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Antitrust and technological innovation in the US: ideas, institutions, decisions, and impacts, 1890–2000

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Abstract

The history of antitrust policy in the US as it relates to technological innovation exhibits major swings every few decades between favoring concentration and favoring deconcentration. This paper sketches for each period the contending ideas that frame antitrust-technology policy debates, the salience of these ideas in the larger antitrust policy process, the institutions for agenda-setting and decision-making in this area, the policy decisions themselves, and (more speculatively) the impacts of these decisions on technological innovation and industrial development. The paper concludes with a preliminary attempt to identify the cyclical, secular, and static processes that have shaped the history of this policy area and to use this analysis to inform future policy-makers.

Keywords: Antitrust policy; Institutions; Ideas

1. Introduction

As Mowery (1992) has pointed out in this journal, antitrust policy has long played a more significant role in the US innovation system than it has in the innovation systems of other nations. Recent events (some of which will be recounted in Section 6) have conspired to refocus the attention of US policy-makers (and, by extension, their counterparts abroad as well) on the relationship between antitrust and technological innovation. That the salience of this issue has risen in the contemporary period points up its near-invisibility in the not-too-distant past and reminds us that innovation systems vary over time as well as across countries. Building on Mowery's and my own previous work (Hart, 1998), this paper offers a compact synopsis of the historical variation in antitrust policy in the US as it relates to technological innovation. Within each of four historical periods, I sketch the contending *ideas* that frame antitrust-technology policy debates, the *salience* of these ideas in the larger antitrust policy process, the institutions for agenda-setting and decision-making in this area, the *policy decisions* themselves, and (more speculatively) the *impacts* of these decisions on technological innovation and industrial development.

The paper's main objective is to describe this evolution. I defend no specific claims of my own about causal mechanisms, although I draw on those of others, particularly with respect to the impacts of antitrust on the economy. By highlighting economic ideas and institutional structures, however, I wish to draw attention to their connections to policy decisions (and vice versa) and to propose that these connections comprise a fertile area for further research. [1] Like technological innovation, policy-making is not a linear process. The causal mechanisms that produce policy decisions (or

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[1] A good starting point for the social science literature on this general subject is Hall (1989).

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institutions or ideas or salience, for that matter) are complicated and may vary over time. Economic ideas that arise in academia, for instance, may find their way into public policy because academic economists consult or are hired by legislators, prosecutors, judges, or lawyers; because policy-makers themselves become educated in these ideas or are replaced with new ones who have been; or because they influence the public and the press (leading the courts, as political lore has it, "to follow the election returns"). Despite this complexity, I make a brief and preliminary attempt in the paper's concluding section to identify the cyclical, secular, and static processes revealed by the narrative and to use this analysis to inform future policy-makers.

The paper opens with a brief exposition of the theoretical connection between antitrust policy and technological innovation. The rest of it is organized chronologically. The first historical section describes the formative period of antitrust policy, from the Sherman Act to the New Deal, which was marked by the establishment of judicial supremacy and *laissez-faire* thinking. I then turn to the period from the 1940s until the 1970s, during which executive branch lawyers asserted their presence, often working closely with economists in an effort to establish market structures for optimal performance, including innovation performance. The Chicago School of Economics and its integration into law and policy over the past three decades is taken up in the third part of the historical narrative. The final major section suggests that the 1990s may be seen as yet another transition point, as such contemporary economic ideas as network externalities and technological lock-in have come to prominence in major cases like US v. Microsoft.

2. Antitrust as technology policy

A famous hypothesis associated with the economist Joseph A. Schumpeter frames the debate about antitrust and technological innovation. Schumpeter contended that market power and innovation often go hand-in-hand. "Monopoly position", as he put it in *Capitalism, Socialism, and Democracy* (CSD), "is in general no cushion to sleep on" (Schumpeter, 1975, p. 102).[2] The "Schumpeterian hypothesis", in this simple form,[3] conjectures the dominance of one set of market incentives over another. Monopolists (or, more generally, firms in highly concentrated industries) have, on the one hand, an incentive to slow the pace of technological change in order to increase their profits from existing products. On the other hand, they also have an incentive to invest in long-term, large-scale R&D, since they can do so without worrying very much about imitators and can therefore appropriate most of the benefits of these investments (Scherer, 1992). In addition, Schumpeter claims, they cannot afford to exclude the possibility that a radical innovation will emerge that will substitute for their existing technology; unless they are vigilant, new challengers are likely to spring up to exploit such opportunities. I refer below to those who agree with Schumpeter in this regard as "concentrationists". Firms in less concentrated industries face a parallel set of conflicting incentives. They might be able to boost revenues and profits by investing in innovations that will allow them to differentiate their products or cut their costs. On the other hand, these innovations may fail to work or be susceptible to copying, providing an advantage to rivals that have avoided such investments and thus an incentive to avoid these costs themselves. I refer to those who believe that the incentive to innovate in such industries dominates the threats of failure and free-riding as "deconcentrationists".

By altering market structures and practices, the implementation of antitrust policy can change the mix of incentives for innovation. The expected effect on technological change of antitrust enforcement depends on whether one takes the concentrationist or deconcentrationist point of view in a particular circumstance. For example, the most extreme remedy for violating the US antitrust law, the breaking-up of

[2] Nelson (1996) argues that much economic research stimulated by the Schumpeterian hypothesis is based on no more than a "casual reading" of Schumpeter's work. The simple-minded search for correlations neglects the dynamism that was the essential element of Schumpeter's vision of capitalism.

