 2007, the Dell ratio soared to 10,475, as the top five averaged $6.7 million in gains from stock options while all of Dell’s other employees—well over 85,000 of them worldwide—received an average of $221.

Just like the stock market boom from which the gains from the exercise of stock options flowed, the high levels of earnings could not be sustained when the ICT markets and the stock markets turned down. The decline in GDP that accompanied the end of the Internet boom lasted from March to November 2001. Subsequently, however, with the resumption of growth, there was a contraction in employment in the U.S. economy as a whole until the fourth quarter of 2003. In this jobless recovery, certain ICT occupational categories were hit particularly hard. Fourth-quarter surveys by the Bureau of Labor Statistics revealed that employment of computer programmers in the United States fell from 530,730 in 2000 to 501,580 in 2001 to 457,320 in 2002 to 403,220 in 2003, with average real annual wages declining from a peak of $65,517 in 2001 to $65,170 in 2003. Fourth-quarter employment of electrical and electronic engineering technicians fell from 244,570 in 2000 to 220,810 in 2001 to 194,960 in 2002 to 181,550 in 2003, although the average real annual wages of those who remained employed rose from $33,155 in 2000 to $46,190 in 2003 (U.S. Department of Labor 2008). The Institute of Electrical and Electronics Engineers (IEEE) estimated an unemployment rate for computer programmers of 6.4 percent on average in 2003 and 7.6 percent on average in the first half of 2004 (IEEE–Central Texas Section 2008). The problem, it was widely argued, was a marked acceleration in the 2000s of offshoring, especially to India (see Chapter 5), of what had been well-paying ICT jobs in the United States. Even in recovery, it seemed, the New Economy was failing to deliver on the promise of prosperity to many of the better-educated groups in the U.S. labor force.
Financial Characteristics

A major reason why stock options made such a significant contribution to the incomes of employees in Silicon Valley during the Internet boom was the competition for high-tech labor not only from established companies, but also from a proliferation of start-ups: stock options acted as the key to inducing interfirm labor mobility. From the beginning of the 1980s, start-ups found ample finance from venture capital, a mode of funding new firm formation in which Silicon Valley was far better provisioned than anywhere else in the world. In the period from 1995 to 2000, when start-ups became integral to the Internet boom, the San Francisco–Oakland–San Jose consolidated metropolitan statistical area (CMSA) accounted for 28 percent of the venture-backed deals and 24 percent of the venture-backed investments in the United States. By comparison, the CMSA around Boston accounted for 11 percent of deals and 9 percent of investments, while the CSMA around New York accounted for 10 percent of deals and 12 percent of investments (PricewaterhouseCoopers 2008a).

In its origins, however, the evolution of venture capital as a distinct industry for new firm formation depended on Old Economy money of East Coast origin. In the immediate post–World War II decades, the wealth of Old Economy families, including the Rockefellers, Mellons, and Whitneys, was an important source of venture capital funding (Wilson 1986, chap. 2). The first formal venture capital organization was American Research and Development (ARD), established in Boston in 1946 for the express purpose of supporting entrepreneurs in the founding of new firms to commercialize the accumulation of advanced scientific and technological capability that, as a result of military spending, had accumulated through World War II. Much of this capability could be found at the Massachusetts Institute of Technology (MIT). In the post–World War II decades, both MIT and ARD played important roles in the growth of the Route 128 high-tech corridor to the north and west of Boston (Hsu and Kenney 2005; Rosegrant and Lampe 1992, chaps. 2–4). From 1958 on, under the Small Business Administration, the U.S. government also supported the growth of venture capital by providing subsidies to small business investment corporations (Kenney and Florida 2000; Noone and Rubel 1970; Reiner 1989, chap. 5; Wilson 1986).
Meanwhile, also in the aftermath of World War II, Frederick Terman, dean of Stanford’s School of Engineering, espoused a vision of a high-tech industrial district, anchored by a major research university, in the area surrounding Stanford in Palo Alto, California (see Berlin 2001; Lécuyer 2000; Leslie and Kargon 1996; Saxenian 1994). During the late 1940s and the 1950s, in the context of Cold War military spending, many start-ups were spun off from Stanford, and many established industrial corporations set up operations in the area, transforming Palo Alto and its environs into a major center for microwave and aerospace technology (Leslie 2000). Semiconductors came to the West Coast in 1955 after William Shockley, an inventor of the transistor at Bell Labs and a preeminent solid-state physicist, failed to work out a deal to set up a semiconductor lab at Raytheon, a leading military contractor in the Boston area with close ties to MIT. Instead Shockley secured the backing of Los Angeles–based Beckman Instruments to set up shop close to Stanford.

