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Unbundling IBM

Antitrust and the Incentives to Innovation in American Computing

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Few American corporations of the twentieth century achieved greater notoriety than International Business Machines (IBM). Under the sustained leadership of Thomas J. Watson and his son Tom, IBM rose from a modest-sized supplier of punched-card accounting equipment in the 1910s to become the world's dominant supplier of electronic computers, the glamour product of the American Century. When the younger Watson relinquished the helm in 1971, IBM had the highest market capitalization of any American company.[1] Foreign governments strained to create their own champions capable of matching the American giant, while vanquished competitors such as General Electric and RCA left the computer market to Big Blue.[2] As further advances in hardware and programming drove computing down in price and size and brought it into a much wider realm of applications, IBM retained a powerful presence in virtually every segment of the broadening market. Its revenue and stock values soared ever higher for another two decades, until the early 1990s, when competitors from Asia and the West Coast seized the initiative and plunged IBM into the sort of crisis that had periodically plagued companies such as Ford.[3]

As IBM navigated a course through the startling technological transformations that have characterized modern information technology, it persistently faced a challenge that did not loom quite so large at Ford and some of the other firms studied in this volume: the threat of antitrust prosecution. In 1936, just months after IBM secured a major contract from the new Social Security Administration that would help make its punched-card equipment a ubiquitous feature of private and public bureaucracies, the Department of Justice won an antitrust suit against the company. As IBM vaulted to leadership in electronic computing during the early 1950s, Justice launched another investigation, which

culminated in 1956 with a comprehensive consent decree.[4] A decade later, with IBM still in the throes of executing the massive System/360 project that replaced its entire product line with machines built from solid state components manufactured in its own plants, Justice intervened once more. The resultant suit, one of the most significant in the annals of antitrust, lasted from early 1969 to 1982.[5] By the time a judge dismissed the suit as "without merit," IBM had successfully launched its widely heralded PC. Even when the firm's fortunes later turned sharply downward, antitrust remained a significant element in its strategic thinking. During the mid-1990s, IBM provided vital testimony on behalf of the Justice Department in its case against Microsoft, the company that had displaced Big Blue atop the industry. Meanwhile, IBM renegotiated its own agreement with government, which agreed to remove key provisions from the consent decree that had governed IBM's behavior since 1956.

The ongoing engagement between IBM and the Department of Justice bore many marks of an epic struggle between rival combatants. Antitrust is an inherently adversarial process. The elder Watson had once gone to jail for antitrust violations while employed at NCR. He brooked no compromise with the Department of Justice and castigated his son for negotiating a consent decree. The younger Watson implied in his memoirs that the stress of countering the suit launched in 1969 and several accompanying private antitrust actions contributed to the heart attack that forced his early retirement as CEO.[6] IBM spent a small fortune defending itself against these claims, as legions of lawyers and economists on both sides devoted years of their professional lives to the cases.

For all the persistent combativeness, however, relations between IBM and the Department of Justice never devolved into a simple doctrinaire feud between habitual adversaries. Government and corporation did not wage some sort of grand battle over the virtues of *laissez-faire*. The disputes and their resolutions turned upon more nuanced considerations. At root, they involved complex questions regarding the ways in which market structure and firm organization shaped incentives and promoted or impeded technological change. The antitrust cases involving IBM essentially provided a forum in which lawyers, economists, and other experts actively worked through the issues that animate this book. The exercise was, of course, far from academic. The immediate economic stakes were large. Yet the cases also served as an extended learning experience—a sustained laboratory experiment, in a sense—through which a large community of participants and observers came better to understand the nature of innovation and the role of the large firm in the innovative process.

At issue, from the first dispute of the 1930s through the Microsoft case, was a fundamental set of business practices that the elder Watson had instilled upon his arrival at IBM in 1914.[7] Those practices were aimed at providing com-

prehensive services obtained from tightly integrated systems. At the heart of these systems stood a proprietary technology, known as the accounting machine in the electromechanical age and later as the central processing unit (or CPU) during the computer era. Attached to it were an array of peripheral devices, including readers to input stored data and printers to present results in various forms. The separate components in an installation were linked through distinctive means—by punched cards of unique format in the electromechanical era, and later by exclusive input-output channels and software programs known as operating systems—over which IBM also retained close proprietary control. The precise mix of devices varied from customer to customer, as IBM representatives in the field worked to tailor each system to the needs of the particular client. IBM technicians visited these sites regularly, in some cases maintaining a virtually constant presence, in order to keep the equipment running and to devise further uses for it. This package of equipment and services came at a single comprehensive price, unique to each installation. For many decades, such prices were expressed strictly in terms of a monthly rental charge, as IBM in all cases retained ownership of the equipment and leased it to customers. The practice remained common even after the 1956 consent decree required IBM to sell as well as lease its products.

Antitrust proceedings against IBM aimed at breaking apart this integrated approach to conducting its business. Both government and private litigators sought to compel IBM to separate the various components of its bundled products and services, to make each available independently from the others, and to set distinct prices for each of them. Though the specific remedies varied from case to case, as technology changed and antitrust doctrine evolved, this was the persistent objective. IBM's adversaries in the antitrust arena looked to "unbundle" the components and services that made up the integrated systems. They sought to establish clearly defined targets of modest scope at which competitors could take aim. Their objectives paralleled precisely those pursued more recently by government prosecutors, and by IBM itself, when they attempted to force software giant Microsoft to draw clear boundaries between its operating systems and applications software.[8]

In pursuing this course, government grappled with problems that were quite familiar to IBM itself. Managers such as the younger Watson worried incessantly about how to establish accountability and to foster incentives to innovate within sprawling yet highly integrated operations. To this end, they reorganized IBM with astounding frequency, redrawing its internal boundaries in ways that realigned incentives. The wisdom of bundling various products and services recurrently came under close scrutiny. Managers, like government officials, struggled continually to assess trade-offs between standardization and product

differentiation. Both groups worried about whether research should be coupled tightly to specific product development efforts or whether researchers should be given broad leeway to pursue innovation and then license their results widely.

It would be a gross distortion, of course, to characterize IBM management and antitrust officials as working in partnership. IBM certainly would have preferred to operate without such oversight, to be left free to redraw its boundaries as it saw fit. The company fought hard to retain such autonomy. Yet at many points in the process, government and the firm actually moved in symphony. At times, government pushed IBM in directions its management hoped to go. The company's enduring record of success resulted in no small measure from its ability to recognize the commonalities and to engage the process constructively.

ANTITRUST DOCTRINE THROUGH MID-CENTURY

IBM began its long engagement with antitrust in the mid-1930s, at a time when its fortunes otherwise ran high. Though rental income dipped slightly following the Crash of 1929, business demand for punched-card equipment soon stabilized, as firms seeking paths to recovery frequently revamped their accounting procedures. New government programs mandating standard reporting of data further stimulated demand. A federal contract to manage information for the new Social Security Administration, secured in 1935, soon accounted for a significant portion of IBM's rising revenues. Watson's profit-sharing agreement made him the nation's highest paid business executive.[9] Such conspicuousness attracted scrutiny. The Department of Justice took IBM to court in May 1936. Sixteen days later, a panel of justices returned a resounding verdict against the company.[10]

The central issue in this case involved IBM's practice of requiring customers who leased its machines to purchase punched cards from IBM. Government prosecutors complained that the provision constituted an illegal "tie" that enabled IBM to earn inordinately large returns from sales of cards to customers who were effectively held captive by the lease agreements. To support their claim, prosecutors noted that the federal government itself, when contracting with IBM for services associated with Social Security and other programs, had secured a special agreement under which it could manufacture its own cards in the standard IBM format. Lawyers for IBM countered that the company must maintain control over cards in order to ensure quality, thereby keeping its leased machines in good working order and preserving its reputation for reliable performance. The government production facility, defense attorneys suggested, would utilize manufacturing equipment supplied by IBM and operate under the watchful eye of its technicians. Paper for the cards would come from

suppliers approved by IBM. A skeptical court, noting that government had agreed to pay substantially higher rental charges in order to gain the privilege of producing its own cards, shrugged away the arguments about quality control. IBM could achieve the same end, judges asserted, by publishing technical standards for cards. The court ordered IBM to drop the card purchase requirement and compelled the firm to assist alternative suppliers of cards in starting production facilities that would compete with IBM's.[11]

In taking these steps, the court drew upon economic reasoning that had long informed antitrust law. Advocates of antitrust activity had persistently tried to restrict firms from leveraging their monopoly control of patented technologies by tying additional products and services to those patented techniques. Concerns about such practices extended back to the very origins of the Sherman Act in the late nineteenth century, when public resentment toward patent monopolists such as the Bell telephone interests ran strong.[12] When Congress revised the antitrust statutes in 1914 with passage of the Clayton Act, Section 3 expressly condemned tying contracts requiring consumers to acquire one product or service with the purchase or lease of another.[13] Conspicuous cases involving the motion picture industry and the United Shoe Machinery Company gave the measure teeth.[14] A supplier such as United Shoe might legally assemble a portfolio of patented machines, the Supreme Court ruled, but it could not prevent lessees of one machine from utilizing others supplied by competitors. Each product must stand on its own merits. Judges cited the case liberally in reaching their quick judgment against IBM. Beyond its immediate potential effects on revenues, which in some recent lean years had come largely from cards, the ruling thus put IBM on guard about its essential business strategy of marketing integrated systems.[15]

Although the judgment against IBM drew upon established precedent, it came at a time when questions about patent monopolies had acquired new prominence. Corporate research facilities at firms such as Du Pont, General Electric, and AT&T had assembled large patent portfolios during the 1920s and early 1930s. In some instances, these firms had entered into controversial patent pooling agreements, through which they shared rights to patents covering such conspicuous consumer technologies as paints, gasoline additives, electric light, and radio. Always suspect, these pooling arrangements came under increasing scrutiny during the long Depression decade. Early in the Depression, most discussion of technology focused on the possibility that investment in industrial technology had generated oversupply and unemployment. Such thinking ultimately fed into Keynesian economics, with its emphasis on macroeconomics and stimulation of demand through fiscal policies. By the mid-1930s, however, a substantial contingent of economic observers had come to consider the possibility

that the real failure of capitalism lay with its inability to generate sufficient innovation and foster new areas of enterprise. The corporate patent pools came under attack for allegedly suppressing innovation by clogging the paths of independent inventors who might pursue more radical change.