[3] The Schumpeterian hypothesis is often interpreted to refer to firm size, rather than market structure. The concepts are related but different. I focus on market structure in this exposition. Size and market structure have often been conflated in policy debates, as demonstrated in the historical narrative below. On size and innovation, see Cohen and Klepper (1996) and references therein.

companies, known as "divestiture" and exemplified in the cases of Standard Oil in 1911 and AT&T in 1982, aims to create competition where little had existed. The most ardent concentrationists would find this remedy objectionable, while deconcentrationists would cheer. However, when policy-makers approve mergers or countenance cooperation among competitors, they hearten concentrationists. The patent law, which invests inventors with monopoly rights, is, one might say, the most concentrationist policy of all. It is not surprising that history is littered with clashes between patent holders and antitrust enforcers inclined to deconcentrationist views.

The challenge for antitrust as a technology policy is to foster a balance of incentives that stimulates a satisfactory level of technological innovation. Yet, innovation has historically been only one of many objectives of antitrust policy and not necessarily the most important one. Some antitrust advocates have worried more about the political consequences of concentrated economic power than about antitrust's impact on innovation (or any other economic value for that matter). In the view of agrarian populists in the late 19th century, for instance, "monopolists" and "big business" (terms with loose definitions) corrupted elected officials and undermined popular sovereignty. Small-town elites also sought on occasion to use antitrust law to protect their control of local society. Even when economic rather than political considerations dominated the antitrust policy debate, research and innovation often mattered less than prices and practices. What was seen as fair to consumers or conducive to static efficiency was not always connected to the possibilities for creating new products or making existing products in new ways. Hence, the following narrative tries to illuminate not only the concentrationist–deconcentrationist dialectic, but also its place in the larger universe of political–economic discourse.

3. The formative period, 1890s–1930s

The dominant idea about antitrust and innovation in the late 19th century US was that technological change was the natural result of economic competition. Most Americans were comfortable with Adam Smith's view that large markets fostered specialization, which in turn nurtured progress. The Yankee inventor was a stock figure. In this context, the emergence of new, large organizational forms, epitomized by the Standard Oil Trust, posed a conundrum. Those who benefited from them tended to view them as providing the organizational means to take advantage of technological opportunities, particularly economies of scale in transportation, communications, and manufacturing, in order to serve the expanding American market. Those whom they crushed saw the "trusts" (a blanket term covering loose combinations as well as integrated corporations) as destroying markets and thereby undermining the republican virtues that made independent invention (not to mention government by the people) possible (Thorelli, 1955, pp. 63–85; Page, 1991).

The economic profession, which was in the process of establishing itself as such during this period, mirrored this division in popular thinking. Imbued with a critical eye toward *laissez-faire* economics by his graduate training in Germany, American Economics Association founder Henry C. Adams argued that "the fundamental explanation... of consolidation of manufacturing... is the desire on the part of the proprietors of inferior plants to shield their capital from the competition of more perfect methods of production... [I]t will, to speak mildly, dampen the ardor for improvement". John B. Clark, on the other hand, came to the view that the threat of competition based on new technologies would prevent the trusts from putting "a blight... upon the progress of inventions". Indeed, potential competition of this sort, Clark thought, could be an improvement upon actual competition, since it did not waste capital. Yet, both Clark and Adams would probably have agreed with their colleague Arthur T. Hadley not only that "this aspect of the matter has hardly received proper attention", but also that "this is a subject on which it is easy to argue and hard to judge" (Rodgers, 1998, pp. 96–97; Adams, 1904, pp. 344–345; Clark, 1901, p. 6; Hadley, 1987, p. 377; Morgan, 1993).

The low salience of the technological consequences of antitrust is evident in the Congressional debate over the Sherman Act, the first major Federal antitrust law, which was enacted in 1890. One senator raised the possibility that a person with "superior skill" who became a great success would be made liable under the law; he was assured by one of the act's sponsors that such a person would not have to worry. Nonetheless, a clarifying amendment related to this point was rejected.

The Act is perhaps best read as an effort to recreate the norms of self-governing markets, under the watchful eye (and perhaps iron fist) of the Department of Justice (DOJ) and the Federal courts, without prejudging the specific organizational forms that would evolve in those markets or worrying much about their consequences. The Supreme Court's decision-making about antitrust law, as it evolved in the ensuing decades, in response to an agenda of cases filed by the Attorney General and by private parties, was equally distant from the discourse about technological innovation that engaged Adams, Clark, and Hadley. The Court forbade cartels, but otherwise focused on trade practices rather than firm size or market structure. Invention and innovation were effective defenses against antitrust suits in this setting, even when the firms that undertook them dominated markets, since neither practice violated market norms. The rights of patent holders, similarly, were largely unaffected. *Standard Oil*, decided in 1911, codified these views in the "rule of reason". The rule required judges to assess whether a firm's practices were "unreasonable" restraints of trade, and the pursuit of efficiency and ingenuity were judged not to be so, although these issues were not joined directly in *Standard Oil* (US Senate, 1890; Peritz, 1996, pp. 13–58; Dewey, 1990, pp. 4–8; Standard Oil of New Jersey v. US, 1911).

