INNOVATION AND COOPERATION: IMPLICATIONS FOR COMPETITION AND ANTITRUST

by

Thomas M. Jorde and David J. Teece

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Nobel Laureate Robert Solow and his colleagues on MIT’s Industrial Productivity Commission recently noted (Dertouzos, Lester, and Solow, 1989, p. 7): “Undeveloped cooperative relationships between individuals and between organizations stand out in our industry studies as obstacles to technological innovation and the improvement of industrial performance” and later (p. 105) that “interfirm cooperation in the U.S. has often, though not always, been inhibited by government antitrust regulation.” These striking conclusions warrant further exploration.

Unfortunately, industrial organization textbooks still discuss horizontal cooperation and competition almost exclusively in terms of standard cartel theory. (On the other hand, vertical cooperation/contracting is viewed differently, and some textbooks provide treatments of supplier-buyer relationships in which cooperation is viewed as enhancing efficiency.) Both in the textbooks and in policy discussion among economists, cooperation among competitors is highly suspect, being perhaps the last bastion of what was once referred to as the “inhospitality tradition” in antitrust. As a result, very little literature addresses how cooperation among competitors can promote competition, notwithstanding that cooperation among competitors may sometimes be essential if innovating firms are to compete in today’s increasingly global markets (Imai and Baba, 1989). Such cooperation is already important in Japan and in Europe.1

1For instance, cooperative R&D and related activities have been important to the success of the Western German machine tool industry. The industry formed a strong association that has a research and teaching institute at Aachen. The West German industry has been described as

Thomas M. Jorde is Professor of Law, University of California, Berkeley, California. David J. Teece is Mitsubishi Bank Professor, Walter A. Haas School of Business, University of California, Berkeley, California.
This paper begins by describing the nature of the innovation process. We then explore socially beneficial forms of cooperation that can assist the development and commercialization of new technology, and suggest modifications to current U.S. antitrust law that would remove unnecessary impediments to organizational arrangements that support innovation and stimulate competition in the United States. The modifications we propose would create "safe harbors" for various forms of cooperative activities among competitors in unconcentrated markets, and they would permit cooperation in concentrated markets if commercialization and appropriability were thereby facilitated. These modifications would bring U.S. antitrust laws closer to what is already in place in Europe and Japan and would promote competition more assuredly than would existing law.\(^2\)

We have no illusion that our proposed changes, standing alone, would dramatically improve the performance of U.S. industry, though specific industries might be transformed. However, the changes we propose in antitrust have the attraction that they do not require the expenditure of public funds. In short, we see existing law as a self-imposed impediment to U.S. economic performance.\(^3\)

**The Nature of Innovation**

Innovation is the search for, and the discovery, development, improvement, adoption and commercialization of new processes, new products, and new organizational structures and procedures.\(^4\) It involves uncertainty, risk taking, probing and reprobing, experimenting, and testing. It is an activity in which "dry holes" and "blind alleys" are the rule, not the exception. Many of these aspects are well-known and have been frequently analyzed in the economics literature.

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\(^2\)There is no necessary conflict between promoting cooperation and competition, if the cooperation improves efficiency or advances innovation. As Schumpeter (1942, p. 85) pointed out, when compared to competition among firms with similar products and technologies, the competition that counts "comes from the new commodity, the new technology, the new source of supply.... This kind of competition is as much more effective than the other as bombardment is in comparison with forcing a door, and so much more important that it becomes a matter of comparative indifference whether competition in the ordinary sense functions more or less promptly."

\(^3\)As this *Journal of Economic Perspectives* issue goes to press, the House Judiciary Committee approved the "National Cooperative Production Amendments of 1990" (H.R. 4611), a bill that incorporates many of the changes we suggest in this article and which we have been advocating since 1988. We discuss the provisions of H.R. 4611 and additional antitrust changes that we believe would advance innovation and U.S. competitiveness later in this article.

\(^4\)Dosi (1988) provides an excellent review of the innovation literature.
However, other aspects of innovation, particularly its organizational requirements, have not been sufficiently explored. The traditional serial model that has served as the basis for current antitrust policy is described below. Its inadequacies are then addressed in light of the “simultaneous” nature of the process, which is particularly relevant in certain industries, like microelectronics, experiencing high rates of technological change.5

The Traditional Serial Model

Traditional descriptions of the innovation process commonly break it down into a number of stages which proceed sequentially and theoretical treatments of R&D in industrial organization reflect this model. According to this view, the innovation process proceeds in a linear and predictable fashion from research to development, design, production, and then finally to marketing, sales, and service (Grossman and Shapiro, 1986, p. 319; Tirole, 1988, p. 389). In simple models, there is not even any feedback or overlap between and among stages.

If the serial model adequately characterizes innovation today, then it is mainly the innovation which occurs in some scale-intensive industries. The initial development of nylon at Dupont perhaps fits this model. The Manhattan Project during World War II is also illustrative. The serial model does not address the many small but cumulatively important incremental innovations that are at the heart of technological change in many industries, especially well-established industries like semiconductors, computers, and automobiles. The serial model of innovation is an analytic convenience which no longer adequately characterizes the innovation process, except in special circumstances.

The serial model has enabled economists to model innovation as a vertical process. Inasmuch as antitrust policy toward vertical restraints is very permissive, many economists and legal scholars do not understand how U.S. antitrust laws could stand in the way of the various kinds of standard and non-standard contracting often needed to support the commercialization of innovation. But as we shall see, matters are not so simple.