In 1957, a little more than a year after being hired by Shockley, eight scientists and engineers—Julius Blank, Victor Grinich, Jean Hoerni, Eugene Kleiner, Jay Last, Gordon Moore, Robert Noyce, and Sheldon Roberts—left Shockley Labs in search of funding. As Kleiner wrote in a now-famous letter to his father’s broker at the New York investment bank Hayden Stone, they were looking for “a corporation interested in getting into the advanced semiconductor device business” in the lower San Francisco Peninsula (quoted in Lécuyer 2000, p. 163). At this time, there were some individuals involved in venture finance working for certain San Francisco financial institutions, most notably Reid Dennis of the Fireman’s Fund and an informal circle of friends (Dennis 2000, pp. 182–183), but there were as yet no firms on the West Coast specifically organized for the purpose of providing venture capital.

Kleiner’s letter asked where the “well-trained technical group” of Shockley defectors might get funding that “could get a company into the semiconductor business within three months.” The broker to whom the letter was written passed it on to Arthur Rock, a young Hayden Stone employee with a Harvard MBA. Rock had already been involved in the venture financing, IPO, and sale of an East Coast semiconductor company, General Transistor (Lécuyer 2000, pp. 163–164). Rock quickly responded, and after considerable time and effort, convinced Fairchild Camera and Instrument (a highly innovative company from
Long Island, New York) to fund Fairchild Semiconductor. The eight Shockley defectors each received a 7.5 percent equity stake in Fairchild Semiconductor, with Hayden Stone holding 17 percent, and the other 23 percent reserved for allocation in hiring new managers. The deal was structured so that, at its option, Fairchild Camera could buy out the shareholders for $3 million at any time before the semiconductor company had three successive years of net earnings greater than $300,000 or for $5 million if the option was exercised between three years and eight years (Berlin 2001, p. 76; Lécuyer 2000, p. 166).

Fairchild Semiconductor experienced almost immediate success. In early 1958 the new enterprise landed a subcontract with IBM for semiconductors for the Minuteman missile. In 1958 Hoerni drew on Bell Labs research to perfect the planar process for the manufacture of silicon chips. Building on this breakthrough, the following year Noyce invented the integrated circuit (Berlin 2001, p. 64). In two years, the semiconductor company had grown from 13 to 700 employees and was highly profitable. Its revenues for its second year through September 1959 were $6.5 million, 80 percent of which were military sales (Berlin 2001, p. 81). In October 1959, just two years after the launch of Fairchild Semiconductor, Fairchild Camera exercised its option to buy back the company for $3 million. The eight scientists and engineers who had founded Fairchild Semiconductor received publicly traded shares of Fairchild Camera and became employees of the company—that they once had collectively owned (Wall Street Journal 1959).

As for Arthur Rock, he was by no means finished with West Coast semiconductor start-ups or with the eight Fairchild Semiconductor founders. In 1960, while still a Hayden Stone employee, Rock arranged financing for two former executives of the West Coast conglomerate Litton Industries to launch Teledyne, a Los Angeles–based electronics firm. Rock remained actively involved in Teledyne’s affairs, and in 1961, Hoerni, Kleiner, Last, and Roberts left Fairchild Semiconductor to found Amelco as a semiconductor division of Teledyne. In the same year, Rock left Hayden Stone and relocated to the San Francisco area, where he quickly teamed up with Tommy Davis, a local financier with a legal background and links with Stanford’s Terman, to establish a venture capital firm, Davis and Rock. Among those who invested in the Davis and Rock venture fund were the eight Fairchild Semiconduc-
tor founders. When two of them, Moore and Noyce, decided to leave Fairchild in 1968 to found their own company, Intel, they turned to Rock for financing. Within days he had raised $2.5 million to fund the start-up (Perkins 1994; Wilson 1986, p. 38).