Even though the Court countenanced the break-up of the Standard Oil Company, its articulation of the rule of reason in the case and its implicit arrogation of decision-making authority over antitrust policy set off a national debate about the competence and ideological predisposition of the judiciary in these matters. Never before and never again would antitrust be so central to a Presidential campaign as in 1912. The three-cornered race pitted the incumbent President William Howard Taft, his predecessor Theodore Roosevelt, and Governor Woodrow Wilson of New Jersey, all of whom staked out different positions with respect to antitrust as a technology policy. Taft, who later ascended to the Chief Justiceship of the Supreme Court, but who finished a humiliating third in 1912, defended the capacity of courts to distinguish between a firm that was efficient and innovative and one that was merely an "octopus" like Standard Oil. He feared politically-motivated antitrust enforcement against firms only because they were big. "Nothing could happen more destructive to the prosperity of this country", he wrote with reference to this question in 1914, "than the loss of that great economy in production which has been and will be effected in all manufacturing lines". Roosevelt, by contrast, called for a strengthening of the Bureau of Corporations, which he had established in the executive branch in 1903. Its expert analysis would create "efficient publicity", permitting the public and its representatives to oversee and even overrule the courts (Taft, 1914, pp. 86, 127–128; Commissioner of Corporations, 1908, p. 5; Link, 1954, pp. 1–24).

Wilson, the eventual victor, went further, advocating a new regulatory system that would limit judicial discretion and vest more agenda-setting and decision-making authority in experts who could look forward to anticipate the future as well as look backward to punish past wrongs. Echoing the deconcentrationist ideas associated with a key adviser, Louis D. Brandeis (Brandeis, 1914, pp. 135–153), Wilson emphasized that concentrated economic power "arrested" industrial development.

> If you want to know how brains count, originate some invention which will improve the kind of machinery [the trusts] are using, and then see if you can borrow enough money to manufacture it. You may be offered something for your patent by the corporation — which will perhaps lock it up in a safe and go on using the old machinery; but you will not be allowed to manufacture (Wilson, 1913, pp. 173–174).

Wilson's victory helped move Congress to pass the Clayton and Federal Trade Commission (FTC) Acts in 1914. The two acts expanded the scope of antitrust policy and created a new administrative process under the FTC that was designed to influence the agenda and make decisions on some cases. Yet, they fell far short of Brandeis's vision, much less fulfilling the hope of Henry C. Adams that technologically dynamic industries with "increasing returns to scale" be managed by the state (Henderson, 1924, pp. 15–27; Adams, 1887, pp. 59–64).

Indeed, the judiciary still dominated antitrust decision-making, a fact brought home most sharply by *US Steel* in 1920. While the Supreme Court did not invoke an exception based on "superior skill" (it found that US Steel did not monopolize its market), the opinion in the case hailed a firm that Brandeis had blasted as a technologically backward behemoth

for its product and process innovations. Like the courts, the antitrust enforcement agencies (FTC and DOJ) settled on a more concentrationist program after World War I. The FTC in particular focused its energy on fostering cooperation among small firms in highly atomized industries. Its "trade practice conferences" aimed, at least some of the time, at the technological revitalization of these "sick" industries. They tried to standardize products, so as to nurture mass production methods, and to catalyze industry-wide research programs, the fruits of which would be shared among all firms. Such cooperation was endorsed by the Supreme Court and heralded by Secretary of Commerce Herbert Hoover as an economic method by which the US would keep pace technologically with the German cartel system without sacrificing its traditional freedoms (US v. US Steel, 1920; Hart, 1998, pp. 39–56; Eisner, 1991, pp. 62–69).

The impacts of antitrust policy on technological innovation and industrial development are intrinsically difficult to assess, since the analyst must compare the actual history with a counterfactual that can always be contested. Bearing this caveat in mind, assessments of the formative period of American antitrust policy, between the Sherman Act of 1890 and the New Deal of the 1930s, offer two sets of conclusions. In the specific industries that were subject to enforcement action, the concentrationist drift of policy decisions may have stifled innovation more than stimulated it. For example, US Steel's legal successes supported its strategy of limiting the introduction of new steel-making machinery; General Electric's court-endorsed control over its massive patent portfolio allowed it to stifle the development of new electric lighting products. The divestiture of Standard Oil, a deconcentrationist exception, appears to have stimulated innovation, for instance, in petroleum cracking. At the broader institutional level, however, the policy seems to have accelerated technological change. By privileging corporations over cartels, legal doctrine inadvertently spurred corporate consolidation, and the consolidated corporations, in turn, enhanced their investments in research and development since they could appropriate its benefits more easily than in the past. The birth of the central corporate laboratories in this period, Mowery suggests, was therefore in part the product of antitrust law. While these laboratories as such were not anticipated by the framers of the Sherman Act and its judicial interpreters, they would not have been unwelcome to those who strove to distinguish between innovative "good" trusts and stultifying "bad" ones (Comanor and Scherer, 1995; Bright and MacLaurin, 1943; Mowery, 1992, pp. 126–128). [4]

4. The New Deal order, 1930s–1970s

The Great Depression, and the failure of the early New Deal's National Recovery Administration (NRA) to solve it, triggered a transition in the economic ideas that dominated antitrust policy. The New Dealers also set in motion a reorganization of some of the key institutions for agenda-setting and decision-making in this policy area. The revised institutional arrangements produced in the ensuing decades decisions of a more deconcentrationist character than those of the formative period of US antitrust policy.