The Simultaneous Model

The simultaneous model of innovation recognizes the existence of tight linkages and feedback mechanisms which must operate quickly and efficiently, including links between firms, within firms, and sometimes between firms and other organizations like universities. From this perspective, innovation does not necessarily begin with research; nor is the process serial. But it does require rapid feedback, mid-course corrections to designs, and redesign.6 This concep-

5This argument is presented at greater length in D. Teece (1989a).
6This process has also been termed “cyclic” (Gomory, 1987, p. 72). The popular press has even begun to recognize and discuss the simultaneous nature of innovation and effective commercialization. See “A Smarter Way to Manufacture,” Business Week, April 30, 1990, 110-117 (discussing “concurrent engineering”).
irtualization recognizes aspects of the serial model—such as the flow of activity, in certain cases through design to development, production and marketing—but also recognizes the constant feedback between and among activities, and the involvement of a wide variety of economic actors and organizations that need not have a simple upstream-downstream relationship to each other. It suggests that R&D personnel must be closely connected to the manufacturing and to marketing personnel and to external sources of supply of new components and complementary technologies, so that supplier, manufacturer and customer reactions can be fed back into the design process rapidly. In this way new technology, whether internal or external, becomes embedded into designs which meet customer needs quickly and efficiently.

The simultaneous model visualizes innovation as an incremental and cumulative activity that involves building on what went before, whether it is inside the organization or outside the organization, and whether the knowledge is proprietary or in the public domain. The simultaneous model also stresses the importance of the speed of the design cycle, and flexibility. IBM followed this model in developing its first PC, employing alliances with Microsoft and others to launch a successful personal computer system. Sun Microsystems and NeXT Computer launched themselves in this way and have remained in this mode for subsequent new product development. Microprocessor development at Intel often follows this logic too.

When innovation has this character, the company which is quickest in product design and development will appear to be the pioneer, even if its own contribution to science and technology is minimal, because it can be first to “design in” science and technology already in the public domain. Both small and large organizations operate by this model, reaching out upstream and downstream, horizontally and laterally to develop and assemble leading edge systems.

In short, much innovation today is likely to require lateral and horizontal linkages as well as vertical ones. As we discuss below, and particularly for small firms, innovation may require accessing complementary assets which lie outside the organization. If innovating firms do not have the necessary capabilities in-house, they may need to engage in various forms of restrictive contracts with providers of inputs and complementary assets. The possibility that antitrust laws could be invoked, particularly by excluded competitors, thus arises. Lying in the weeds to create mischief for unsuspecting firms engaged in socially desirable but poorly understood business practices are plaintiffs’ attorneys and their expert economists entreat the courts to view reality through the lens of monopoly theory and modern variants such as raising rivals. These theories

Moreover, the linkage from science to innovation is not solely or even preponderantly at the beginning of typical innovations, but rather extends all through the process. “Science can be visualized as lying alongside development processes, to be used when needed” (Kline and Rosenberg, 1986). Design is often at the center of the innovation process. Research is often spawned by the problems associated with trying to get the design right. Indeed, important technological breakthroughs can often proceed even when the underlying science is not understood.
have been honed in the context of a hypothetical world of unchanging technology. If new technology does arrive it often falls like manna from heaven; behavior which is anticompetitive in the static context may be procompetitive in a dynamic one. Because the study of innovation is largely outside the mainstream of economic research and antitrust jurisprudence, the possibility of expensive and distracting litigation followed by judicial error is significant. Paradoxically, the giant integrated enterprises are not most heavily at risk. Instead, most at risk are mid-sized enterprises that have developed and commercialized important innovations, because such firms are likely to have some market power (under orthodox definitions) and have the need to engage in complex forms of interfirm cooperation. Because of these risks, managers may choose to forego socially desirable arrangements and investments, and innovation and the competition it engenders will be attenuated.

Organizational Requirements of Innovation

Whether innovation is serial or simultaneous, it requires the coordination of various activities. The serial model suggests a rather simple organizational problem; the simultaneous model a more complex one, often employing various forms of non-standard contracting. To the extent that economists employ just the serial model, they greatly oversimplify the organizational challenges which innovation provides and underestimate potential antitrust problems. Also, they probably exaggerate the importance of research and downplay the importance of other factors. As discussed below, except in special cases, a firm's R&D capability is for naught if it cannot organize the rest of the innovation process efficiently and effectively, particularly if that innovation is taking place in an already-established industry.

For innovations to be commercialized, the economic system must somehow assemble all the relevant complementary assets and create an interactive and dynamically efficient system of learning and information exchange. The necessary complementary assets can conceivably be assembled by administrative processes, or by market processes, as when the innovator simply licenses the technology to firms that already own the relevant assets, or are willing to create them. These organizational choices have received scant attention in the context of innovation. Indeed, the serial model relies on an implicit belief that arm's-length contracts between unaffiliated firms in the vertical chain from research to customer will suffice to commercialize technology. In particular, there has been little consideration of how complex contractual arrangements among firms can assist commercialization—that is, translating R&D capability into profitable new products and processes. The one partial exception is a tiny literature on joint R&D activity (Grossman and Shapiro, 1986; Ordover and Willig, 1985); but this literature addresses the organization of R&D and not the organization of innovation.8

8For a more complete statement of our own views on this, see Teece (1977, 1989b).
If innovation takes place in a regime of tight appropriability—that is, if the technological leader can secure legal protection, perhaps by obtaining an ironclad patent (Teece, 1986)—and if technology can be transferred at zero cost as is commonly assumed in theoretical models, the organizational challenge that is created by innovation is relatively simple. In these instances, the market for intellectual property is likely to support transactions enabling the developer of the technology to simply sell its intellectual property for cash, or at least license it to downstream firms who can then engage in whatever value-added activities are necessary to extract value from the technology. With a well-functioning market for know-how, markets can provide the structure for the requisite organization to be accomplished.