As the Depression persisted, this line of reasoning gained influential footholds within Congress and the Roosevelt administration. Pressured by Congress, the Federal Communications Commission (FCC) conducted a prominent inquiry into the pooling of patents pertaining to radio. At the Department of Justice, FDR appointee Thurman Arnold deployed the tools of antitrust against the patent pools. Arnold lent his support to the radio investigations, spurring an ultimately successful private antitrust action by upstart Zenith, and pursued a highly visible case against petroleum and chemical interests who had pooled patents to form the Ethyl Corporation.[16] In December 1938, Arnold secured another platform when he joined the Temporary National Economic Committee (TNEC). Convened jointly by the Roosevelt administration and Congress and commonly referred to as the Monopoly Committee, this group immediately cast its investigative eye on the patent pools, which FDR had expressly identified as one of three principal areas of concern.[17]

Patent pools drew such ire in part because they seemingly provided a ready subterfuge for cartel behavior. By artificially adjusting prices for shared intellectual property rights, skeptics argued, parties to these agreements effectively fixed prices for final goods and services. Such suspicions enjoyed widespread currency in the economics profession of the 1930s, much of which fully embraced antitrust as an appropriate remedy for horizontal alliances aimed at price-fixing.[18] Those looking to limit such opportunities for subterfuge often pushed for reforms that would curb the numbers of patents granted. Growing numbers of observers also embraced the idea of requiring patent holders to license their patents to anyone willing to pay a reasonable fee. Mandatory licensing, which various parties had proposed since the late nineteenth century, became a central objective of Arnold and his reinvigorated antitrust initiative.[19]

Calls for patent reform and mandatory licensing met with intense resistance from many quarters. Corporate research directors such as Frank Jewett of Bell Labs fought mandatory licensing at every turn. Jewett and many others defended strong patent rights as an essential component of the dynamic, innovation-based competition that economists such as Joseph Schumpeter heralded as the essence of modern economic life. In his *Capitalism, Socialism and Democracy*, Schumpeter dismissed antitrust as irrelevant, because it focused not on emergent new industries but on static competition in highly developed markets for stable goods. In tempering the effects of price competition in established markets, antitrust simply forestalled the day when firms faced the crises

that might stimulate transformative innovative activity. Companies would take such bold steps, moreover, only if assured the prospect of recouping monopoly profits for some time after expending their effort and investment on innovation. Growth occurred through the ongoing struggle to derive monopoly returns from the creation of distinctive assets providing at least temporary barriers to entry. Patents offered an essential means of establishing such barriers.[20]

Even many advocates of dynamic competition, however, harbored doubts about whether the patent system functioned in quite such benign fashion in a world increasingly populated by highly organized research institutions. The brilliant young economist Alfred Kahn, who would later become a prominent figure in the campaign for government deregulation, wrote an influential essay in 1940 portraying the corporate patent pools as necessary evils forced upon innovative corporations by an anachronistic patent system. In assigning rights so indiscriminately to every little improvement, the patent system clogged the modern mechanisms of technical advance, which relied upon a broad-based cooperative effort conducted by organized research laboratories operated by firms, universities, and government. Companies looking to commercialize particular improvements derived from the collective effort simply must pool their patents, Kahn argued, or risk having their creations blocked by others claiming patent infringement. Convinced that the barriers erected by the patent system thus worked against innovation, Kahn called for sweeping reform of the patent system. Failing that, he embraced antitrust as a means of ferreting out those who abused patents and impeded technical change.[21]

Similar strains of ambivalence came from no less a figure than Vannevar Bush, the former dean of engineering at MIT, who came to Washington in 1939 to head the Carnegie Institution and direct FDR's wartime science policy.[22] Like Kahn, Bush stressed that technological innovation had necessarily taken on an increasingly collaborative character. Corporate laboratories had emerged in response to the changing nature of the innovative process, and they were now indispensable to it. But Bush, who had seen some of his own early inventions absorbed into the corporate morass, also insisted that small firms and entrepreneurs must always remain vital to the process as well. So too must the large cohort of independent scientists and engineers working in American universities.

As Bush orchestrated the federal government's massive wartime investment in research and development and contemplated the shape federal support for science and technology should take after the war, the issue of who should take ownership of the fruits of collaborative research grew ever more prominent. A 1945 report issued by Roosevelt's National Patent Planning Commission, which included famed research director Charles Kettering of General Motors and

president Owen Young of General Electric, managed to squelch the TNEC proposal for mandatory licensing but failed to suppress the idea entirely.[23] When Bush pressed Congress to create a permanent National Science Foundation, skeptics wondered who would own rights to patents generated through its activities. Firmly committed to private enterprise, whether large or small, Bush successfully resisted proposals that government itself should retain rights to such patents.[24] In securing this triumph, however, he may well have lent further momentum to the cause of compulsory licensing of corporate patents, because the laboratories generating those patents might now be perceived as having benefited substantially from public funds. Massive spending by Cold War defense agencies, much of which also flowed to corporate research programs, only reinforced the perception.

A decade after the first antitrust ruling against IBM, the idea of using antitrust law to curb patent rights thus steadily gained momentum. As efforts to reform the patent system languished, a spate of developments in antitrust law filled the void. In a major case launched during the war, the Supreme Court in 1947 embraced DOJ reasoning that effectively established a clear *per se* rule banning ties involving patented technologies.[25] Other cases sought to fix universal principles establishing that dominant firms necessarily abused their market power when they deployed certain types of leveraging tactics.[26] A new suit against United Shoe, ultimately resolved in the DOJ's favor in 1953, banned the firm from bundling free service with leases for its patented equipment.[27] In 1950, Congress weighed in with the Celler-Kefauver Act, which severely constrained the freedom of dominant firms to acquire others.

Bolstered by what observers came to refer to as the New Sherman Era, Thurman Arnold and his allies at the Justice Department began to negotiate consent decrees requiring some of the most prominent firms in the United States to license their patents. One of the first and perhaps the most famous of these actions involved AT&T and Bell Laboratories. Launched in January 1949 and culminating with a consent decree signed seven years later, this suit marked a fateful turn in the ongoing controversies that had swirled around the telephone monopolist since its founding three quarters of a century before. The Labs would now function as something like a public resource, providing the fruits of science and technology at minimal cost in exchange for AT&T continuing to enjoy a virtual monopoly in telephone services.[28] Serendipitously, the onset of the investigation coincided almost precisely with Bell Labs's announcement of its revolutionary new electronic component, the transistor. As a good faith gesture, AT&T agreed to make the transistor and other solid state technologies available to anyone willing to pay a $25,000 license fee, years before the final consent decree imposed mandatory licensing of all patents emerging from the Labs.[29]

This stream of developments in antitrust law had a profound impact on IBM. Like so many other institutions in the United States, IBM had been transformed by World War II. Demand for its traditional products soared, as the military draft, weapons procurement contracts, and a greatly expanded income tax system all generated record-keeping requirements of staggering proportions.[30] Annual net income grew nearly threefold over the course of the war, topping $36 million in 1945, when the value of IBM's installed base of rental equipment reached more than $115 million.[31] Confident that customers had grown accustomed to IBM equipment and would soon find additional uses for these systems, Watson authorized design of a new generation of accounting devices utilizing a punched card of larger format.

The war and its aftermath left IBM in healthy financial condition, but they also presented the firm with a new set of challenges. Wartime projects had rapidly pushed back the frontiers of advanced calculating among scientists and engineers. Several projects utilized state-of-the-art electronic and magnetic devices to store and manipulate arithmetical information in novel ways. Such developments held obvious implications for IBM. Anyone doubting this needed only to follow the well-publicized exploits of J. Prespert Eckert and John Mauchly, the University of Pennsylvania professors who had headed the effort to create the Electronic Numerical Integrator and Calculator (known as ENIAC) used to calculate ordnance tables. Shortly after the war, the two resigned their university posts and boldly announced that they would sell a revised version of ENIAC for use in the business world. They targeted major banks and insurance companies, long some of IBM's most prestigious and lucrative accounts.[32]

The handful of electronics engineers employed by IBM, most of whom had temporarily left the firm for wartime defense assignments, operated in the shadows of a research and manufacturing culture in which a mechanical engineering ethos held sway. They returned to IBM humbled by their limited understanding of electronics and daunted by its vast potential. Their wonder and discomfort only grew when Bell Labs announced in 1947 its discovery of the solid state transistor, a device which promised to substitute for the expensive and troublesome vacuum tubes that constituted the backbone of most electronic circuits.[33]

Although electronics certainly posed a formidable challenge that IBM could not long ignore, the rapidly emerging technology did not plunge the company into immediate crisis. IBM was not facing the sort of emergency that confronted the Ford Motor Company during its postwar reconversion to civilian production or the oil shocks of the 1970s.[34] Advanced electronic calculating

presented an opportunity for growth in an emergent market of scientists and engineers.[35] Outside this niche, in realms where performance was judged across a broader range of criteria than mere calculating speed, electronics still had a great deal to prove. Eckert and Mauchly would need to achieve considerable economies in order to make a machine developed under the largesse of a military contract pay dividends in the commercial marketplace. Neither Eckert and Mauchly nor anyone else engaged in the field of advanced calculation, except IBM, possessed the established capabilities in manufacturing and service necessary to accomplish that sort of refinement. Those competitors, moreover, faced just as daunting a challenge as IBM in trying to stay abreast of further developments in electronics.[36]

As IBM plotted its course into the world of electronics, the firm thus found itself in a curious position. Seizing the new opportunity within the scientific and engineering market called for highly entrepreneurial activities of a sort often associated with small startup organizations. Thomas Watson turned the task over to his eldest son, an unseasoned executive who had just returned from military service and was looking to gain additional managerial experience.[37] Yet IBM was not a small entrepreneurial firm. In its established realm of punched-card data processing, IBM operated as a dominant firm whose presence had grown ever more prominent, despite efforts to tame it through antitrust.