The NRA was President Franklin D. Roosevelt's first stab at healing the ailing economy that was largely responsible for his election in 1932. It echoed the 1920s FTC in its penchant for fostering cooperation among firms in the same industry. Even though the economy continued to recover during its brief existence, the NRA was a legal and administrative mess and a political failure. When the economy faltered anew in 1937, there was no chance that the New Dealers would return to its concentrationist approach. While the President's conservative critics dubbed the downturn the "Roosevelt recession", his partisans, like DOJ antitrust chief (and future Supreme Court justice) Robert Jackson, blamed business. Large corporations, they argued, used their legal and market power to inhibit technological innovation (among other things), thereby choking off economic growth and causing unemployment (Hart, 1998, pp. 83–84).

These deconcentrationist views found support in a series of economic studies, many of which were sponsored by government organizations, in the years immediately prior to the US's entry into World War II. A study under the joint auspices of the Temporary National Economic Committee (TNEC) and the FTC, for instance, compared process innovation among

[4] Bittlingmayer (1996), however, argues that antitrust enforcement in this period was associated with macroeconomic downturns, although he does not specifically examine its effects on innovation.

firms and found that "the largest companies made, on the whole, a very poor showing" (FTC, 1941). Pioneering work on corporate R&D spending, funded by the Works Progress Administration (WPA), revealed that such spending was highly concentrated in a few big firms and interpreted this finding to mean that these firms used their control of the research agenda to suppress new ideas (Perazich and Field, 1940). Corporate patent practices, like restrictive licensing, which had been upheld in pre-depression court cases, were assailed as well (Lynch, 1946; Hamilton, 1941). Perhaps the most influential work, that of Joe Bain, argued broadly that high barriers to entry might deter innovation in some industries (Bain, 1992). In fact, Schumpeter was surely moved to advance his hypothesis so strongly in 1942 by his disdain for these trends in his profession.

Thurman Arnold, who took over DOJ's antitrust division from Jackson in 1938, not only found the views of the deconcentrationist economists congenial, he also hired some of them (such as Corwin Edwards) to work for him. Arnold's stated objective was to convert antitrust from a "folklore" that pacified popular passions, but accomplished little economically, into a tool for "breaking bottlenecks", including those that inhibited technological innovation. DOJ soon filed suit against some of the nation's best-known high-technology companies, including Standard Oil of New Jersey, DuPont, General Electric, and Alcoa, and focused particularly on the patent holdings of some of these firms. Cases like these strengthened the DOJ's role as an antitrust policy agenda-setter; the agency also augmented its decision-making power. Arnold's dramatic expansion of the use of consent decrees, for instance, allowed DOJ to establish the terms for settlement with defendants and excluded the judiciary from the process of resolving many cases. [5] Over the course of the next decade, despite opposition in Congress and from big business and the military, Arnold and his followers moved antitrust policy in an increasingly deconcentrationist direction. Compulsory patent licensing, for instance, for the first time became a common element in antitrust settlements in the immediate post-World War II period (Arnold, 1937, 1940; Hart, 1998, pp. 84–96; US Senate, 1960).

[5] The Tunney Act of 1974 eventually gave judges the power to review consent decrees.

The judiciary's role in decision-making was diminished, but it was hardly eliminated by the New Deal reforms; many cases, whether initiated by the government or by private plaintiffs, still went to trial. Yet, the deconcentrationist influence of the New Deal can be found in judicial opinions as well as administrative actions. In part this trend in policy decisions resulted from new appointments made to the bench by Presidents Roosevelt and Harry S. Truman, but other mechanisms were also at work.

Alcoa, written by Judge Learned Hand (who was not a New Deal appointee) in 1945, undermined *Standard Oil* and *US Steel* by holding that a firm could be found to be a monopolist under the Sherman Act even when it had not been shown to have intended to dominate its market by engaging in unreasonable restraints of trade. While Hand held open the possibility that "superior skill, foresight, and industry" could vindicate some defendants, he implied that Alcoa's 90% market share was so great as to exclude this defense. Hand's decision was intimately linked to an administrative process involving DOJ and other agencies (as well as members of Congress) that led to the sale to new competitors of aluminum plants that had been built and run by Alcoa to supply the war effort. Alcoa was forced to license key patents as well (US v. Alcoa, 1945; Stein, 1952; Graham and Pruitt, 1990, pp. 239–271).

Hand's *Alcoa* opinion was far from a model of clarity, and as Harvard economist Edward Mason pointed out, it rested on a dubious economic analysis. US v. United Shoe Machinery Corporation (1953) undertook to elaborate on the issue of "superior skill". Aided by Mason's colleague and former student Carl Kaysen, who served as special master in the case, Federal District Judge Charles Wyzanski narrowed the exemption and placed the burden for proving superior skill with the defendant once the plaintiff had shown the existence of monopoly. Echoing Hand's comment that "rivalry is a stimulant to industrial progress", Wyzanski concluded that United Shoe's basic research program was not a "social advantage" sufficient to justify its monopoly. Kaysen, in his own book on the case and in a book with Kennedy-era antitrust division chief Donald Turner, argued that earlier decisions had been unduly lenient with respect to superior skill and that cases in which it justified substantial market power were very rare. In the post-*Alcoa* paradigm of "structure, conduct, performance" elaborated by these

and other academics, "technological progressiveness" was only one facet of performance that was assessed in antitrust cases (Mason, 1949; US v. Alcoa, 1945; US v. United Shoe Machinery Corporation, 1953; Kaysen, 1956; Kaysen and Turner, 1959; Areeda and Hovenkamp, 1996, pp. 32–38).