Rock was, therefore, a leading venture capitalist in both the first and second waves of Silicon Valley semiconductor start-ups. As shown in Figure 2.7, there was a coevolution between venture-capital firm entrants in the Silicon Valley region and semiconductor start-ups. As with the founding of semiconductor firms, the pattern of venture-capital firm entrants exhibits three waves of growing amplitude, the first around 1958–1962, the second around 1968–1972, and the third around 1978–1983. With the exception of Rock, however, who himself had become involved with West Coast start-ups while in the employ of an East Coast investment bank, there was little involvement of San Francisco Peninsula venture capital with semiconductor start-ups until the second wave.

**Figure 2.7 Coevolution of Venture Capital Entrants and Semiconductor Start-Ups in Silicon Valley, 1957–1983**

![Coevolution of Venture Capital Entrants and Semiconductor Start-Ups in Silicon Valley, 1957–1983](image)

That involvement picked up slowly in the middle of the second wave, and toward the end of the period the semiconductor industry began contributing some of its well-known executives to the venture capital industry. In 1972 Donald Valentine, an engineer who had been head of marketing at Fairchild before joining National Semiconductor in 1967, founded Sequoia Capital, which became one of Silicon Valley’s most successful venture capital firms. Also in 1972 Eugene Kleiner joined with HP executive Thomas Perkins to found a venture capital firm, Kleiner Perkins, which, renamed Kleiner Perkins Caufield and Byers in 1978, is commonly considered to be the exemplar of Silicon Valley venture capital. The firm’s offices were located in a still largely vacant new complex at 3000 Sand Hill Road in Menlo Park, adjacent to Stanford and with easy access to the San Jose and San Francisco airports (Lane 1994). Sequoia also located there, as did many other Silicon Valley venture capital firms and the Western Association of Venture Capitalists, out of which grew the National Venture Capital Association (NVCA) in 1973. The second wave of semiconductor start-ups, therefore, not only gave Silicon Valley its name but also laid the foundation for an organized venture capital industry.

In the 1980s technology-oriented venture capital firms had become integral to both Silicon Valley and NEBM. These firms were organized as general partnerships of venture capitalists who handled five duties: 1) raised funds, largely from institutional investors such as pension funds, universities, and banks; 2) reviewed and selected the particular portfolio of industrial ventures in which to invest; 3) maintained control over resource allocation to these ventures, including the staging of funding as the venture evolved; 4) maintained control over resource allocation by these ventures, including the hiring and firing of executive personnel; and 5) sought to realize returns to the venture capital fund through either an IPO of the stock of the venture-backed industrial firms or a mergers and acquisitions (M&A) deal with an already-established corporation. It was Silicon Valley practice, which became the standard for U.S. venture capital by the 1980s, for the general partners of the venture capital firm to receive, in addition to a 2 percent management fee, a “carried interest” of at least 20 percent of the returns of a particular venture capital fund that they raised, distributing the remainder to the institutions or individuals who, as limited partners, provided the general partners with the capital for the fund (see Sahlman 1990).
It was the innovative capabilities of the companies in which venture capitalists invested that created the value from which money could be made. By the 1970s, the microelectronics revolution had resulted in a growing range of business and household product applications, and, coming out of the semiconductor revolution, the Silicon Valley venture capitalists had become part of the regional institutional environment. What was needed now was an adequate supply of capital for the investments in new ventures that could take advantage of the plethora of technological and market opportunities that the microelectronics revolution had opened up. Over the course of the 1970s, a number of changes in U.S. financial institutions encouraged the flow of capital into venture capital funds, thus favoring the growth of Silicon Valley and NEBM.