As much as the younger Watson might have wished to pursue electronics and scientific calculation free of antitrust concerns, in open competition with startup firms such as Eckert-Mauchly and Engineering Research Associates, such a course was effectively foreclosed to him. IBM's increasingly dominant position in the commercial sector made it highly vulnerable to the new antitrust regime. The company soon discovered, moreover, that it could not so readily insulate its entrepreneurial activities from its established commercial activities. Over the long run, both old and new equipment were destined to share a common technical underpinning in electronics. Lessons learned on the entrepreneurial side might well make their way into the established commercial line. That certainly was young Tom Watson's fervent hope. Along the way, those entrepreneurial activities in turn drew considerable strength from business practices developed on the commercial side. Developed routines in areas such as manufacturing, customer service, and field engineering provided vital assistance that often gave IBM a crucial advantage over its rivals in emergent markets.[38]

This convergence might have unfolded quite gradually, over the course of a decade or longer, if not for the bold aggressiveness of Eckert and Mauchly. In late 1947, the upstarts secured a design contract from Prudential Insurance, one of IBM's largest customers and also its sole lender. Two years later, Pru-

dential contracted with Eckert-Mauchly for an electronic computer utilizing data inputted from magnetic tape. Use of tape for data storage threatened to displace the bays of punched cards that had long kept customers such as Prudential so dependent upon IBM.[39]

As a galvanized IBM scrambled to plot a response, its management received a sharp lesson about how antitrust would shape its freedom of action. Eckert-Mauchly, despite securing support from Prudential, still found itself woefully short of funds necessary to carry out its contracts. Its founders actively sought a more experienced suitor with ready access to capital. Tom Watson met with the inventors to discuss a buyout, but he soon abandoned the idea after consulting with lawyers at IBM and the Justice Department.[40] At the time, Congress was about to pass the Celler-Kefauver Antimerger Act, which severely curbed acquisitions by firms with large market shares.[41] Rebuffed by Watson, Eckert-Mauchly turned instead to Remington Rand, IBM's longtime chief competitor in the commercial data processing sector. The Justice Department gave its imprimatur to that merger and also permitted Remington Rand to acquire Engineering Research Associates, a startup company that had provided IBM with some of its stiffest competition in the market for scientific and engineering computing.[42]

These steps by its major competitor and by the Department of Justice sent clear notice to IBM that electronic calculating and computing fell within the broader orbit of its established business activities. Yet in so doing, they ironically reinforced the very message Tom Watson himself was struggling to promulgate within IBM. Frustrated with slow progress in electronics, Watson in 1949 had pledged to the IBM salesforce that within a decade all IBM products would be built exclusively from electronic components. In cutting IBM off from the option of acquiring expertise in electronics in wholesale fashion through merger, while allowing its principal competitor to exercise that option at will, Justice also lent further urgency to the younger Watson's insistence that IBM must reorient its own internal research and development efforts around the new technology of digital electronics. At the dawn of the electronics age, government pushed IBM in directions in which it was itself straining to move.

As the younger Watson orchestrated IBM's transition into the new era under the ground rules established by Justice, he and his colleagues found they could draw on a variety of outside sources of expertise through means other than outright merger. At the earliest opportunity, for instance, IBM sent personnel to seminars in solid state electronics offered at minimal charge by AT&T under terms of its consent decree.[43] It hired skilled personnel from RCA and other electronics companies who also benefited from knowledge promulgated by Bell Labs.[44] Later in the decade, as new startups gained the upper hand in semiconductor

production, IBM entered a critically important joint agreement with Texas Instruments. By guaranteeing TI large purchases of electronic components and providing it with technical assistance in circuit assembly technology, IBM obtained expertise in silicon devices that proved vital to the System/360 line of computers introduced in the mid-1960s.[45]

Another avenue open to IBM was defense contracting. Watson turned aggressively in that direction during the early 1950s, as defense spending surged with the escalating arms race and the onset of conventional military action in Korea. Spillovers from these projects occurred more slowly than Watson had imagined, however, and in some cases left IBM embroiled in expensive patent disputes with fellow contractors.[46] More modest development projects, funded internally and aimed at established markets, often generated surprisingly robust returns. These successes drew extensively upon skills and business practices that antedated the rise of electronics. The ability to mobilize and coordinate a broad range of ongoing activities, including systems assembly, maintenance, and custom programming at the site of customers, loomed large. Such competencies, perfectly suited to the vaunted salesforce the elder Watson had always considered the heart of IBM, were useful even in the rarified realm of military contracting. IBM secured such contracts in large measure because it knew how to close a deal and keep a customer satisfied.[47]

As with the Social Security contract in the 1930s, success in winning government business apparently came at a price in the antitrust arena. The advantages IBM derived from its established business practices generated complaints from its competitors and scrutiny from the Department of Justice. In January 1952, the guillotine fell. The Department of Justice filed suit. While publicly vowing to fight the claim, the younger Watson negotiated with Justice, over the strenuous objections of his father.[48] When the Supreme Court ruled against United Shoe in 1953, in a case which again had close parallels to that against IBM, government clearly held the upper hand. In 1956, the same year his father died, Tom Watson entered into a formal consent decree with the Department of Justice.[49]

GOING IT ALONE: THE 1956 CONSENT DECREE AND THE BIRTH OF SYSTEM/360

The 1956 decree bore marks from virtually every arrow in the antitrust quiver. Revisiting the principal matter from the 1936 case, it called for IBM to take concrete steps to ensure that competitive card manufacturers entered the field, so that IBM would have less than 50 percent of the market for cards. New clauses took direct aim at IBM's core business practices. IBM agreed to sell as well as lease its products and to set distinct prices for the various devices and routine services, such as regular maintenance, that constituted its integrated

systems installations. All of this paralleled the latest ruling against United Shoe. In an added wrinkle, IBM would be required to set up an independent service bureau, not for the purpose of maintaining its machines but to develop and market data processing applications using IBM equipment. The clause establishing the service bureau marked an early effort to separate hardware from software, before the latter had come fully into the consciousness of either IBM or its customers.[50] Last but not least, IBM also agreed to license its proprietary technologies for reasonable fees, while paying rival Remington Rand substantial licensing fees for its patents.

Although many of its details were new, the 1956 consent decree reflected the persistent concern that had informed discussions of antitrust, patents, and innovation during the previous half century or more. Every element of the decree sought to isolate the various technical components that made up an accounting or data processing system, to force IBM to make each stand on its own merits and to give competitors clear targets at which to focus their own efforts. The clause regarding licensing of technology pushed this vision further up the innovative pathway. Competition would not occur merely at the machine level; it would at least to some degree involve individual components and processes that went into the machines themselves. Stipulations regarding maintenance charges and the service bureau would impose the same philosophy but work in the opposite direction, toward applications in the field at customer installations. The unifying goal of government was to draw clear boundaries among the various machines and activities that together composed an integrated data processing operation.

In placing such emphasis upon boundary-making, antitrust activity once again mirrored to considerable degree concerns that already occupied Tom Watson himself. At the time he consented to the decree, Watson was struggling to reorganize IBM's internal operations. In 1956, he broke the firm into divisions responsible for various products. Three years later, he dramatically reshuffled those divisions, added a new one responsible for developing advanced systems applications, and created a new level of "group executive" responsible for certain clusters of products.[51] In the interim, IBM announced the creation of its first central research facility.[52] Early in 1961, the firm added a Components Division. Distinct from Research, it would supply basic electronic circuits for all IBM machines produced by the various product divisions.[53] Those product divisions, throughout all the reshuffling, shared a common sales organization that stretched across the entire firm.

This incessant organizational churning reflected IBM's ongoing concern about how best to stimulate technological learning and product innovation. Watson and others within IBM worried that a project-based approach, in which contractors essentially funded learning and innovation through purchase of

state-of-the-art systems, had not yielded the widespread benefits they desired. Three years into the initial reorganization, the division responsible for these high-end projects had absorbed some 70 percent of IBM's engineering resources, while generating just 30 percent of its revenue.[54] Those projects, moreover, contributed little innovation of obvious utility to the divisions that earned the lion's share of revenue by providing serviceable computer systems to the broad business and educational markets. Neither branch of IBM, moreover, appeared willing to undertake dramatic forays into advanced solid state technology that Watson and many other observers considered essential to sustaining leadership in computing.[55]

At root, these matters involved nagging questions about incentives and accountability. Stand-alone product development projects, aimed at a particular segment of the commercial market, offered a high degree of accountability. But by targeting limited markets, such projects generated little incentive (or resources) to take bold steps at innovation. High-end projects focused on enhanced technical performance, in contrast, tended to lack economic discipline and ultimate accountability. Susceptible to large cost overruns, they rode off of the faith that they would generate useful spinoffs.