Arguments about the adequacy of the defendant's technological performance figured in a few of the major antitrust cases of the 1950s, 1960s, and 1970s. A Federal court in California found, for instance, that IBM's innovativeness justified such conduct as the redesign of interfaces that made it difficult for competing manufacturers of peripherals to interconnect their products with the firm's computers. By and large, though, "technological progressiveness" seems to have lost salience in the "structure, conduct, performance" paradigm as time passed, perhaps because it was devilishly hard to assess. The merger guidelines of 1968, for example, called for the application of strict market share criteria. The "nine no-nos" that governed antitrust analysis of intellectual property dealings were similarly rigid. Yet, even as structure came to be used as a surrogate for performance, economists were reaching the conclusion that the Schumpeterian hypothesis linking structure to innovation performance was misspecified. Variables other than market share (or firm size) were much more important determinants of firms' technological behavior; any rule based strictly on market share was thus likely to be wrong much of the time. *Fortune's* 1950 conclusion that the New Deal had created a "new rule of reason" that united law and economics seemed dated by the 1970s. The two fields had drifted apart, at least with respect to the governance of technological innovation (Ross, 1993, p. 30; Peritz, 1996, p. 232; Tom and Newburg, 1998; Mansfield, 1963; Williamson, 1965; McDonald, 1950). [6]

Reviewing the impact of antitrust policy on technological innovation in 1974, Jesse Markham judged that "one would be hard put to document a case where the prescribed remedy sacrificed past or prospective innovational intensity in the interests of greater allocative efficiency". In some important areas of technology, including electronics, petrochemicals, and pharmaceuticals as well as aluminum, compulsory patent licensing and other overt efforts to deconcentrate industrial structures probably hastened the pace of innovation, particularly by providing space for new firms to grow. The indirect effects of the New Deal order in antitrust policy, though, were at least as important as decisions in particular cases. David Hounshell and John Smith's study of DuPont, for instance, shows that that firm shifted resources from acquiring the promising technologies of would-be competitors to funding in-house R&D projects in the decades after World War II. The threat of antitrust action constrained corporate strategy and day-to-day decision-making for R&D, mergers and acquisitions, and other matters of structure, conduct, and performance in this period (Markham, 1974; Peck, 1961; Scherer, 1977; Hounshell and Smith, 1990).

5. The consolidation of the Chicago School, 1970s–1990s

In his criticisms of the New Deal order in antitrust policy, Schumpeter was ahead of his time. Not until the 1970s did such a critique gain substantial traction in the economics profession and the legal community. As the economy soured during that decade, scholars from the University of Chicago and elsewhere produced a vibrant literature that dwelt on the power of potential competition (as well as actual competition) to influence corporate behavior, a theme that echoed John B. Clark's views at the turn of the century as well as Schumpeter's at mid-century. The Chicago School and its close cousin, public choice theory, called for a radical relaxation of antitrust enforcement. They argued forcefully that New Deal antitrust policy had had a malign impact on technological innovation as well as on a wide range of other valuable economic activities.

The key idea of Chicago Schoolers in this regard was that the New Dealers had exaggerated the barriers to entry facing potential competitors even in concentrated industries. The findings of Bain and others to the contrary were reanalyzed and found to be anomalous or mistaken. In fact, this work contended, almost all markets were "contestable", particularly through the introduction of new products or processes. If firms were free to merge, set prices, and otherwise contract with one another as they saw fit, the market would tend to produce the most efficient industrial structure.

[6] Page (1995), labels this approach "formal realism". For an authoritative review of the economics literature, see Cohen and Levin (1989).

As Clark had suggested decades earlier, the absence of entry might well be a sign of efficiency, since firms were reacting effectively enough to the threat of entry to deter it (Brozen, 1992; Baumol, 1992).

The Chicago School concluded that antitrust policy decisions could rarely improve upon market outcomes, but could easily make them worse. By following rigid rules regarding industrial structure, for instance, policy-makers could prevent markets from adapting efficiently in response to changes in underlying technological and other circumstances. On the other hand, inconsistency in applying rules, which was virtually certain given the stresses and strains on prosecutors and judges, induced uncertainty among economic actors that could undermine investments in innovation. Public choice theory put the institutions of agenda-setting and decision-making under the microscope and found that they could produce systematic biases. Antitrust policy, public choice theorists argued, was vulnerable to exploitation by sore losers who were good lobbyists, including technologically stagnant firms that sought to win politically what they could not win in the market competition against more dynamic rivals. Prosecutors and judges, too, faced a public choice critique; they had incentives to seek bureaucratic power and legal fame rather than pursue efficiency or even justice (Baumol and Ordover, 1992; Ginsburg, 1979; Tollison, 1992; Page, 1999).