The launch of NASDAQ in 1971, with its much less stringent listing requirements than the NYSE, made it much easier for a young company to do an IPO, thus enhancing the ability of venture capitalists to use this mode of exit from their investments. In 1971, for example, less than three years after being founded, Intel did its IPO on NASDAQ, with a loss before extraordinary items of $513,000, offset by a gain of $1,427,000 for “sale of manufacturing know-how,” for a net income of $914,000 (Intel 1973). Fourteen of the 20 New Economy firms in Table 1.7 are listed on NASDAQ: Intel (IPO in 1971), Applied Materials (1972), Apple Computer (1980), Microsoft (1986), Sun Microsystems (1986), Oracle (1986), Dell Computer (1988), Cisco Systems (1990), Qualcomm (1991), Sanmina (now Sanmina-SCI) (1993), EchoStar (renamed DISH Network in 2008) (1995), Yahoo! (1996), Amazon.com (1997), and Google (2004). The other six are listed on NYSE.

In 1975 the SEC barred stock exchanges from charging fixed commissions on stock-trading transactions, ending a practice that had prevailed on Wall Street since 1796 (Wall Street Journal 1974a). This change made it less costly for stock-market investors to buy and sell shares to realize capital gains as an alternative to holding the shares for the sake of a stream of dividend income. This change thus facilitated early IPOs of new ventures that were not yet profitable enough to pay dividends. It also favored the subsequent growth of the firm as a publicly listed company because of the willingness of capital-gains oriented stock-market investors to forego dividends, thus leaving more earnings in the company for internal investment.
In 1978, in response to intensive lobbying led by AeA and NVCA (both of which were dominated by Silicon Valley interests), the U.S. Congress reduced the capital-gains tax from as high as 49.875 percent to a maximum of 28 percent, thus reversing a 36-year trend toward higher capital gains taxes (Pierson 1978). In 1981 the capital-gains tax rate was further reduced to a maximum of 20 percent (Auten 1999). Venture capitalists saw lower capital-gains taxes as encouraging both entrepreneurial investment in new companies and portfolio investment by individuals in the publicly traded stocks of young, potentially high-growth companies.

During the 1970s, however, venture capitalists still faced constraints on the amount of money that they could raise for venture funds, mainly because of restrictions on their access to the vast accumulation of household savings held by pension funds. In the early 1970s, there was only a trickle of institutional money invested in venture capital, and even that flow dried up when the passage of the Employee Retirement Income Security Act (ERISA) in 1974 made corporations responsible for underfunded pensions and pension fund managers personally liable for breaches of their fiduciary duty to use the “prudent man” rule when making investments (Niland 1976). Under these circumstances, pension fund managers, who controlled the allocation of an ever-increasing share of U.S. household savings, avoided investment in venture capital funds. On July 23, 1979, however, the U.S. Department of Labor decreed that pension fund money could be invested not only in listed stocks and high-grade bonds but also in more speculative assets, including new ventures, without transgressing the prudent man rule (Ross 1979).

As a result, pension fund money poured into venture capital funds. Funds raised from pension funds (in 1997 dollars) by independent venture partnerships (the type that prevailed in Silicon Valley) were $69 million in 1978 (15 percent of all funds raised), $160 million in 1979 (31 percent), $400 million in 1980 (30 percent), and $421 million in 1981 (23 percent). By 1983, pension fund investment in independent venture partnerships had reached $1,808 million in 1997 dollars, of which private pension funds accounted for $1,516 million. Throughout the 1980s and 1990s, pension funds provided anywhere from 31 percent to 59 percent of the funds raised by independent venture capital
partnerships, which in turn increased their share of all venture funds raised from 40 percent in 1980 to 80 percent a decade later (Gompers and Lerner 2002, p. 8).

Like the reduction in the capital gains tax rate, the clarification of ERISA did not just happen. Both the venture capital community and the managers of large corporate pension funds lobbied the U.S. government for the relaxation of the strictures of ERISA (Avnimelech, Kenney, and Teubal 2005, pp. 200–201). For example, in 1998, the NVCA gave its first Lifetime Achievement Award to NVCA cofounder David Morgenthaler for his seminal efforts in leading the NVCA in lobbying for the capital gains tax reduction as well as for the clarification of ERISA (Morgenthaler 2008).