One solution to this dilemma was to create a centralized research function, independent of any particular product development effort, with a clear mandate to generate bold but useful innovation that divisions could draw upon when developing new products. But how, under such an arrangement, could IBM maintain accountability within either the centralized research facility or the product programs that drew upon it? What would keep some product programs from acting as free riders, collecting the fruits of the centralized effort without shouldering their fair share of the cost? And what would keep centralized research from going off in directions that favored one division over another, or even worse, none at all?

Such questions tormented Watson and IBM during the late 1950s and early 1960s. Announcing the 1959 reorganization, Watson described the prevailing practice as "management according to who shouts the loudest."[56] He hoped the new organizational arrangements would create a less capricious mechanism. Within a year, however, such issues again reached a crescendo as IBM contemplated creating its Components Division.[57] Some managers complained vigorously that requiring divisions to obtain essential electronic building blocks from a common internal source would undermine their autonomy and with it their accountability. For a time, top management seriously entertained the idea of having the new components division sell its products in the open market. Outside sales, in addition to building volumes and spreading capital costs, would provide a check on the division's performance and establish a value for its offerings.

At this point, antitrust considerations appear to have substantially influenced Watson's course of action. If IBM chose to sell components on the open market, Watson and his management team realized, it must under terms of the consent decree agree to license the techniques involved in component production to outside parties. Components would, like peripheral devices, become susceptible to direct competition from outside providers. Such licensing ran directly against the purposes of IBM's backward integration into components production, through which IBM aimed to recapture the initiative from Texas Instruments and other electronics firms as technological change forced a convergence between components production and systems design. If IBM wished to integrate backward, then, it must do so definitively and develop close ties between its new capabilities in components and its production of "boxes" such as central processors. It could not go halfway. In the end, Watson authorized the Components Division without fully resolving the issues of accountability.[58]

The tension over components was a particularly dramatic example of a more general phenomenon. In creating divisions charged with producing systems for different segments of the market for computing, IBM ran considerable risk of duplicating its engineering efforts. This possibility existed not only with regard to basic electronic components but also in other areas such as input-output devices and applications programming. In these realms, too, IBM felt mounting incentives to concentrate its resources upon common products that might be used across a range of systems. In addition to reducing development and manufacturing costs, standardization in these areas might generate significant economies in sales and service.

The lure of standardization ultimately prompted IBM to embark on development of a comprehensive new product line. Eventually known as System/360, it featured a series of central processing units built from common components. These processors would possess "compatibility," by which IBM meant that they could run common applications programs, with higher-performance machines executing the routines faster. To every extent possible, these systems would utilize common input-output devices such as card readers, disc and tape drives, terminals, and printers. Though they were initially slated to appear over the course of some eighteen to twenty-four months, IBM ultimately introduced most of the line at a single blockbuster announcement in April 1964.[59]

THE COMPLEX LEGACY OF SYSTEM/360

System/360 has been widely heralded as one of the boldest and most successful strategic initiatives in the annals of American business.[60] Many observers have echoed a famous contemporary article from *Fortune* magazine, which dubbed

it a "$5 billion gamble" because IBM had "bet the company" on a single product.[61] With System/360 leading the way, IBM's revenue and profits jumped to new heights. In 1969, worldwide revenues topped $7 billion and generated net income of nearly $2 billion, double the levels of 1965.[62] In its wake, foreign governments in Europe and Asia scrambled to create firms that could imitate IBM's success.[63]

In the eyes of some influential observers within IBM itself, however, System/360 was hardly an unmitigated triumph. The announcement plunged the firm into a state of crisis. Delays at facilities responsible for component production and circuit assembly created a massive scheduling problem with ramifications across the entire line. Programmers missed deadlines and accumulated alarming cost overruns as they struggled to achieve the promised compatibility while also scrambling to accommodate new applications such as time-sharing, which the salesforce had promised to dissatisfied customers. By early 1966, Watson had placed the entire program in the hands of an emergency management team. Headed by future CEOs Frank Cary and John Opel, this small group of executives imposed order over existing operations while also contemplating the lessons for the future. Its basic recommendation was neatly captured in the mantra, "Never Again."[64]

Criticism of System/360 went beyond the immediate difficulties of delivering products to market. Skeptics such as Cary and Opel also questioned the strategy System/360 embodied. Architects of that strategy had tried to address multiple concerns in one fell swoop. By relentlessly pursuing modularity in hardware and compatibility in software, they sought to gain the economies of Fordist mass production, without turning the computer industry into strictly a commodity business. IBM would continue to provide distinctive systems to each customer, only now, those systems would be assembled from common building blocks and would run common programs. By imposing this change across the entire line and building large volumes, IBM would be able to concentrate its resources and take a leap forward technologically, while also establishing a new hegemonic design. Customers would make a wholesale transition to the new system in order to gain the substantial advantages of the technological leap. Once having done so, customers would remain captive to System/360, as its modularity and compatibility enabled them to add computing capability more readily and cheaply than through any other alternative.[65]

Holes in the strategy came to light almost as soon as IBM announced the new line.[66] Customers at the lower end of the performance spectrum looked for incremental improvement rather than the clean break IBM had desired. They pressured IBM to offer an emulator program that would make System/360 compatible with previous generations of equipment, including machines recently introduced by major competitors. Meanwhile, users at the higher end

complained that System/360 failed to meet their needs. Rival Control Data Corporation (CDC) won prestigious contracts for a new top-of-line computer for use in advanced scientific applications.[67] Another gap in the System/360 line opened when rivals began offering popular time-sharing systems, which allowed several operators to utilize a single central processing unit at the same time.[68] Much to Watson's chagrin, IBM could not meet either challenge without substantially modifying System/360 hardware or software.

The sudden rise of time-sharing also exposed the risks inherent to modularity. Time-sharing systems effectively shifted computing expenditures away from central processors and toward peripheral devices such as terminals, storage systems, and printers. Under terms of the 1956 consent decree, IBM had to permit customers to obtain these stand-alone, "plug-compatible boxes" from rival manufacturers. The modular design of System/360 had made it easier than ever for potential rivals to exploit such opportunities and drive down the cost of individual boxes. Any attempt to deviate from easy interconnectivity, say by designing a time-sharing system that utilized distinctive programming channels housed in each of the attached boxes, would undoubtedly be seen as an effort to retard the growth of plug-compatible manufacturers and would almost certainly arouse further scrutiny under antitrust law.[69]

And, sure enough, antitrust action soon followed. CDC sued, claiming IBM had prematurely announced what amounted to a phantom machine intended to stave off competition at the high end. Its lawyers quietly collected a book of case histories documenting how the IBM salesforce had strained to retain valued accounts through dubious practices, including exaggerated claims and provision of free services. Other firms launched private suits over time-sharing and peripherals. Most important of all, the Department of Justice itself again began investigating IBM. By late 1967, Watson once more found himself considering how to avoid a major government antitrust suit. Only this time, to his shock and disgust, Watson failed. In January 1969, on the last day of the Johnson administration, government brought suit. Amazingly, the suit would stretch across more than a dozen years. It ended about the same time John Opel succeeded Frank Cary as CEO. During his nearly decade-long tenure, Cary would never know a day without the suit.[70]

The government antitrust action, though vigorously contested by Cary and ultimately dismissed as without merit, must be counted as one more black mark against System/360. The case gained strength from the successful action of Control Data, which quickly secured a highly favorable settlement from IBM. As part of the agreement, IBM took possession of the case histories assembled by CDC's lawyers and immediately destroyed them. This act, which by Watson's own admission deprived government of evidence that would have significantly

enhanced its case, further fueled the resolve of government and helps account for the inordinate length and vituperation of the case.[71]

Even before government launched the suit, moreover, the Justice Department extracted further concessions from IBM regarding its fundamental business practices. As before, government directed much of its concern toward tying or bundling. It objected in particular to IBM's practice of offering many services, including much of its programming and software, without explicit charge. Government asserted that IBM won key accounts from its competitors by lavishing customers with software and programming services for which it charged no published price. Such bundling undercut the objective of establishing clear price and performance targets for computer products. IBM counsel Burke Marshall, who in his former capacity as assistant attorney general had overseen government antitrust litigation, characterized the practice to Watson as "a classic tie" and advised him to adjust the policy if he wished to avoid a lawsuit.[72] Following months of internal study embracing every branch of the corporation, IBM announced on December 6, 1968, that it would begin charging set prices for much of its programming at the start of the following July.[73] The move seemed so significant within IBM that managers preparing for the anticipated competitive environment dubbed their work "New World."[74]

WHAT WROUGHT ANTITRUST? COMPETITIVE FORCES IN COMPUTING IN THE 1970S AND 1980S

Whether these steps and the pallor that shadowed IBM throughout the long antitrust case really exerted such profound influence upon the course of events in the computer industry remains a matter of conjecture. In the annals of the software industry, the unbundling of software from hardware has often been heralded as giving birth to the industry.[75] Several pioneering software firms of the day certainly considered it a watershed event at the time, and their founders recall it as such.[76] But the record is not quite so straightforward. In dropping the bundled programs and software services, IBM dropped the price of associated hardware a mere 3 percent. Available statistics regarding the subsequent development of the industry suggest that figure captures the immediate economic impact fairly accurately.[77]

Perhaps the bigger problem in assessing the influence of antitrust involves the counterfactual argument, advanced forcefully by IBM counsel during the subsequent trial, which holds that IBM would have unbundled even in the absence of action by government. Competition from firms such as CDC and Digital Equipment Corporation, which offered little programming or services, would have compelled IBM to charge for them. Similar logic suggested that

IBM could not have long succeeded by tying what should be separate components into larger integrated systems through proprietary operating systems or channels.[78]

In light of this defense, which has acquired considerable credence among economists and other students of antitrust, the question of whether antitrust altered events largely comes down to one of pace rather than direction. Would IBM have permitted the inevitable forces of change to work so freely in the absence of pressure from government? And if not, could it have mounted an effective resistance, one which at least would have bought it some time to adjust its strategy and cover its mistakes? Or might IBM, fearing reprisals from government, actually have moved more radically than economic forces themselves would have dictated? Might IBM have erred, for instance, by not tying components of its systems as tightly as warranted by grounds of efficiency?