These ideas crept into antitrust policy decisions during the 1970s and then moved to center stage after the election of President Ronald Reagan in 1980. The appointments of Chicago Schoolers William Baxter to run DOJ's antitrust division and James Miller as chairman of the FTC were followed by dramatic reductions in appropriations and staffing. The number of private antitrust suits also declined, as the courts followed the conservative reorientation of the polity, and patent holders gained ground in their struggle to defend themselves in antitrust cases. The AT&T divestiture might be seen as a counter-example to the trend (and, in fact, there was substantial support in the Reagan White House for dismissing the AT&T case), but it is perhaps better interpreted as a blow against Federal Communications Commission (FCC) regulation, which the Chicago School disliked even more than aggressive antitrust enforcement. Baxter wanted, among other things, to ensure that the phone company's technology was deployed more quickly and so pushed successfully for breaking AT&T up into local and long-distance companies, rather than detaching Bell Labs and Western Electric from the phone service providers, as DOJ had proposed on a number of earlier occasions (Eisner, 1991, pp. 184–227; Economist, 1989; Dewey, 1990, pp. 44–49; Coll, 1986). [7]

One should be careful not to exaggerate the salience of technological innovation, which Chicago Schoolers lumped under the rubric "productive efficiency", in their thinking about antitrust. Prices, production, and profits — "allocative efficiency" — remained at the heart of their debate with the deconcentrationists of the New Deal order. The salience of Schumpeterian themes rose in the early 1980s, however, to the point that Congress entered into the decision-making process by enacting the National Cooperative Research Act (NCRA). The NCRA explicitly relaxed antitrust sanctions against cooperative R&D ventures of otherwise competing firms. The NCRA was a response to pressure from high-technology firms that wanted to work together (for instance, in the Microelectronics and Computer Technology Corporation (MCC)) and to a widespread desire to accelerate the pace of technological innovation and restore American competitiveness in the international economy, which seemed to many observers to have declined in the wake of the oil shocks and recessions of the 1970s (Wright, 1986).

Chicago Schoolers easily justified the NCRA as a step toward fuller freedom of contracting, an accommodation of new organizational forms, like research consortia, that were better adapted to new competitive circumstances. More interestingly, the NCRA reflected the crumbling of the New Deal antitrust consensus within the Democratic Congressional majority, which was triggered by the emergence of Japanese competition in microelectronics. Many Democrats believed that industry-wide research projects sponsored by the Ministry of International Trade and Industry (MITI) had contributed critically to Japan's success. Policies that had previously been seen in the national market to be concentrationist, fostering collusion to suppress innovation, came to be seen as deconcentrationist in the global market, overcoming collective action problems that inhibited innovation. Of course, the degree to which the government would play a role

[7] AT&T vertically disintegrated itself in the mid-1990s, spinning off Lucent and NCR.

in supporting cooperative R&D, as the Pentagon did in the formation of Sematech, an R&D consortium that served the semiconductor industry, divided the two political parties and their intellectual champions. So, too, did the degree to which the law ought to be relaxed downstream from the laboratory in production and marketing, which, as Thomas Jorde and David Teece have argued, can be seen as "complementary assets" essential for innovations to be diffused (Shoch, 1993; Jorde and Teece, 1989; Brodley, 1990). [8]

It is probably too soon to assess the impact of Chicago School-style antitrust policy on technological innovation and industrial development. Kenneth Flamm and others have found that innovation in telephone equipment and services has accelerated since the break-up of AT&T, although some commentators continue to express concern about the loss of long-term research formerly done by Bell Labs. Sematech may have aided the revival of the US semiconductor industry, but shifts in market preferences seem to have played a much bigger role. Patenting has accelerated dramatically in the past decade or so, yet there are reasons to think that this trend may be more a shift in legal than technological activity (Flamm, 1989; Grindley et al., 1994; Kortum and Lerner, 1999).

6. Antitrust approaches the millennium

The salience of technological innovation in the making of antitrust policy continued to rise in the 1990s. "Innovation", wrote *The Economist* in a special section devoted to the subject in February 1999, "has become the industrial religion of the late 20th century". The wellsprings of this faith lie in the "revolution" wrought by personal computers and the Internet. Whether or not the oft-overheated rhetoric of the information age ultimately bears up under careful analysis, the renewed attention to technology in the discipline of economics in recent years has produced a new set of contending ideas about antitrust policy. To some extent, these ideas have been taken up by antitrust enforcement agencies and by private litigants, placing technological issues on the antitrust policy agenda in a more prominent way than at any time in recent memory. We may stand at the brink of another "inflection point" (to use a favored phrase of Intel's Andrew Grove) in the history of antitrust as a technology policy, although crucial decisions remain to be made (Valery, 1999, p. 6; Grove, 1996).

The new critics of the Chicago School, who hailed as often as not from high-tech California, attacked their elders' claim that markets are nearly always contestable. Some markets for high-technology products, particularly those connected in networks and thus characterized by increasing returns to scale, they argued, are "winner-take-all". Winning, however, may not be due to technical optimality or productive efficiency, as the Chicago School would have it, but rather, as Stanford's W. Brian Arthur wrote, to "a series of trivial circumstances". The first product in a market subject to network effects might catch on as a result of a clever advertising campaign, for example, despite important technological defects. Once the market has "tipped" in a particular product's direction, its users quickly come to comprise an installed base that is very difficult to displace. Marketing and legal tactics as well as relatively trivial technical changes can be employed to sustain and deepen "lock-in", even at the cost of suppressing or inhibiting superior technological alternatives (Arthur, 1990; Shapiro and Varian, 1999).