But in reality, the market for know-how is riddled with imperfections (Arrow, 1962). Simple unilateral contracts, where technology is sold for cash, are unlikely to be efficient (Teece, 1980, 1982). Complex bilateral and multilateral contracts, internal organization, or various hybrid structures are often required to shore up obvious market failures (Williamson, 1985; Teece, 1986). This section will examine various market failures and the institutional arrangements which can ameliorate them.

Technology Transfer Efficiency

The transfer of technology among the various activities that constitute innovation is not costless. This is especially true if the know-how to be transferred cannot be easily bundled and shipped out in one lot—which is clearly the case when the development activity must proceed simultaneously and when the knowledge has a high tacit component. In these instances, the required transfer of technology cannot be separated from the transfer of personnel, which is typically difficult if the contractual relationship is arms-length and non-exclusive.

Besides the problems of getting technology-driven concepts to market, there is the converse problem of getting user-driven innovations to developers. In some industries, users other than the manufacturers conceive of and design innovative prototypes. The manufacturers’ role in the innovation process is somehow to become aware of the user innovation and its value, and then to manufacture a commercial version of the device for sale to other users. User-dominated innovation accounts for more than two-thirds of first-to-market innovations in scientific instruments and in process machinery used in semiconductor and electronic subassembly manufacture (von Hippel, 1988). Clearly, user innovation requires two kinds of technology transfer: first from user to manufacturer, and then from the manufacturer to the developer-user and other users.

Mirroring the role that users play in stimulating innovation upstream is the role that suppliers play in stimulating downstream innovation. For example, a good deal of the innovation in the automobile industry, including fuel injection,
alternators and power steering, has its origins in upstream component suppliers. Bendix and Bosch developed fuel injection and Motorola the alternator. The challenge to the manufacturer then becomes how to "design in" the new components and how to avoid sole source dependency. As discussed below, deep and enduring relationships need to be established between component developer-manufacturers and suppliers to ensure adoption and diffusion of the technology.10 These relationships, while functionally vertical, could well turn out to be viewed as horizontal by a court. Unless the courts have an adequate model of innovation and competition presented to them, beneficial contractual arrangements with attendant restraints could well be viewed negatively.

Scale, Scope, and Duplication Issues

Successful new product and process development innovation often requires horizontal and lateral as well as vertical cooperation. It is well understood that horizontal linkages can help overcome scale barriers in research; they can also assist in defining technical standards. But it is common to assert that if firms need to engage in joint research to achieve these economies, the maintenance of competition requires that firms participating in joint research work go their own way with respect to related activities such as manufacturing. However, a requirement that firms participating in a joint research arrangement commercialize the technology independently can impose an unnecessary technology transfer burden. As discussed above, the imposition of a market interface between "research" and "commercialization" activities will most assuredly create a technology transfer challenge, a loss of effectiveness and timeliness, and higher costs.

Collaborative research also reduces what William Norris, CEO of Control Data Corporation, refers to as "shameful and needless duplication of effort" (David, 1985). Independent research activities often proceed down identical or near-identical technological paths. This is sometimes wasteful and can be minimized if research plans are coordinated. The danger of horizontal cooperation, on the other hand, is that it may reduce diversity. This concern is legitimate and is commonly stressed by economists.11 Unquestionably, a system

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10A related set of vertical relationships involving innovation has been remarked upon by Rosenberg (1972, pp. 98-102) in his treatise on technology and American economic growth. The machine tool industry in the 19th century played a unique role both in the initial solution of technical problems in user industries, such as textiles, and as the disseminator of these techniques to other industries, such as railroad locomotive manufacture. Rosenberg's description suggests that the users played a role in the development of new equipment. He notes that before 1820 in the United States, one could not identify a distinct set of firms that were specialists in the design and manufacture of machinery. Machines were either produced by users or by firms engaged in the production of metal or wooden products. Machinery-producing firms were thus first observed as adjuncts to textile factories. However, once established, these firms played an important role as the transmission center in the diffusion of new technology.

11Nalebuff and Stiglitz (1983) argue that the gains from competition may more than offset the losses from duplication. Also, Sah and Stiglitz (1989) show that in a model with ex post Bertrand competition where there is knowledge of which research projects others are undertaking, the number and range of research projects undertaken will be a constrained Pareto optimum.
of innovation that converges on just one view of the technological possibilities is likely to close off productive avenues of inquiry.

However, a private enterprise economy without horizontal coordination and communication offers no guarantee that the desired level of diversity is achieved at the lowest cost. In addition, cooperation need not be the enemy of diversity. If firms can coordinate their research programs to some degree, duplication can be minimized without the industry converging on a single technological approach. Indeed, Bell Labs has been noted for the very considerable internal diversity it has been able to achieve, at least in the pre-divestiture period.

Rent Dissipation Issues

Innovation has well-known free rider and public good characteristics. Know-how leakage and other spillovers impair incentives to innovate by redistributing benefits to others, particularly competitors and users. To maintain adequate incentives to invest in innovative activity, without providing government subsidies, free riding must be curtailed. This is how economists justify patents, copyrights, trade secrets, and other aspects of intellectual property law.

The organizational form in which innovation takes place, interacting with the protection provided by intellectual property law (Teece, 1986), will affect the degree of rent dissipation which the innovator experiences. If the innovation has value and intellectual property protection is effective, an innovator specializing just in early stage activity is in a good position to capture a portion of the returns from innovation.