We will likely never arrive at definitive answers to these questions. Publicly, Cary maintained that IBM would conduct its business without concern for antitrust. Whether managers actually carried out that directive is less clear. During the years of the suit, IBM abandoned plans for a comprehensive product development effort comparable to System/360 and instead embraced a strategy that called for targeted focus on various market segments.[79] Computer systems proliferated, as plants and divisions became known for particular products. Within each line, IBM pursued a vertically integrated approach, with basic components and programming generated largely from internal sources. In some cases integration brought a retreat from modularity, as elements such as memory and control channels were incorporated into comprehensive proprietary designs. In others, such as disk storage units, printers, and terminals, IBM looked to utilize common sources across the firm.[80]

Virtually all IBM products—peripherals and systems—faced clearly identifiable rivals in their markets. Only rarely, however, did IBM face the same competitor in multiple market segments. The largest and most expensive computers, aimed at major institutions with large routine data processing operations, were targeted primarily by Japanese electronics manufacturers such as Hitachi and Fujitsu.[81] Mid-size computers came from Boston's Route 128 and later from Sun Microsystems, an archetypal firm of what was becoming known as Silicon Valley.[82] Rivals in disk storage spun off from IBM's own facility in San Jose, at the heart of the Valley.[83] IBM jockeyed with Xerox, its fellow East Coast giant, for the printer and copier markets.[84] As IBM began to resemble a conglomerate, it began to think less in terms of winning accounts from competitors and more about producing machines that could match or surpass competitive offerings. In a situation quite reminiscent of the late 1950s, tensions mounted between the centralized salesforce and the product development groups, and

top management grew frustrated attempting to forge compromises and overcome bureaucratic resistance to change.[85]

Out of this situation came two fateful decisions during the early 1980s. The first involved IBM's move into the realm of personal computing, which startup companies such as Apple had pioneered during the late 1970s. A frustrated Cary, anxious to demonstrate that IBM could still react nimbly, placed responsibility for IBM's PC in an independent business unit (IBU).[86] Freed from the usual corporate constraints, this small group of liberated IBMers chose to obtain both the central processing component and the basic operating system for the PC from outside sources. The former came from Intel, the latter from Microsoft. IBM had, in effect, handed the advantages provided by its brand reputation and established market presence to the two upstart suppliers. To make matters worse, engineers also inadvertently designed the PC as what would later become known as an open system, with nonproprietary input-output channels. Competitors could readily manufacture clones assembled from alternative circuit boards, memories, disk drives, monitors, keyboards, and printers. As each of these components rapidly became a target of feverish competition, prices and profit margins plummeted. What had taken years to occur in mainframe computing had happened virtually overnight with the PC.[87]

Though these developments initially reshaped computing in ways long desired by antitrust prosecutors and other critics, concerns about antitrust do not appear to have figured prominently in IBM's strategic choices regarding the PC. IBM had not hesitated to build proprietary input-output channels into computer systems targeted at other market segments during the 1970s, and the PC designers had not intended for the channels in their machine to be nonproprietary. When their mistake came to light, they immediately scrambled (unsuccessfully) to undo the gaffe with revised designs for subsequent models.[88] The choice to rely on outside suppliers, which in retrospect appears to have been an even bigger mistake, seems to have been made with open eyes. Participants recall that in final meetings of corporate staff and top management prior to announcement of the PC, concerns were raised about excessive dependence on outside suppliers. IBM stayed the course, not because it feared antitrust action if it acted otherwise, but because management was anxious to culminate the experimental venture and because a general feeling prevailed that "you could not make big mistakes in small markets."[89] This assessment, however ironic it might come to appear in light of the subsequent evolution of computing, was entirely consistent with the approach IBM had taken to the computer market since System/360.

The second fateful decision of the early 1980s occurred when IBM abandoned leasing entirely and began offering all of its products on strictly a sales basis.[90] In

a world dominated by rapid product turnover in virtually every market segment, management presumed that IBM would be better off letting customers take ownership and assume the risk of possible obsolescence. The move culminated the steady drift toward a business model based on commodity sales rather than ongoing account management. As IBM soon discovered, however, leasing still provided a useful buffer against swings in demand. Coffers swelled for a time, as customers paid up front for machines they previously had leased while established leases continued to run their course. But when old leases expired and demand for new machines fell below expectations, IBM lost billions.[91]

In addition to bringing IBM to the brink of financial disaster, the two decisions contributed to a further strategic blunder. In developing the PC group as an independent business unit, IBM had not perceived that small computers might effectively turn the computer industry upside down, or inside out. As the transforming power of decentralized computing grew ever more apparent, IBM then faced the difficult choice of whether to let the new IBU continue to take the lead in executing IBM's move into the new realm, or whether to absorb the PC group within the larger structure of the parent company. Flushed with confidence from the surge in revenue in mainframe computing, and reasoning that the vast resources available within IBM could better perform tasks such as developing a new operating system, linking the PCs more effectively in a network, and tying them to centralized databases, management chose the latter course. Unfortunately for IBM, the marriage proved awkward and ineffective. Its efforts consistently trailed those of Microsoft, Cisco, and Oracle, firms that had sprung to life with the emergence of distributed computing and intuitively grasped its essential character.[92]

REORIENTING IBM: OPEN SYSTEMS AND THE GERSTNER ERA

As IBM at last confronted the sort of disruptive crisis that had periodically plagued other large firms, it turned outside for new leadership, for the first time since the elder Watson had arrived in 1914. The new CEO, Louis Gerstner, brought a drastically different perspective to staid, bureaucratic Big Blue. Gerstner had cut his teeth working for the management consulting company McKinsey before achieving prominence as head of RJR Nabisco, a firm forged through a highly chronicled hostile takeover. Part of the new breed of flamboyant and highly compensated chief executives, Gerstner had breathed new life into its brands while drastically trimming costs.[93]

At IBM, Gerstner set off on much the same course. He slashed the total workforce to just over half its peak of the mid-1980s.[94] Product divisions and research incurred especially deep cuts, while spending on corporate advertising actually

increased, as Gerstner looked to shore up IBM's image among the large business consumers he believed constituted his firm's core market sector. The campaign's slogan, "solutions for a small planet," conveyed what Gerstner considered IBM's greatest asset: its reputation for providing comprehensive, reliable services to business managers instituting change across large organizations. The new emphasis restored sales and customer service to a preeminence they had not enjoyed since the days of the elder Watson.

In one important respect, moreover, Gerstner actually outdid Watson: he allowed IBM salespeople and business consultants to use non-IBM products in assembling systems for specific customers. This move effectively mobilized IBM's salespeople and business consultants as key agents of innovative activity. Rather than trying to coordinate various product divisions in an effort to arrive at a single comprehensive systems design, Gerstner looked for numerous groups within the sales and consulting forces to experiment with their own distinctive assemblies of products that might come from any number of sources. If this meant lots of PCs and few large computers, or the reverse, so be it. Product divisions must no longer engage in internecine struggles to gain a foothold within comprehensive IBM programs and thus secure for themselves a large guaranteed internal market. Rather, they must scramble to generate products that the marketers and consultants, acting as free agents, deemed useful and competitive. The move dramatically redrew the boundaries of the firm, both internally and externally, and restructured the incentives to innovation.

While releasing the sales and consulting forces to contract freely with alternative suppliers, Gerstner also encouraged personnel involved in research and development activities to seek markets and partners outside IBM. He created special incentives for ambitious laboratory researchers and other technicians to bypass the established product divisions and work directly with partners in IBM marketing to commercialize their ideas. Gerstner also instructed IBM researchers to license their patents and ideas to outside parties. Taking the step Tom Watson had resisted in the early 1960s, Gerstner authorized the components facilities to sell their products on the open market and to enter cooperative agreements with outside companies, including former rivals such as Sun Microsystems. Remarkably, IBM became one of the most vocal proponents of so-called open systems, patched together from hardware and software supplied by numerous sources. No single approach, argued Gerstner, should dominate computing.