The ideas of the Californians gave the antitrust enforcement agencies a new rationale for activism. As Daniel Rubinfeld (University of California, Berkeley and DOJ) put it, the key question for prosecutors was now "whether the quantity and quality of innovation would be significantly improved were the dominant firm to make its decisions on the basis of real economic efficiencies." Yet, even those of the Californians who entered government service were not wholehearted in their advocacy of an aggressive policy that would force such firms to do so. Michael Katz (University of California, Berkeley and FCC) and Carl Shapiro (University of California, Berkeley and DOJ), for instance, balanced the possibility of lock-in against the prospect that high-tech markets might exhibit "insufficient friction", leading technology to change more rapidly than was economically optimal. They also noted that market failures due to either lock-in or insufficient friction could be solved by mechanisms other than government intervention, including coordinated action by the firms involved. The Chicago School's skepticism about the competence of antitrust policy-making

[8] In 1993, Congress extended the NCRA's rules into production joint ventures to a limited degree.

institutions has been absorbed even by many of its critics (Rubinfeld, 1998; Katz and Shapiro, 1994).

The signal case [9] of the new era, US v. Microsoft, engages these issues. In a brief that acknowledged assistance from Arthur and his Stanford colleague Garth Saloner, Netscape's law firm argued in 1995 that the "application of 'increasing returns' economic analysis would reasonably predict that, given the present situation, Microsoft will succeed in monopolizing the entire network... and that the monopoly will remain in place for a very long time... unless there is strong government intervention" (Reback et al., 1995). Microsoft retorted that these lock-in effects were merely hypothetical, a theoretical possibility without empirical substantiation. "Our message is simple:" wrote economists Stanley Liebowitz and Stephen Margolis, whose analysis supported Microsoft's defense (although it was not presented in court), "Good products win" (Liebowitz and Margolis, 1999, p. 235). The DOJ's briefs in this debate, prepared by Kenneth J. Arrow (a Stanford economist of an earlier generation than Arthur and Saloner) and Franklin M. Fisher (an MIT economist who had been IBM's chief economic witness in its antitrust defense), took a middle path. While apparently accepting their colleagues' increasing returns analysis of the personal computer software market, they refused to rest the case on it. Even if such markets were prone to what Arrow labeled "purely natural barriers to entry", these might well be transient; in any event, government action would not necessarily solve the problem. Instead, DOJ alleged that Microsoft's behavior violated well-established legal norms ("black-letter principles") for a firm with market power, such as those that restrict bundling together of otherwise distinct products (like operating systems and applications) and forbid the maintenance of monopoly by limiting consumer choice (Arrow, 1995; Fisher, 1998; Lopatka and Page, 1995). [10]

The government's effort to rehabilitate dusty precedents while judiciously blending in new economic ideas in *Microsoft* is indicative of a new antitrust enforcement agenda that focuses on at high-technology industries. Another example is the FTC's allegation that Dell "ambushed" previously agreed standards for interconnection in order to create uncertainty among potential customers of its competitors, echoing charges made against IBM in the 1970s. Similarly, the administration entered into a dispute over intellectual property rights and access to technical information between Intel and firms that were both customers and competitors of Intel. And, DOJ and the FTC together have offered new guidelines for the review of proposed mergers that involve "innovation market analysis" to determine whether the merger will reduce competition to develop new products as well as offer existing products. Ciba-Geigy and Sandoz, for instance, were required to license patents related to gene therapy as a condition of approval of their merger (Moore, 1993; Yang, 1994; Baer, 1998; Hay, 1995; Gilbert and Sunshine, 1995).

The editor of the *Antitrust Law Journal* summed up the new antitrust enforcement agenda as "reverse Schumpeterian" (or, in my terminology, deconcentrationist) (Brunell, 1995). But this claim goes too far. Sensing the theoretical and legal limits of the new economics of technological innovation, the FTC and DOJ explicitly reject a return to the rigid rules of the 1970s, preferring case-by-case consideration (Federal Trade Commission, 1996). Cooperation among competitors, like the major auto manufacturers, that would have been viewed with extreme skepticism by the agencies a generation ago, is now routinely accepted (and championed by the President himself) in the context of global competition (Wald, 1993). Moreover, crucial decisions on the new agenda have yet to be rendered. The Chicago School remains a potent force. Many of its adherents still sit on the Federal bench (as Microsoft well knows), and the case-by-case approach gives the judiciary a louder voice in decision-making than it has had at some points in the past.

Only time will tell whether this blend of concentrationist and deconcentrationist elements is stable. It is also too soon to evaluate the impacts of recent antitrust policy. Pronouncements of the death of "Wintel" (Microsoft operating systems and Intel microprocessors) are surely premature. Even if Java and Linux displace Windows and network computing supplants the personal computer, analysts will have face an enormous challenge in isolating the effect of the change in antitrust policy from the technological

[9] Technically, there have been four cases against Microsoft, involving a variety of different charges. I abstract from them for expository reasons here.