But surveys show that intellectual property law has a limited ability to provide protection from imitation,12 even though there have been recent efforts by the courts to tighten enforcement. For a sample of 48 patented product innovations in the chemical, drug, electronics and machinery industry, one group of researchers found that within four years of their introduction, 60 percent of the patented successful innovations in the sample were imitated (Mansfield et al, 1982). Not surprisingly, the social returns to innovation are greater than the private returns. Underinvestment in innovative activities is to be expected.

A "research joint venture" may not do enough to overcome appropriability problems, unless many potential competitors are in the joint venture. Thus, a

12See Levin, Klevorick, Nelson, and Winter (1987). These researchers surveyed R&D managers in various industries. The survey shows that, on a seven-point scale (1 = not at all effective, 7 = very effective) for 18 industry categories with 10 or more respondents, managers in only chemicals (specifically drugs, plastic materials, inorganic chemicals, and organic chemicals) and petroleum refining rated process patents effectiveness higher than 4 on the scale, and only these same chemical industries and steel mills rated product patents higher than 5. These findings make very clear that managers have little confidence that patents suffice as mechanisms to protect intellectual property from free riders. The results also show that other methods of appropriation such as first mover advantages (lead time and learning curve advantages), secrecy, and investment in sales or service support were more effective.
single firm or even a consortium with good intellectual property protection will often need to bolster its market position and its stream of rents by other strategies and mechanisms. These mechanisms include building, acquiring, or renting (on an exclusive basis) complementary assets and exploiting first-mover advantages. We use the term *complementary assets* to refer to those assets and capabilities that need to be employed to package new technology so that it is valuable to the end user.\(^\text{13}\) Broad categories of complementary assets include complementary technologies, manufacturing, marketing, distribution, sales, and service.

It is essential to distinguish further between generic and specific complementary assets. Generic assets include general purpose facilities and equipment and nonspecific skills; they tend to be disembodied and codified and hence easy to transfer. Specific assets, on the other hand, include highly differentiated system and firm-specific assets and skills. Specific assets and capabilities are typically embedded in the organization; or even if not embedded in the organization (like a specialized machine) are of reduced value in a different organizational context. In a sense, specific assets represent the firm's particular assemblage of physical assets and prior learning. Accordingly, they are difficult for competitors to replicate.

Thus, when imitation of aspects of a firm's technology is easy, it is essential for firms to be world-class—or to be linked to partners who are world-class—in the less imitatable complementary activities. Accordingly, the best defense against product imitators may well be the development of a less easily imitable superior manufacturing process to make the product, or it may be the firm's superior service capability. In short, because a firm's comparative advantage in research does not necessarily coincide with an advantage in the relevant complementary assets, the expert performance of the innovator's contractual partners in certain key activities complementary to the easily imitable activities is often essential if the innovator is to capture a portion of the profits that the innovation generates. The antitrust laws must be shaped so that they do not impair such beneficial linkages.

In this regard, many British and American firms responsible for important product innovations have captured very little value from innovations for which they have been responsible because of their weaknesses in manufacturing. Often competitors can quickly reverse engineer new products. Once the new product design is apparent to competitors, success in the marketplace is determined by manufacturing costs and quality. In these circumstances, firms that are excellent at manufacturing—and this excellence is often harder to replicate than a new product is to reverse engineer—can garner practically all of the profits associated with the new product designs. Hence it is critical that

\(^{\text{13}}\) There has been almost no treatment in the economic literature of the concept of complementary assets. It does not map easily into the familiar concept of indivisibilities, which is perhaps the closest analogue. For a more complete treatment, see Teece (1986).
innovating firms protect themselves from such outcomes by developing or somehow uniquely accessing the requisite complementary assets. The next section explains why cooperation may be necessary for firms to perform this function.

**Governance Alternatives**

The previous section has argued that innovation often requires firms to enter complex contracts and relationships with other firms to bring technology to the market, and to hold imitators at bay. This section considers in more detail the range of organizational alternatives available to the innovator to generate, coordinate and control such complementary assets.

Consider first the price mechanism. Theoretical treatments generally assume that the requisite coordination and control can be achieved by the invisible hand. Efficient levels of investment in complementary assets are brought forward at the right time and place by price signals. Entrepreneurship is automatic and costless. This is the view implicit in textbook presentations; in turn, the textbook view seems implicit in U.S. antitrust law.

However, many economists seem to have what Tjalling Koopmans calls an “overextended belief” regarding the efficiency of competitive markets as a means of allocating resources in a world characterized by ubiquitous uncertainty. Market failures are likely to arise because of the ignorance which firms have with respect to their competitors’ future actions, preferences, and states of technological information (Koopmans, 1957, part II). In reality, nothing guarantees that investment programs are made known to all concerned at the time of their inception. This uncertainty is especially high for the development and commercialization of new technology. Accordingly, innovating firms need to achieve greater coordination than the price system alone appears to be able to bring about.

A second mechanism for effectuating coordination is the administrative processes within the firm. A company’s internal organization can serve to shore up some market imperfections and provide some of the necessary coordination. As Alfred Chandler (1977) has explained, the modern multidivisional business enterprise “took over from the market the coordination and integration of the flow of goods and services from the production of raw materials through the several processes of production to the sale to the ultimate consumer ... administrative coordination replaced market coordination in an increasingly large portion of the economy.” Oliver Williamson (1985) has developed an elegant and powerful framework to explain the relative efficiencies of markets and administrative processes. However, one property of large integrated structures is that they have the potential to become excessively hierarchical and less responsive to market needs (Teece, 1989c). Accordingly, at least for some aspects of innovative activity, smaller organizations are often superior.
In between pure market and full administrative solutions are many intermediate and hybrid possibilities, including interfirm agreements. Interfirm agreements can be classified as unilateral (where \( A \) sells \( X \) to \( B \)) or bilateral (whereby \( A \) agrees to buy \( Y \) from \( B \) as a condition for making the sale of \( X \), and both parties understand that the transaction will be continued only if reciprocity is observed). Such arrangements can also be multilateral.