In adopting this stance, IBM was of course confronting Microsoft, whose nearly ubiquitous Windows operating system had secured it a position in distributed computing much like that IBM had enjoyed in the mainframe era. In a move rich with irony, IBM carried its battle with Microsoft into the antitrust

arena.[95] When the Justice Department accused Microsoft of leveraging its operating system unfairly by forcing manufacturers of PCs to place its Web browser and other applications programs in prominent spots on the opening monitor display, IBM provided essential testimony in support of the claim. The evidence IBM marshaled helped Justice secure a resounding victory. An initial ruling by Judge Thomas Benfield Jackson would have compelled Microsoft to split itself in two, with one part responsible for operating systems and another for applications programs. The threat harkened back to the 1956 consent decree, which called for IBM to spin off its service bureau as a distinct subsidiary. Though Judge Jackson's ruling was later severely modified upon appeal, keeping Microsoft intact, the software giant did alter many of its more objectionable business practices. At century's end, it remained in the crosshairs of antitrust surveillance.

While lending assistance to the crusade against Microsoft, Gerstner quietly renegotiated IBM's own agreements with the Justice Department. He secured an important concession when government agreed to abandon the dictates of the 1956 consent decree calling for IBM to establish separate pricing for various products and services.[96] Henceforth, IBM salespeople and business consultants would be free to assemble various mixes of hardware, software, and services and offer them at a single, comprehensive price unique to each customer. IBM had, in effect, come full circle. Account management, with fully bundled packages and no clear targets at which competitors could take aim, once again characterized its core business practices. Owing largely to a resurgence of activity in services, revenue and employment reached levels many observers had presumed IBM could no longer attain, though its profit margins lagged well behind those of its own heyday and those of Microsoft, the firm that had assumed its place in the antitrust arena.

CONCLUSION

At the close of the twentieth century, antitrust activity was often portrayed by its many critics as unwarranted and unwise meddling with beneficent market mechanisms. Perhaps no single case did more to bolster that view than the long suit begun against IBM in 1969. When at last dismissed as without merit, after absorbing staggering amounts of legal resources, the case became a ready symbol for those seeking to highlight the potential waste and futility that might result from such wholesale intrusion into the operations of private enterprise. The suit also generated a sophisticated body of economic analysis that has continued to influence antitrust policy and case law ever since.

Yet in tracing IBM's long odyssey with American antitrust law, what seems most striking is not the stark opposition between antitrust intervention and

market mechanisms, but rather their frequent symbiosis. Government persistently pushed in precisely the direction that IBM and its industry were being drawn by the workings of the market and the ongoing process of technological change those market processes stimulated. Antitrust policy toward the industry exhibited a remarkable coherence across the twentieth century. In consistently pressing to break apart linkages whose necessity seemed tenuous, government looked to preserve or even stimulate market competition. Fearful that inherited legacies or unwarranted bundling might interfere with the play of market forces and slow their solvent effects, an impatient government intervened. In at least some instances, these actions mirrored those of managers themselves, who also worried about the possibility that bundles and legacies might insulate groups within their enterprises from the inevitable forces of change.

Whether those actions by government significantly altered IBM or the computer industry remains an open question. The issue comes down largely to a matter of pace. Did antitrust remove impediments and accelerate the currents of change? Or did it merely introduce disruptive eddies into the flow? Certainly many participants in the story considered antitrust extraordinarily important at the time. At several junctures, IBM clearly altered its strategic course, or at least significantly speeded up the pace of its moves, in direct response to antitrust intervention. Competitors often felt heartened by those interventions and gained tangible benefits from them. The overall performance of the American computer industry, which has outpaced the rest of the world as well as virtually every other domestic industry, hardly suggests that antitrust has inflicted serious damage.

When viewed from a comparative international perspective, antitrust in fact jumps out as perhaps the most distinctive feature of the American landscape. Virtually all industrial nations of the postwar era identified computing as a field of enormous national significance, both militarily and economically. Governments the world over poured resources into the industry and pursued policies intended to foster healthy and vibrant domestic champions such as IBM. None spent more lavishly than the United States itself, with its postwar affluence and overriding concern with containing communism. Yet alone among nations, the United States simultaneously took steps to curb the power of its leading firm. From its granting of the Social Security contract onward, the American government consistently challenged IBM under antitrust even as it turned to the firm for critical technologies. The pattern held through the Depression, the Cold War, and the economic challenges of mounting global competition. While fighting national struggles, Americans consistently embraced an economic policy intended to break apart concentrated power and preserve market forces.

NOTES

1. Richard S. Tedlow, *The Watson Dynasty: The Fiery Reign and Troubled Legacy of IBM's Founding Father and Son* (New York: HarperBusiness, 2003), 260. In 1970, IBM ranked fifth in the Fortune 500, behind General Motors, Esso, Ford, and General Electric. Its market capitalization of $41.5 billion on January 2, 1970, was twice that of GM, three times that of Esso, and six times that of GE. IBM's valuation on that date exceeded that of AT&T by more than $14 billion. Kevin Maney, *The Maverick and His Machine: Thomas Watson, Sr. and the Making of IBM* (New York: John Wiley & Sons, 2003).

2. Steven W. Usselman, "IBM and Its Imitators: Organizational Capabilities and the Emergence of the International Computer Industry," *Business and Economic History* 22 (Winter 1993): 1–35, reprinted in *Industrial Research and Innovation in Business*, ed. David E. H. Edgerton (London: Edward Elgar, 1996), 452–86; and Steven W. Usselman, "Fostering a Capacity for Compromise: Business, Government, and the Stages of Innovation in American Computing," *Annals of the History of Computing* 18 (Summer 1996): 30–39.

3. Paul Carroll, *Big Blues: The Unmaking of IBM* (New York: Crown, 1993).

4. *United States* v. *International Business Machines Corporation* 1956 U.S. District LEXIS 3992; 1956 Trade Cas. (CCH) P68, 245. The suit was filed by the Department of Justice on January 21, 1952, and settled on January 25, 1956.

5. Franklin M. Fisher, James W. McKie, and Richard B. Mancke, *IBM and the U.S. Data Processing Industry: An Economic History* (New York: Praeger, 1983); and Franklin M. Fisher, John J. McGowan, and Joen E. Greenwood, *Folded, Spindled, and Mutilated: Economic Analysis and U.S. v. IBM* (Cambridge, Mass.: MIT Press, 1983).

6. Thomas J. Watson Jr. and Peter Petre, *Father, Son & Co.: My Life at IBM and Beyond* (New York: Bantam Books, 1990), 230–33.

7. On these business practices, see Tedlow, *The Watson Dynasty;* Maney, *The Maverick and His Machine;* Robert Sobel, *IBM: Colossus in Transition* (New York: Times Books, 1981); and Emerson W. Pugh, *Building IBM: Shaping an Industry and Its Technology* (Cambridge, Mass.: MIT Press, 1995).

8. Elizabeth Wasserman and Patrick Thibodeau, "Microsoft, IBM Face Off," *Info World* 21 (June 14, 1999): 30. The case has been the subject of extraordinary journalistic coverage. Three compilations are Joel Brinkley and Steve Lohr, *U.S. v. Microsoft: The Inside Story of the Landmark Case* (New York: McGraw-Hill, 2001); Richard B. McKenzie, *Trust on Trial: How the Microsoft Case Is Reframing the Rules of Competition* (Cambridge, Mass.: Perseus, 2001); and Ken Auletta, *World War 3.0: Microsoft and Its Enemies* (New York: Random House, 2001). For more academic analyses of issues germane to the case, see Jerry Ellig, ed., *Dynamic Competition and Public Policy: Technology, Innovation, and Antitrust Issues* (Cambridge and New York: Cambridge University Press, 2001).

9. Maney, *The Maverick and His Machine;* and James W. Cortada, *Before the Computer: IBM, NCR, Burroughs, and Remington Rand and the Industry They Created, 1865–1956* (Princeton: Princeton University Press, 1993).

10. *International Business Machines Corp.* v. *United States* 298 U.S. 131 (1936).

11. *International Business Machines Corp.* v. *United States* 298 U.S. 131 (1936).

12. Donald Dewey, *Monopoly in Economics and Law* (Chicago: Rand McNally, 1959), esp. 171–78; William Letwin, *Law and Economic Policy in America: The Evolution of the Sherman Antitrust Act* (New York: Random House, 1965), esp. 115–16 and 151–52, and Hans B. Thorelli, *The Federal Antitrust Policy: Organization of an American Tradition* (Baltimore: Johns Hopkins University Press, 1955), esp. 62 and 325. Ironically, in blocking firms from acquiring competitors and their patents, antitrust law often served as an inducement to the formation of internal corporate research and development programs that enabled firms in some cases to assert stronger control over technologies. See David A. Hounshell, "Industrial Research and Manufacturing Technology," in *Encyclopedia of the United States in the Twentieth Century*, ed. Stanley Kutler (New York: Scribner's, 1996), 831–57; and Leonard S. Reich, *The Making of American Industrial Research: Science and Business at GE and Bell, 1876–1926* (New York: Cambridge University Press, 1985).

13. For a case citing the Congressional debate, see *International Business Machines Corp.* v. *United States* 298 U.S. 131 (1936).

14. *Motion Picture Patents Co.* v. *Universal Film Manufacturing Co.* 243 U.S. 502 (1917) and *United Shoe Machinery Co.* v. *United States* 258 U.S. 451 (1922). For a recent discussion of this and related cases, see Keith N. Hylton, *Antitrust Law: Economic Theory and Common Law Evolution* (New York: Cambridge University Press, 2003), 285. As Hylton points out, the Court's concern with limiting the leverage of patents during this period can also be seen in its insistence that patent holders could not enter price maintenance agreements with secondary consumers of products incorporating their patents. A patentee could control the price charged by a licensee who manufactured the patented product, but not that charged by someone who incorporated the licensee's product into another product or process. See Hylton, *Antitrust Law*, 254–56 and 261. The relevant cases are *Bauer & Cie* v. *O'Donnell* 229 U.S. 1 (1913) and *Straus* v. *Victor Talking Machine Co.* 243 U.S. 490 (1917).