[10] Microsoft case documents, including can be found at http://cyber.law.harvard.edu/msdoj/index.html. On 3 April 2000, Judge Jackson issued his "Findings of Law", holding in favor of the Justice Department on most aspects of the case.

and organizational changes that coincide with it (Chandresekan, 1999; Wong, 1999).

7. Conclusion

In important respects, the history of US antitrust policy as a technology policy, as I have told it in the preceding four sections of this paper, is cyclical. The trend in economic ideas, for example, has swung back and forth between favoring concentration and favoring deconcentration over the past 110 years. These variations in the intellectual environment have influenced the policy agenda, giving it a cyclical character as well, particularly after economists were integrated into policy-making institutions during and after the New Deal. As might be expected, the cycle of policy decisions seems to lag behind that of the policy agenda, and the swings are less marked. This dampening reflects the intrinsic conservatism of the judicial process and the capacity of that process to retain a substantial share of control over antitrust policy decision-making, despite the rise of alternative administrative processes. Overall, the cycles in antitrust policy-making correspond reasonably well with realignments in the American political system; these, in turn, correspond with major economic downturns, with the curious exception of the current period, which may or may not prove to be a true turning point in retrospect. If contemporary "new" Democrats continue to control the Presidency, they may eventually put as strong a mark on the judiciary and its policy decisions as their New Deal forbears did. Or, such influence may elude them, as it did Woodrow Wilson (Burnham, 1970; Wood and Anderson, 1993).

The salience of technological innovation in antitrust policy-making has followed a rather different cycle. It peaked first in the late 1930s and 1940s and has returned to prominence in the past couple of decades. In the first period of prominence and in the 1990s, policy-makers worried that US industrial organization stifled economic growth by permitting technologically powerful firms so much freedom that they could crush innovative rivals too easily; in the 1980s, the dominant concern was that firms had too little freedom to cooperate and consolidate in the face of new, technologically innovative, international competitors. These variations perhaps reflect trends in popular interest in technology as an element in economic development and related popular doubts and fears. One would be hard-pressed, I think, to associate them with realignments or with long waves in the economy, although these hypotheses might merit further study.

The cyclical reading of the narrative can be made more sophisticated by attending to secular trends that have overlain the policy cycles. The expansion of the scope of markets and the increasing complexity of the organizations that serve markets are, along with technological change itself, perhaps the most profound of these trends. Larger markets and larger firms continually bring new issues to the policy agenda and complicate decision-making. The emergence of national markets in the late 19th and early 20th century centuries and the parallel rise of national corporations, for instance, evoked an anti-technology and anti-corporate backlash and brought all three branches of the Federal government into the regulatory process. Globalization of markets and firms in the current period has prompted industry-wide technology partnerships at the national level and cross-national strategic alliances and has challenged policy-makers to rethink their established methods of analyzing market structure. Under these conditions of economic and organizational dynamism, one period's precedents with regard to, say, cartels or market shares, are not easily applied to the next period's cases. This secular trend makes it easier to reinterpret the past in order to accommodate shifts in antitrust policy decision-making.

Lurking beneath the cyclical and the secular in this history are the static features of antitrust policy-making in the US. Agenda-setting and decision-making institutions are and always have been fragmented and relatively open to a range of participants; the policies they produce are therefore neither fully consistent with one another nor permanently locked-in. Judges appointed to serve for life by a president from one party, for example, often confront antitrust prosecutors working for a president from the other party. Private parties can initiate policy change even when the administration would prefer the status quo. Against the main current in each era of policy, then, one can find eddies and counter-currents that may serve as the basis for the next change of course.

I do not believe that history yields unqualified policy recommendations, but it can raise possibilities for debate. One potentially useful insight from

this history stems from the observation that interest in technological innovation among antitrust policy-makers is sporadic and relatively rare over the long run. The salience of high-technology issues today will not be sustained unless actors with an abiding interest in such issues make a concerted effort to build new institutional linkages between antitrust and technology policy. The antitrust enforcement agencies might be given a reporting responsibility with regard to technology issues, for instance, that gives them incentives to bolster their staffs with relevant expertise. With due attention to the potential for conflict of interest, representatives of these agencies might also be brought into interagency technology policy coordinating bodies.

Such steps would mark progress beyond the so-called "postwar consensus" in US technology policy. As the dominance of the private sector in US research and innovation continues to grow, technology policy-makers will need to draw on a broader range of tools if they are to maintain their influence on innovation. Antitrust enforcement is one such tool, and, judiciously deployed, it can complement tax incentives, trade regulations, and other relatively new dimensions of technology policy, not to mention the more traditional tool of public R&D funding.

This history should also teach us humility, however. Integration in this policy area can at best be partial and temporary. "Muddling through", as Charles Lindblom would have it, is likely to be a permanent condition of post-Cold War technology policy. The chastening effect of the Chicago School on the antitrust policy proposals of their California critics should find an echo in the technology policy community, even as we embrace a wider range of policy instruments in our analysis and recommendations than ever before. There is plenty of scope for public policy to do damage. We should continue to explore non-governmental mechanisms for carrying out publicly beneficial tasks. Working on the margins of a messy system, however, is not the same as doing nothing. If policy-makers can enhance the "positive interference" between antitrust enforcement and public R&D spending, for instance, such that these two policy instruments acting together are more effective than each acting separately, technology policy will have taken an important step forward.

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