An especially interesting interfirm agreement is the strategic alliance, which can be defined as a bilateral or multilateral relationship characterized by the commitment of two or more partner firms to a common goal. A strategic alliance might include (1) technology swaps, (2) joint R&D or co-development, and/or (3) the sharing of complementary assets, such as where one party does manufacturing and the other distribution for a co-developed product. If the common goal was simply price-fixing or market-sharing, such an agreement might constitute a cartel, especially if the agreement included substantially all members of an industry.

By definition, a strategic alliance can never have one side receiving cash alone; it is not a unilateral exchange transaction. Nor do strategic alliances include mergers, because alliances by definition cannot involve acquisition of another firm’s assets or controlling interest in another firm’s stock. Alliances need not involve equity swaps or equity investments, though they often do. Strategic alliances without equity typically consist of contracts between or among partner firms that are nonaffiliated. Equity alliances can take many forms, including minority equity holdings, consortia, and joint ventures. Such interfirm agreements are usually temporary, and are assembled and disassembled as circumstances warrant. Typically, only a limited range of the firm’s activities are enveloped in such agreements, and many competitors are excluded.

Strategic alliances, including consortia and joint ventures, are often an effective and efficient way to organize for innovation, particularly when an industry is fragmented. Interfirm cooperation preserves market selection and responsiveness; in a sense, it is the pure private enterprise solution. The case for planning and industrial policy recedes if a degree of operational and strategic coordination can be attained through private agreements. The benefits associated with less hierarchical structures can be obtained without incurring the disadvantages of insufficient scale and scope.

**Antitrust Treatment of Interfirm Agreements**

Current U.S. antitrust law needlessly inhibits interfirm agreements designed to develop and commercialize new technology. The problem is that the legal standards for interfirm agreements are ambiguous. While “rule of reason” analysis will generally be applied to contractual arrangements designed to advance innovation, the elements of rule of reason analysis are quite muddled.
In addition, although current law seems to recognize a "safe harbor" for mergers and acquisitions between firms that will have less than 20 percent market share, it does not recognize a similar safe harbor for horizontal contractual arrangements among firms.

The Clayton Act also permits private parties to sue for treble damages for alleged antitrust injuries, and allows state attorney generals to recover treble damages on behalf of persons residing in the state. Successful plaintiffs can also recover attorneys' fees. These remedies are available only in the United States. They provide a powerful incentive for plaintiffs to litigate, and given the current state of the law, a powerful disincentive for businesses to form cooperative innovation arrangements and strategic alliances. While measuring the missed opportunities for cooperative innovation caused by the threat of treble damage litigation is difficult, we believe the loss is substantial. Moreover, these disincentives work to the particular detriment of small and medium-sized innovative firms in industries where the innovative process is simultaneous.

Congress has recognized that these provisions may inhibit technological innovation, and the National Cooperative Research Act (NCRA) of 1984 took two significant steps to remove legal disincentives to cooperative research. First, the NCRA provides that "joint research and development ventures" must not be held illegal per se, and that such ventures instead should be "judged on the basis of [their] reasonableness, taking into account all relevant factors affecting competition, including, but not limited to, effects on competition in properly defined, relevant research and development markets." Second, the NCRA establishes a registration procedure for joint research and development ventures, limiting antitrust recoveries against registered ventures to single damages, interest, and costs, including attorney's fees. Thus, Congress eliminated the threat of treble damages for litigation challenging cooperative R&D arrangements, provided that the parties to the arrangement first register their venture. But R&D is only a small piece of the innovation puzzle.

In our view, the NCRA is not sufficiently permissive. The substantive protections provided by the NCRA—guaranteed rule of reason treatment and reduction of damages—extend only to research, and downstream commercial activity "reasonably required" for research and narrowly confined to marketing intellectual property developed through a joint R&D program. Treatment of other agreements designed to facilitate innovation is thus left uncertain, to be determined only by interpretation of the "reasonably required" standard. The NCRA unwise precludes joint manufacturing and production of innovative products and processes, which is often necessary to provide the cooperating ventures with significant feedback information to aid in further innovation and product development, and to make the joint activity profitable. The NCRA implicitly accepts the serial and not the simultaneous model of innovation.

In addition, the NCRA gives little guidance concerning the substantive content of its rule of reason approach. While the Act did require that markets be defined in the context of research and not the products that might result from it, the NCRA fails to specify factors to be considered within rule of reason
analysis. It simply requires consideration of "all relevant factors affecting competition," paying no special attention to the special characteristics of the innovation process in a quickly changing industry.

Finally, while the NCRA's elimination of treble damages for registered ventures is an important step forward, cooperating firms are still not protected from antitrust litigation. Even after the NCRA, antitrust law still permits private plaintiffs to engage in treble damage litigation against cooperative arrangements facilitating commercialization. Moreover, single damages are still available even against those registered under NCRA. The cost of defending antitrust suits is not materially reduced by the exceedingly narrow circumstances in which the Act permits an award of attorneys' fees to prevailing defendants. Moreover, the threat of litigation, with attendant managerial distraction, can be extremely damaging to the competitive performance of a fast-paced industry.