As another example, in 1994 Janet Hickey, now comanaging director of Sprout Group, a venture capital affiliate of Credit Suisse, was one of the first inductees into the Private Equity Hall of Fame for her lobbying of the U.S. Department of Labor to permit pension funds to invest in venture capital at a time when she was involved in the management of General Electric’s pension fund, one of the largest in the United States (Sprout Group 2009).

The massive infusion of capital into venture funds from the pension savings of U.S. households underpinned the third wave of entry of Silicon Valley venture capital firms. These venture capitalists in turn became much more active in funding semiconductor start-ups as well as those new firms producing the array of electronic products that silicon chips made possible. Semiconductor firms were supplying microprocessors and ASICs for a growing range of computer applications, which created a multitude of new opportunities in computer hardware and software that venture capitalists could fund, extending from video games and disk drives in the early 1980s to e-commerce and optical networking gear in the late 1990s.

Apple Computer's highly successful IPO in December 1980 is generally credited with setting off the start-up and IPO boom of the early 1980s. After achieving spectacular returns on its investments, averaging about 35 percent, between 1978 and 1983, the venture capital industry was punished for overinvesting, as its returns averaged less than 10 percent in the latter half of the 1980s. After 1990, returns moved up once again, soaring to almost 150 percent at the peak of the Internet boom before turning negative in the crash of 2001 and 2002 (Lerner 2002).
The Silicon Valley venture capital model spread to other parts of the United States, especially during the 1990s, with investments being made in many different locations and a wide range of industries. Measured in 2000 dollars, total venture capital investment in the United States rose from $9.1 billion in 1995 to $22.3 billion in 1998 before soaring to $55.9 billion in 1999 and $105.0 billion in 2000. After falling to $39.5 billion in 2001, venture capital investment averaged $21.4 billion per year from 2002 to 2007, including $25.3 billion in 2007 (or $30.5 billion in 2007 dollars; PricewaterhouseCoopers 2008b). Silicon Valley has remained, however, by far the world’s most important location for venture capital (Gompers and Lerner 2002, p. 14; Green 2004).

Over time there have been shifts in the leading sectors for venture financing. Office and Computer Machinery was the leading sector from the second half of the 1960s through the first half of the 1980s, before being barely surpassed by the Communications and Electronics sectors in the latter half of that decade. In the first half of the 1990s, Biotechnology became important (Gompers and Lerner 2002, pp. 12–13; Green 2004). If we consider Media and Entertainment investments to be Internet related, the average share of ICT in venture capital investment was 69 percent in 1996–1999, 71 percent in 2000–2003, and 54 percent in 2004–2007 (PricewaterhouseCoopers 2008b). The 17-percentage-point decline in the ICT share of investment in 2004–2007 compared with 2000–2003 has been more or less offset by an increase in the shares of Biotechnology and Medical Devices. In 2004–2007 Biotechnology absorbed 17.6 percent of venture capital investment and Medical Devices 10.9 percent.

The importance of telecommunications and networking as recipients of venture capital in the 1990s and beyond reflects the evolution of converged information and communication technologies out of what had been, in the absence of networking, just information technologies. The origins of this convergence go back to the early 1970s when, at Xerox PARC, the Palo Alto–based research arm of the Old Economy copier company, Robert Metcalfe led a team that developed Ethernet, a technology that enabled computers to communicate with one another (Hiltzik 2000, ch. 13). When Xerox declined to commercialize this technology, Metcalfe sought to do so by cofounding 3Com—which stands for “computer, communication, and compatibility”—in 1979. With the widespread adoption of the IBM PC from 1982 on, 3Com was
well positioned to be a leader in providing the hardware and software for local area networks (LANs).

After 3Com acquired the Silicon Valley company Bridge Communications in 1987, it became the largest supplier of LAN equipment, followed by Novell, based in Provo, Utah (Mulqueen 1989a). By this time, however, business, government, and nonprofit organizations that had installed LANs in geographically dispersed locations wanted bridges or routers that would link their LANs with wide area networks (WANs). The company that, by the beginning of the 1990s, was most successful in developing this internetworking technology was Cisco Systems.