15. The justices emphasized that their opinion was not predicated upon the high profit margins IBM earned on its card sales.

16. *Zenith Radio Corp.* v. *Radio Corp. of America, et al.* 106 F. Supp. 561, June 13, 1952; Reich, *The Making of Industrial Research;* and August W. Giebelhaus, *Business and Government in the Oil Industry: A Case Study of Sun Oil, 1876–1945* (Greenwich, Conn.: JAI Press, 1980), 198–270.

17. In addition to taking extensive testimony, the committee commissioned a report on the topic: Walton Hamilton, *Patents and Free Enterprise*, TNEC monograph no. 31 (Washington, D.C.: U.S. Government Printing Office, 1941). This monograph and the committee hearings pertaining to this topic are examined in Larry Owens, "Patents, the 'Frontiers' of American Invention, and the Monopoly Committee of 1939: Anatomy of a Discourse," *Technology and Culture* 32 (Oct. 1991): 1076–93. See also George E. Folk, *Patents and Industrial Progress: A Summary, Analysis, and Evaluation of the Record on Patents of the Temporary National Economic Committee* (New York: Harper and Brothers, 1942), for a rebuttal to Hamilton funded by the National Association of Manufacturers. On TNEC and its place in the larger history of antitrust, see Ellis W. Hawley, *The New Deal and the Problem of Monopoly: A Study in Economic Ambivalence*. (Princeton: Princeton University Press, 1966), esp. 368–70 and 404–71.

18. Donald Dewey, *The Antitrust Experiment in America* (New York: Columbia University Press, 1990).

19. On the idea of mandatory licensing, see esp. Folk, *Patents and Industrial Progress.*

20. Joseph A. Schumpeter, *Capitalism, Socialism and Democracy*, 3rd ed. (New York: Harper and Row, 1950), esp. 78–106.

21. Alfred E. Kahn, "Fundamental Deficiencies of the American Patent Law," *American Economic Review* 30 (Sep. 1940): 475–91.

22. On Bush, see G. Pascal Zachary, *Endless Frontier: Vannevar Bush and the Engineering of the American Century* (Cambridge, Mass.: MIT Press, 1999).

23. Owens, "Patents," 1084 and 1092.

24. Zachary, *Endless Frontier*; and Daniel Lee Kleinman, *Politics on the Endless Frontier: Postwar Research Policy in the United States* (Durham, N.C.: Duke University Press, 1995).

25. *International Salt Co.* v. *United States* 332 U.S. 392 (1947). Hylton, *Antitrust Law*, 286–92.

26. *United States* v. *Griffith* 334 U.S. 100 (1948) was especially important in this regard.

27. *United States* v. *United Shoe Machinery Corp.* 110 F. Supp. 295 (D. Mass 1953). The court's reasoning has itself come under intense scrutiny by scholars of antitrust, but my concern here is merely with establishing the mind-set that prevailed at the time, not on assessing the merits of the economic reasoning involved.

28. See Chapter 4 in this volume, by Kenneth Lipartito.

29. Michael Riordan and Lillian Hoddeson, *Crystal Fire: The Birth of the Information Age* (New York: W. W. Norton, 1997).

30. On the significance of World War II for American business, including IBM, see Thomas K. McCraw, *American Business, 1920–2000: How It Worked* (Wheeling, Ill.: Harlan Davidson, 2000), 73–102.

31. *IBM Annual Report* (1946).

32. JoAnne Yates, *Structuring the Information Age: Life Insurance and Technology in the Twentieth Century* (Baltimore: Johns Hopkins University Press, 2005); and Arthur L. Norberg, *Computers and Commerce: A Study of Technology and Management at Eckert-Mauchly Computer Company, Engineering Research Associates, and Remington Rand, 1946–1957* (Cambridge, Mass.: MIT Press, 2005).

33. Charles J. Bashe, Lyle R. Johnson, John H. Palmer, and Emerson W. Pugh, *IBM's Early Computers* (Cambridge, Mass.: MIT Press, 1986), 135–64; and Pugh, *Building IBM*, 167–74 and 185–86.

34. David A. Hounshell, "Assets, Organizations, Strategies, and Traditions: Organizational Capabilities and Constraints in the Remaking of Ford Motor Company, 1946–1962," in *Learning by Doing in Markets, Firms, and Countries*, eds. Naomi R. Lamoreaux, Daniel M. G. Raff, and Peter Temin (Chicago: University of Chicago Press, 1999), 185–208; and David Halberstam, *The Reckoning* (New York: Morrow, 1986).

35. On IBM's successful efforts in this market, see Bashe et al., *IBM's Early Computers*, 68–72, 84–86, and Atsushi Akera, "IBM's Early Adaptation to Cold War Markets: Cuthbert Hurd and His Applied Science Field Men," *Business History Review* 76 (Winter 2002): 767–802.

36. Norberg, *Computers and Commerce.*

37. Maney, *The Maverick and His Machine*; Tedlow, *The Watson Dynasty*; and Watson Jr. and Petre, *Father, Son & Co.*

38. For more detailed discussion, based on numerous documents in IBM's corporate archives, see Steven W. Usselman, "Learning the Hard Way: IBM and the Sources of Innovation in Early Computing," in *Financing Innovation in the United States, 1870 to the Present*, eds. Naomi R. Lamoreaux and Kenneth L. Sokoloff (Cambridge, Mass.: MIT Press, 2007), 317–63.

39. Yates, *Structuring the Information Age*, 113–50, and Norberg, *Computers and Commerce*, 73–116 and 167–208. On IBM's response, see Bashe et al., *IBM's Early Computers*, 102–3 and 114–16; Usselman, "Learning the Hard Way"; and "Summary of Products Committee Meeting Held on October 30th and 31st, 1947" T. J. Watson Sr. Papers, IBM Corporate Archives, Somers, New York.

40. Thomas J. Watson Jr., interview by Steven W. Usselman and Richard Wight, March 27, 1986, Armonk, New York.

41. For two recent perspectives on this bill and its effects, see David M. Hart, "Antitrust and Technological Innovation in the U.S.: Ideas, Institutions, Decisions, and Impacts, 1890–2000," *Research Policy* 30 (July 2001): 923–37, and Louis Galambos, "The Monopoly Enigma, the Reagan Administration's Antitrust Experiment, and the Global Economy," in *Constructing Corporate America: History, Politics, and Culture*, eds. Kenneth Lipartito and David Sicilia (New York: Oxford University Press, 2004), 149–67.

42. Norberg, *Computers and Commerce*, 205–8.

43. Bashe et al., *IBM's Early Computers*, 372–95.

44. B. N. Slade, interview by Steven Usselman, Poughkeepsie, New York, November 4, 1985.

45. "The IBM-Texas Instruments, Inc. Relationship," Chapter 10 of Components Division Procurement Role in System/360, Legal Papers, IBM Archives. This material includes copies of the IBM-TI agreement, December 23, 1957; a memo from P. N. Whittaker to J. W. Birkenstock et al., January 23, 1958 (PT10275), explaining its origins and the philosophy behind it; and the letter officially amending the agreement on May 5, 1960 (PT10276). On the technical dimensions of transistor work at IBM and TI, see Bashe et al., *IBM's Early Computers*, 390–95 and 399–406.

46. Emerson W. Pugh, *Memories That Shaped an Industry: Decisions Leading to IBM System/360* (Cambridge, Mass.: MIT Press, 1984).

47. Usselman, "IBM and Its Imitators"; and Bashe et al., *IBM's Early Computers.*

48. Maney, *The Maverick and His Machine*, 385–92; Tedlow, *The Watson Dynasty*, 193; Watson Jr. and Petre, *Father, Son & Co.*, 215–20; Watson Jr. interview by Usselman and Wight.

49. *United States* v. *International Business Machines Corporation* 1956 U.S. District LEXIS 3992; 1956 Trade Cas. (CCH) P68, 245.

50. On the significance of the service bureau, see Steven W. Usselman, "Public Policies, Private Platforms: Antitrust and American Computing," in *Information Technology Policy: An International History*, ed. Richard Coopey (Oxford, U.K.: Oxford University Press, 2004), 97–120.

51. IBM Organization Chart, May 20, 1959, with accompanying remarks by Thomas J. Watson Jr. and T. Vincent Learson, Organization Papers, IBM Corporate Secretary's Office, Armonk, New York.

52. Bashe et al., *IBM's Early Computers*, 544–50.

53. IBM officially announced formation of a separate Components Division on March 31, 1961. Numerous reports and letters in the Corporate Management Committee Papers, IBM Corporate Secretary's Office, Armonk, New York pertain to the formation of this division. See esp. R. H. Bullen to A. K. Watson, December 8, 1964. See also W. B. McWhirter to T. V. Learson, June 29, 1960, with R. H. Bullen to file, n.d., attached; Learson to A. L. Williams, July 1, 1960; Bullen to file, July 5, 1960; Learson to Bullen, August 3, 1960; and Bullen to T. J. Watson Jr., March 16, 1961.

54. IBM Organization Chart, May 20, 1959, with accompanying remarks by Thomas J. Watson Jr. and T. Vincent Learson, Organization Papers, IBM Corporate Secretary's Office, Armonk, New York.

55. Among those expressing this opinion was Mervin Kelly, head of research at Bell Labs, whom Watson had hired as a consultant. Watson Jr. interview by Usselman and Wight, 1985; Bullen to file, July 5, 1960; and B. L. Havens to E. R. Piore, June 1, 1961, CMC Files.