Businesses seem to have recognized the limited nature of the steps taken by the NCRA. Not surprisingly, only 111 separate cooperative ventures registered under the NCRA between 1984 and June 1988. Our review of these filings indicates that they are very modest endeavors that are aimed at solving industry problems and are not of great competitive moment. We believe that if an approval procedure existed under which procompetitive arrangements could obtain exemptions from further antitrust exposure to private damage actions, then many more competitively beneficial ventures would utilize the NCRA.

In contrast to this picture of U.S. antitrust law, the antitrust and business environment in Japan and Europe is more hospitable to strategic alliances and cooperative arrangements for innovation. The basic Japanese attitude is that joint R&D activities are procompetitive and thus should not be touched by the Antimonopoly Act. Significantly, the literal Japanese translation of "R&D"—kenkyu kaihasu—implicitly includes commercialization; there is no semantic distinction between the concepts of R&D and commercialization.

In Japan, the Fair Trade Commission is responsible for executing and enforcing the Antimonopoly Act of 1947, which (like the Sherman Act) broadly prohibits unreasonable restraints of trade. While the Act provides no specific legislative exemption for joint innovation arrangements, Japan's FTC has been able to exempt cooperative innovation efforts from the scope of the law by virtue of its power as the primary enforcer of the Act. FTC policy also states

14 The basic administrative policy outlining the standards by which such joint innovation efforts are to be scrutinized is contained in a report of Japan's Fair Trade Commission (1984, 37-39). The report states that the evaluation of the anticompetitive effect of joint R&D at the product market stage will depend significantly "on the competition and market shares among the participants and the market structure of the industry to which the participants belong .... In cases where the market shares of the participants are small .... the effects will be small." Although "small" is not defined in the report, Japan's Merger Guidelines state that the FTC is not likely to closely examine cases in which the combined market share of the merging parties is less than 25 percent. See H. Iyori and A. Yesugi (1983, pp. 86-88). Our discussions with MITI and FTC officials confirm that the horizontal merger safe harbors would be equally applicable to cooperative contractual arrangements.
that if anticompetitive effects are alleged, the procompetitiveness benefits of innovation must be balanced, too. Balancing will take place not only within a particular market but also across markets (FTC, 1984), because "there is a possibility of the emergence of competition at the intersection of industrial sectors as a result of joint R&D between firms in different sectors."

In considering anticompetitive effects of cooperative innovation arrangements, Japan's FTC analyzes market shares and market structure. The FTC specifically recognizes the needs of innovators and articulates procompetitive justifications that include: (1) the difficulty of single-firm innovation; (2) the faster innovation created by cooperation and specialization between joint participants; (3) the pursuit of innovation in new fields by utilizing shared technology and know-how; and (4) enhancement of the technological level of each participant through the interchange of technology.

When MITI seeks to promote cooperative R&D activities (for example, as authorized by the Act for Facilitation of Research in Key Technology, or the Research Association for Mining and Manufacturing Technology Act), the FTC is consulted in advance. Once the FTC clears an activity, it is extraordinarily unlikely to pursue antitrust remedies at a future time. Significantly, treble damages are not available to private parties seeking to enforce Japanese antitrust laws, and private suits for single damages are very rare and usually unsuccessful. Thus, Japanese firms cooperating on innovation and commercialization of innovation have little to fear from Japanese antitrust laws.

Under this type of antitrust environment, it is not surprising that collaboration for innovation is frequent. Although regular statistics are not kept in Japan, because there is no reporting requirement for collaborative research and commercialization activities, a Fair Trade Commission report issued in 1984 contains statistics suggestive of the quantity and variety of joint innovation activities in Japan. The survey results indicate that joint R&D projects among corporations in the same industrial sector, which might be classified as horizontal collaboration, represent 19.1 percent of total projects.¹⁵

The antitrust environment shaping cooperation in the European Community is also markedly different from the United States. In 1968, the European Commission issued a "Notice of Cooperation between Enterprises" which indicates that horizontal collaboration for purposes of R&D is normally outside the scope of antitrust concerns as defined in Articles 85 and 86 of the EEC Treaty. The Commission has consistently taken a favorable position on R&D

¹⁵Questionnaires were sent to 484 manufacturing corporations in the fields of electronics, telecommunications, automobiles, chemicals, ceramics, steel and nonferrous metals, whose stocks were listed in Tokyo and Osaka Stock Exchanges. Data was provided by 242 corporations, representing 1.9 percent of the total manufacturing industry that engage in R&D activities in terms of the number of corporations and 16.7 percent in terms of sales. As to the nature of the joint R&D projects, 54.3 percent of the total cases were developmental research. Basic and applied research were 13.6 and 32.1 percent, respectively. In the case of large corporations with capital of more than 10 billion yen, the total basic and application research amounted to 52.1 percent.
agreements unless the large entities involved imply serious anticompetitive consequences.

In 1984, the European Commission adopted Regulation No. 418/85 (hereafter Reg. 418) expanding the favorable antitrust treatment of R&D. For firms whose total market share does not exceed 20 percent, it provides blanket exceptions for horizontal R&D arrangements, including commercialization—which the Commission views as "the natural consequence of joint R&D"—up to the point of distribution and sales.\textsuperscript{16} In addition, under Article 85(3), the Commission is authorized to grant exemptions for cooperative efforts that do not fall within the automatic safe harbor. Such exemptions may be granted when a horizontal agreement contributes to economic or technological progress in the research, production, or distribution of goods, and when procompetitive features outweigh anticompetitive aspects.