In 1984 Leonard Bosack and Sandy Lerner, a husband-and-wife team, founded Cisco and initially ran it from their living room. While working in computing in different parts of Stanford University, Bosack and Lerner had been involved in the development of the university’s LANs and then had taken up the challenge of internetworking them. At the end of 1987, Cisco received an infusion of $2.5 million in venture funds from Sequoia Capital (Bellinger 1989; Mulqueen 1989b; Watson 1988). Yet with $10 million in revenues in fiscal 1988, venture finance was probably the least important of Sequoia’s contributions to the growth of the firm. The case of Cisco exemplifies the nonfinancial role of Silicon Valley venture capitalists in developing a promising start-up into a going concern. The Sequoia partner most actively involved with the young company was Donald Valentine, who became a member of Cisco’s board of directors. During 1988 Valentine directed the hiring of professional managers at Cisco, including John Morgridge as Cisco president and CEO. More generally, with over a quarter century of experience in Silicon Valley as first a semiconductor executive and then a venture capitalist, Valentine provided Cisco with business expertise that was based on an intimate understanding of the industrial environment in which the firm was trying to compete.

Morgridge stepped down as CEO in 1995 but remained Cisco’s Chairman of the Board until 2006. Valentine also remained a member of the board until 2006. Beyond the initial professionalization of the company in the late 1980s, Morgridge and Valentine oversaw the phenomenal growth of Cisco from less than $28 million in sales in the year ending July 1989 to over $22 billion in sales in the year ending July 2001. The ways in which Cisco financed this growth as a publicly traded company exemplify NEBM.
Cisco’s IPO in February 1990 netted the company $48 million which was used for working capital and cash reserves. Funds from operations easily covered the company’s capital expenditures, not only in 1990 but also for every subsequent year. During its 18 years of existence as a public company, Cisco has collected $18.3 billion from its employees as they have exercised their stock options, a result of the fact that the company uses its stock as a compensation currency. But Cisco has never done another public stock offering. Rather, as will be detailed in Chapter 6, Cisco has also used its stock as a combination currency, doing 81 acquisitions for $38.1 billion from 1993 to 2003, 98 percent of which was paid in stock.

Typifying NEBM, Cisco has never paid any dividends. Of the 20 New Economy companies listed in Table 1.7, only five are currently paying cash dividends on an ongoing basis: Intel since 1992, Microsoft and Qualcomm since 2003, Applied Materials since 2005, and Jabil Circuit since 2006. Another four have paid dividends sporadically: Apple from 1987 through 1995, Computer Sciences once in 1998, EMC once in 2001, and EchoStar one time each in 2004 and 2008. Like Cisco, the other 10 leading New Economy ICT companies have never paid dividends.

In all 20 cases, no distributions to shareholders were made during the early years as public companies; all earnings were reinvested in the growth of the firm. Once these New Economy companies had reached a certain level of maturity, however, most of them began to distribute cash to shareholders by repurchasing their own stock. For the decade of 1998–2007, five of the companies did repurchases in every year: Microsoft (a 10-year total of $87.2 billion), Intel ($53.0 billion), Dell ($28.1 billion), Oracle ($25.5 billion), and Applied Materials ($8.9 billion). Cisco did repurchases every year from 2002 to 2007 for a total of $43.1 billion. In 2007 13 of the 20 companies in Table 1.7 did buybacks, averaging $4.1 billion. As I show in Chapter 6, the sole purpose of stock buybacks is to boost a company’s stock price.

As we have seen in this chapter, the stock market played a major role in the emergence and growth of NEBM. As manifested by stock buybacks, by the 2000s, stock-price performance had become integral to the resource allocation decisions of top executives at these companies. In the boom years of the late 1990s, employees of these companies, as participants in broad-based stock-option plans, saw their com-
Compensation rise and in some cases soar as a result of the run-up in their companies’ stock prices. Stock repurchases redound to the benefit of these employees, but only if they can keep their jobs. The main issue for high-tech workers in the 2000s is employment security under NEBM. If, in the 1980s and 1990s, these workers had responded to the lure of stock-based compensation by eschewing secure employment in Old Economy companies for insecure, but potentially more remunerative, employment in New Economy companies, in the 2000s they would find that their ticket across business models had been one-way. By the 2000s, as we shall see in the next chapter, the leading Old Economy ICT companies had made the transition from OEBM to NEBM and in the process had put an end to the tradition of “the organization man.”