56. IBM Organization Chart, May 20, 1959, with accompanying remarks by Thomas J. Watson Jr. and T. Vincent Learson, Organization Papers, IBM Corporate Secretary's Office, Armonk, New York.

57. See note 53.

58. For persistent concern on the part of Watson about measuring the performance of the division against outside suppliers, either by selling its products on the open market or by obtaining them from a second source, see T. J. Watson to T. V. Learson, June 14, 1963; A. H. Eschenfelder to Watson, March 3, 1964; Watson to Paul Knapland, February 19 and December 3, 1965; and Knaplund to Watson, February 24, 1965; Watson Jr. Papers.

59. These developments can be traced in the files of the Corporate Management Committee, the Executive Conference Papers, and the Watson Jr. Papers. A watershed moment came in early January, 1962, when the group executive responsible for the System/360 initiative, Vin Learson, reported on the program to Watson. T. V. Learson to T. J. Watson Jr. and A. L. Williams, January 15, 1962, Watson Jr. Papers. On escalation of System/360 into worldwide effort across all machines, see T. J. Watson Jr. to T. V. Learson and A. K. Watson, January 15, 1963, and A. L. Williams to Dr. E. R. Piore, January 22, 1963, Williams Papers, IBM Corporate Archives, Div. 10/602, Box 70856.

60. For a recent treatment, see Alfred D. Chandler Jr., *Inventing the Electronic Century: The Epic Story of the Consumer Electronics and Computer Industries* (New York: Free Press, 2001).

61. T. A. Wise, "IBM's $5,000,000,000 Gamble," *Fortune* 74 (Sep. 1966): 118–23, 224, 226, and 228. The idea may have come to the reporter from the common joke at the time that IBM Co. stood for "I bet my company." See also T. A. Wise, "The Rocky Road to the Marketplace," *Fortune* 75 (Oct. 1966): 138–43, 199, 201, 205–6, and 211–12.

62. *IBM Annual Reports* (1965–1969).

63. Usselman, "IBM and Its Imitators."

64. At an executive conference in May of 1966, after hearing reports from Cary and Opel, Tom Watson identified the "major lesson" of System/360 as "At our size, we can't go 100 percent with anything new again." Executive Conference Papers, IBM Corporate Secretary's Office, Armonk, New York. "When we have learned from one experience like the 360," he wrote to top-level staff a few months later, "it is necessary that we confirm

our learning by clearly stating we will never do it again and, accordingly, it should be our policy in the future never to announce a new technology which will require us to devote more than 25% of our production to that technology and equipment dependent upon it during the first year of major production of that technology." Watson to R. H. Bullen, F. T. Cary, W. C. Hume, G. E. Jones, T. V. Learson, A. K. Watson, and A. L. Williams, September 9, 1966, Watson Papers.

65. T. V. Learson to T. J. Watson Jr. and A. L. Williams, January 15, 1962, Watson Jr. Papers.

66. On emulators, see Fisher et al., *IBM and the U.S. Data Processing Industry*, 89 and 118, and Gerald W. Brock, *The U.S. Computer Industry: A Study in Market Power* (Cambridge, Mass.: Ballinger, 1975), 15. Their importance in altering IBM strategy associated with System/360 is readily apparent in IBM corporate files pertaining to the launch of the new line.

67. Fisher et al., *IBM and U.S. Data Processing Industry*, 93–94; Pugh, *Building IBM*, 296–97; and Watson Jr. and Petre, *Father, Son & Co.*, 382–85.

68. Fisher et al., *IBM and the U.S. Data Processing Industry*, 159–67; and Fisher et al., *Folded, Spindled, and Mutilated*, 284–88.

69. Fisher et al., *IBM and the U.S. Data Processing Industry*, 286–303 and 327–39; and Fisher et al., *Folded, Spindled, and Mutilated*, 331–36.

70. Filed January 16, 1969, the case was settled on January 8, 1982. Fisher et al., *Folded, Spindled, and Mutilated*, 1 and 353–69; and Watson Jr. and Petre, *Father, Son & Co.*, 376–89.

71. Watson Jr. and Petre, *Father, Son & Co.*, 387–89 and *IBM Annual Report* (1972), 3 and 26–27.

72. Watson Jr. and Petre, *Father, Son & Co.*, 381.

73. *IBM Annual Report* (1968), 5–6, and *IBM Annual Report* (1969), 5–6.

74. Watt S. Humphrey, "Reflections on a Software Life," in *In the Beginning: Personal Reflections of Software Pioneers*, ed. Robert L. Glass (Los Alamitos, Calif.: IEEE Computer Society, 1999), 29–53; and Watson Jr. and Petre, *Father, Son & Co.*, 381. For documents pertaining to the unbundling of software, see Box 3, IBM Legal Papers, Accession 1980, Hagley Museum and Library, Wilmington, Delaware, esp. PX 2717.

75. See R. N. Langlois and D. C. Mowery, "The Federal Government Role in the Development of the U.S. Software Industry," in *The International Computer Software Industry: A Comparative Study of Industry Evolution and Structure*, ed. D. C. Mowery (New York: Oxford University Press, 1996), 53–85; and Kira R. Fabrizio and David C. Mowery, "The Federal Role in Financing Major Innovations: Information Technology During the Postwar Period," in Lamoreaux and Sokoloff, *Financing Innovation in the United States*, 283–316.

76. Glass, *In the Beginning;* and Walter F. Bauer, "Software Markets in the 70's," in *Expanding Use of Computers in the 70's: Markets, Needs, and Technology*, ed. Fred Gruenberger (New York: Prentice-Hall, 1971), 53–57.

77. Usselman, "Public Policies, Private Platforms."

78. Fisher et al., *IBM and the U. S. Data Processing Industry;* and Fisher et al., *Folded, Spindled, and Mutilated;* Brock, *The U.S. Computer Industry;* and Franklin M. Fisher, "Innovation and Monopoly Leveraging," in Ellig, *Dynamic Competition and Public Policy*, 138–59.

79. One initiative, known as Future Systems (FS), is discussed in Pugh, *Building IBM*, 307–17. The head of this initiative, Bo Evans, later attempted to resurrect the strategy by leveraging the Reduced Instruction Set Computer (RISC) architecture into a new basic platform for all IBM computers. See Carroll, *Big Blues*, 201. RISC technology, though developed within IBM, ultimately reached the computer market through upstart Sun Microsystems, a Silicon Valley firm. See AnnaLee Saxenian, *Regional Advantage: Culture and Competition in Silicon Valley and Route 128* (Cambridge, Mass.: Harvard University Press, 1994). For additional perspective on Evans and his strategic thinking, see Frederick P. Brooks Jr., *The Mythical Man-Month: Essays on Software Twentieth Anniversary Edition* (Reading, Mass.: Addison-Wesley, 1995).

80. Pugh, *Building IBM*, 301–22; and *IBM Annual Reports*.

81. Martin Fransman, *The Market and Beyond: Cooperation and Competition in Information Technology Development in the Japanese System* (Cambridge, U.K.: Cambridge University Press, 1990).

82. Saxenian, *Regional Advantage*.

83. David G. McKendrick, Richard F. Doner, and Stephan Haggard, *From Silicon Valley to Singapore: Location and Competitive Advantage in the Hard Disk Drive Industry* (Palo Alto, Calif.: Stanford Business Books, 2000).

84. Michael Hiltzik, *Dealers of Lightning: Xerox PARC & the Dawn of the Computer Age* (New York: HarperCollins, 1999).

85. Carroll, *Big Blues*; and Doug Garr, *IBM Redux: Lou Gerstner and the Business Turnaround of the Decade* (New York: HarperBusiness, 1999).

86. Carroll, *Big Blues*, 18–44, surveys IBM decisions regarding the PC.

87. Richard N. Langlois, "External Economies and Economic Progress: The Case of the Microcomputer Industry," *Business History Review* 66 (Spring 1992): 1–50.

88. Carroll, *Big Blues*, 120–59.

89. Humphrey, "Reflections"; and Carroll, *Big Blues*, 22–23.

90. Carroll, *Big Blues*, 59–60.

91. After earning record profits in 1990, IBM declared losses of $2.9 billion in 1991, $5 billion in 1992 (including $5.4 billion in the fourth quarter), and $8.1 billion in 1993. See Garr, *IBM Redux*, 13.

92. See Carroll, *Big Blues*, for an excellent and engaging account of the conflicting approaches to software development at IBM and Microsoft. For broader perspectives on software development, see Detlev J. Hoch, Cyriac R. Roeding, Gert Purkert, and Sandro K. Lindner, *Secrets of Software Success: Management Insights from 100 Software Firms Around the World* (Boston: Harvard Business School Press, 2000); and Martin Campbell-Kelly, *A History of the Software Industry: From Airline Reservations to Sonic the Hedgehog* (Cambridge, Mass.: MIT Press, 2003). On Oracle and Cisco, see David A. Kaplan, *The Silicon Boys: And Their Valley of Dreams* (New York: William Morrow, 1999).

93. My treatment of IBM during the Gerstner era is based largely upon Garr, *IBM Redux*, supplemented with contemporary news coverage.

94. Before the turnaround that began in 1994, IBM employment stood at just over 200,000. Garr, *IBM Redux*, 282.

95. See note 8 for sources on IBM and the Microsoft case.

96. Ira Sager and Diane Brady, "Big Blue's Blunt Bohemian," *Business Week* June 14, 1999, 107–8.