**Proposed Modifications to U.S. Antitrust Law**

To insure that antitrust law is responsive to the needs of innovating firms and does not inhibit U.S. firms from competing effectively in global markets experiencing rapid technological change, we believe the following changes are in order:

First, the rule of reason should be clarified to take specific account of the appropriability regime, the pace of technological change, the diversity of sources of new technology, the need to access complementary assets and technologies, and the need to have cheek-by-jowl cooperation to manage the innovation process simultaneously rather than serially.

Second, a safe harbor defined according to market power should be expressly adopted that would shield from antitrust liability interfirm agreements that involve less than 20 to 25 percent of the relevant market.

Third, market definition should be tailored to the context of innovation and should focus primarily on the market for know-how; specific product markets become relevant only when commercialization is included within the scope of the cooperative agreement. Even then, the extent of appropriability should be factored in when analyzing product market issues. The geographic market should be presumed to be worldwide, with the burden upon the challenger to demonstrate otherwise.

\textsuperscript{16} Regulation No. 418/85 of 19 December 1984 on the application of Art. 85(3) of the Treaty to categories of research and development agreements, O. J. Eur. Comm. (No. L 53) 5 (1985), entered into force March 1, 1985, and applicable until December 31, 1997. The statutory framework of Reg. 418 is complex. It applies to three categories of agreements involving R&D: (1) joint research and development of products or processes and joint exploitation of the results of the R&D; (2) joint exploitation of the results of R&D product or processes pursuant to a prior agreements between the same parties; and (3) joint research and development of products without joint exploitation should the agreement fall within the purview of Art. 85(1). Under Reg. 418, joint exploitation is interpreted to mean joint manufacturing and licensing to third parties. Joint distribution and sales, however, are not covered and required individual exemptions pursuant to Art. 85(3).
Fourth, antitrust law should not bias the selection of interfirm organizational forms; at a minimum, integration by contract or alliance should be treated no less favorably than full mergers.

Fifth, the NCRA should be amended to include joint commercialization efforts to exploit innovation.

Sixth, an administrative procedure should be created, involving both the Justice and Commerce Departments, to allow evaluation and possible certification of cooperative arrangements among firms with higher market shares, when dynamic efficiency gains are likely and rivalry robust. We favor providing the opportunity for firms to either simply register and receive relief from treble damages as with the NCRA, or to apply for a certificate of exemption from the Justice and Commerce Departments that would provide even more protection. However, the quid pro quo would be greater disclosure and scrutiny of business plans. The firms themselves would choose which path to take.

Seventh, private antitrust suits challenging cooperative innovation arrangements should be limited to equitable relief, and attorneys' fees should be awarded to the prevailing party.

The first four of these proposals could be accomplished by courts interpreting the rule of reason and the National Cooperative Research Act. We hope courts will not hesitate to employ the tools of evolutionary, common law interpretation and development to achieve these changes. However, to achieve the complete package of substantive and procedural changes most quickly, and thus assure certainty and predictability, legislation is the best overall solution.

At a U.C. Berkeley Conference on "Antitrust, Innovation and Competitiveness" in October 1988, we distributed a draft of legislation that combined a "registration" and "certification" approach for cooperative commercialization ventures. Shortly thereafter, Congressmen Edwards (H.R. 1025) and Congressman Fish (H.R. 2264) advanced a "registration" approach to cooperative commercialization efforts and Congressmen Boucher and Campbell (H.R. 1024) proposed a "certification" approach. After three hearings on these bills, Chairman Jack Brooks of the House Judiciary Committee introduced and the Judiciary Committee passed the National Cooperative Production Amendments of 1990 (H.R. 4611). H.R. 4611 would amend the National Cooperative Research Act to extend its registration approach to joint production ventures. At the same time, Attorney General Richard Thornburgh and Commerce Secretary Robert

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17 Professor Jorde testified on July 26, 1989, in favor of both a registration and certification approach. See "Legislative Proposals to Modify the U.S. Antitrust Laws to Facilitate Cooperative Arrangements to Commercialize Innovation" (with David Teece), in Hearings Before the Subcommittee on Economics and Commercial Law, Committee on the Judiciary, U.S. House of Representatives (July 26, 1989). Legislation advancing a registration approach for production joint ventures has also been introduced in the Senate by Senators Patrick Leahy (D-VT) and Strom Thurmond (R-SC) (S.1006). Three aspects of H.R. 4611 bear noting. First, relevant market definition under rule of reason analysis would specifically consider the worldwide capacity of suppliers. Second, foreign participation in a production joint venture would be limited to 30 percent of the voting securities or equity interests, and all production facilities would have to be located in the United States or its
Mosbacher announced the Bush Administration's support of a registration approach for production joint ventures.18

As mentioned above, we support both a registration and certification approach. We do not see them as alternatives. Rather, we believe they should be combined into a single, two-track approach. Firms could choose the level and then form of protection most appropriate for their joint activity. Greater disclosure could buy greater protection.

The case for these changes rests on three fundamental pillars. The first is that the innovation process is terribly important to economic growth and development, because it yields social returns in excess of private returns, and because innovation is a powerful spur to competition. Hence, if antitrust policy is going to err, it ought to do so by facilitating innovation, rather than inhibiting it. This principle is well-understood in Europe and Japan.

Second, economic theory tells us that if certain organizational arrangements are exposed to governmentally-imposed costs while others are not, firms will substitute away from the burdened forms (in this context, interfirm agreements) and in favor of the unburdened forms (in this context, hierarchy), even when the former are potentially economically superior. According to Aoki (1989), the slowdown in total factor productivity in the United States can be attributed in large part to a mismatch between organizational form and the requirements of new technology; in particular, he is concerned that hierarchical solutions are overused, at least in the United States. As we have explained at some length above, we are concerned that present laws do not give full recognition to the interorganizational requirements of the innovation process; failure to do so is damaging when innovation must proceed according to the simultaneous model.