Notes

1. The first public use of the term “Silicon Valley” is credited to the journalist Don C. Hoefler in a series of articles that he wrote for *Electronic News* in 1971.

2. In 1986, however, amid the crisis among U.S. chip companies in the face of Japanese competition, AMD’s no-layoff policy came to an end (see *Electronic Times* 1986).

3. Semiconductor employees are in SIC 3674 (semiconductors and related devices) for 1994–1997 and NAICS 334413 (semiconductor and related device manufacturing) for 1998–2006. Software publishing employees are in SIC 7372 (prepackaged software, which includes software publishing and reproduction of software) for 1994–1997 and NAICS 511210 (software publishers) plus NAICS 334611 (software reproducing) for 1998–2006. The proportion of NAICS 334611 employees to all software publishing employees is small, ranging from a low of 0.73 percent in 2003 to 1.57 percent in 1997. For the matching of SIC and NAICS classifications, see U.S. Census Bureau (1997).

4. Since the mid-1990s, companies have reported not only the number of options exercised in any given year but also the weighted average exercise price (WAEP) of the options exercised. To generate these estimates of employee gains from the exercise of stock options, I assume that employees exercise options evenly over the course of the year in all months in which the highest market price of the stock is greater than the WAEP for the year. I then use the difference between the mean market price and WAEP during each such month to derive the gains over the course of the year, shown in Table 2.2. For Table 2.3, I use the highest monthly market price rather than the mean market price to calculate the average gains per employee in order to avoid biasing the calculations of relative gains from exercising options in favor of high top five/employee ratios. I am grateful to Yue Zhang for her assistance in developing these estimates.
5. In 1957 Boston-based ARD backed the founding of Digital Equipment Corporation, taking 78 percent of the ownership for a $70,000 investment (Wilson 1986, p. 19). When the eight defectors from Shockley Labs did get funding to start Fairchild Semiconductor in 1957, Fairchild Camera’s investment was $1.38 million. Even if these eight men had been willing to relocate to Route 128, it is unlikely that they would have been able to raise that kind of money through ARD.

6. The first firm in the San Francisco Peninsula devoted specifically to venture capital was Draper, Gaither, and Anderson (DGA), started in 1959; see BusinessWeek (1960), New York Times (1959), and Wilson (1986, p. 34). A product of the Cold War, DGA was founded by men who included two former generals in the U.S. Armed Forces, William H. Draper, Jr., and Frederick Anderson, and the former chairman of the Ford Foundation, H. Rowan Gaither, Jr., who was also the titular head of the committee that, in the wake of the Soviet launch of Sputnik in October 1957, produced the top secret Gaither Report, officially titled “Deterrence and Survival in the Nuclear Age,” to advise President Dwight D. Eisenhower on the capability of the United States to respond to a nuclear attack (see Halperin 1961).

7. See Rock (2000, p. 141): “The reason I got so excited about Fairchild Semiconductor was because I’d already been in the semiconductor business through General Transistor.”

8. The head of Fairchild Camera and Instrument, Sherman Fairchild, was no ordinary corporate backer. His father had been a founder and chairman of Computing-Tabulating-Recording Company, which in 1924 changed its name to International Business Machines. As a result, Sherman Fairchild ended up as IBM’s largest single shareholder. He also invented the aerial camera, founded Fairchild Camera in 1920, and founded Fairchild Aviation in 1925 (see http://en.wikipedia.org/wiki/Sherman_Fairchild).

9. In announcing that his company would exchange Fairchild Camera shares for all of the Fairchild Semiconductor shares, President John Carter said the expansion of Fairchild Semiconductor’s sales and profits would allow the company to grow without additional equity financing (Wall Street Journal 1959).

10. The company’s name, short for San Francisco, was actually spelled “cisco,” with a lower-case initial “c,” until it went public in 1990.