Third, cartelization of industries experiencing rapid technological change, and which are open to international trade and investment, is very difficult. So long as these industries remain open and innovative, antitrust policy should err on the side of permitting rather than restricting interfirm contracts.

Beneficial cooperation will eventually expand if antitrust laws are revised along the lines we propose. The response may not be immediate, particularly with respect to consortia, because the experience base in U.S. industry in this area is thin, because of our antitrust history, and because U.S. firms, at least in the postwar period, have been large relative to their foreign competitors. Accordingly, the need to cooperate has not been as powerful in the past as it is now. However, once organizational learning accumulates, we expect consortia to begin to flourish even in the absence of government funding. We also expect...
the reinforcement of bilateral alliances already common in U.S. industry. We briefly discuss the kinds of activities that might take place.

**Cooperative Manufacturing and Commercialization**

In a number of circumstances, cooperative activity beyond early stages will benefit innovating firms. As discussed, sometimes this is true because of scale, risk, and appropriability considerations. Sometimes it is true because prohibition of cooperative commercialization imposes a significant technology transfer problem, for instance from the research joint venture (if there is one) back to the funding companies. In most cases, firms will not wish to cooperate all the way from research through to commercialization. But in some instances they will, or they will wish to cooperate simply on a downstream production venture. When cartelization of the industry is not a threat, we see no reason for antitrust restraints.

The now defunct U.S. Memories, Inc. consortium wanted to invest $500 million to $1 billion to develop and manufacture for its members and for the market advanced dynamic random access memories (DRAMs). With fabrication facilities costing hundreds of millions, acting alone is beyond the financial resources of many companies in this industry who might otherwise wish to have some control over their DRAM supply. This proposed consortium had to contend with a number of difficulties, including threats of third party litigation (Jorde and Teece, 1989b). While antitrust was not the main reason for the failure of this enterprise, the antitrust environment did nothing to help it succeed. A certification procedure would have provided important certainty to this venture, and others like it. A registration procedure would provide less certainty, but still would be a significant advance over current antitrust law.

Similarly, in the area of superconductors, it is likely that the real challenges will come not in developing superconductors, but in their commercialization. Applying superconductors in systems like railroads, computers, and electricity distribution will require great amounts of time, resources, and capital—probably greater than any single business can muster internally. Accordingly, a public policy stance that treats only early stage activity as potentially requiring cooperation is misguided and will thwart both early and later stage activities. Most firms will not have much incentive to engage in early stage, joint development if later stage, stand-alone commercialization appears too expensive to accomplish profitably.

**Cooperative Innovation Designed to Achieve Catch-Up**

Cooperative activities in Japan and Europe have frequently been motivated by a desire to catch up with the world's technological frontier, which in the postwar years was usually the technology of U.S. firms. However, U.S. firms are increasingly slipping behind the frontier. For instance, U.S. firms are now behind in areas like ceramics and robotics, and in products like VCRs, facsimiles, and HDTV. Just as foreign firms have found cooperative ventures useful
for catch-up in the past, U.S. firms could utilize cooperation for this purpose. For example, U.S.-based firms, acting together and with foreign firms, may still have a slender chance of competing in the market for high definition televisions (HDTV) and related products expected to evolve in the 1990s. In the absence of cooperative interfirm agreements, we doubt that development of HDTV systems is possible in the United States. If America's potential "reentrants" to the consumer electronics business combine to attempt reentry, they cannot be sure of avoiding serious antitrust problems involving treble damages, particularly if they are successful.

At minimum, the legislative changes proposed would facilitate unfettered information exchange and strategic coordination with respect to reentry strategies. If such efforts facilitated profitable reentry into high technology businesses when reentering would otherwise not occur, or would occur in a more limited and unprofitable way, we do not see why antitrust concerns ought to interfere.

Cooperation in Response to Foreign Industrial and Technology Policy

In high technology industries, both European and East Asian nations have active industrial and technology policies that significantly impact market outcomes, both in their own countries and abroad. Airbus is a case in point. The dominant U.S. attitude is one of laissez-faire, and many economists are of the view that the United States should send a letter of thanks to foreign governments who subsidize exports to the United States. Such a view is insensitive to the dynamics of technological change, to the importance of cumulative learning, and to reentry costs.

Some U.S. policy makers, however, favor retaliation against foreign countries which have active industrial policies. We support a modification of U.S. antitrust laws which in some circumstances would permit a competitive response by U.S. industry acting collectively. The proposals we advance to encourage greater cooperation among U.S. firms do not require government expenditures nor do they involve the government "picking winners." But they would soften the tensions emerging in the United States between technology, antitrust and trade policies.

Conclusion

The past two decades have wrought significant changes in the business environment. Markets have become globalized, sources of new technology are increasingly pluralistic, and "simultaneous" systems of innovation have substituted for linear, hierarchical ones. Moreover, the ability of foreign firms to utilize technology developed in the United States has increased markedly. Imitation is easier, not harder, in spite of recent court decisions which have strengthened patents.
Accordingly, innovative firms confront significant challenges in capturing value from new technology. Success in research and development does not automatically translate into a financial success, even if the technology developed meets a significant market need. To succeed financially, innovative firms must quickly position themselves advantageously in the appropriate complementary assets and technologies. If they are not already integrated, the best solution often involves bilateral and multilateral cooperative agreements.19

U.S. antitrust policy, like so much of our economic policy, has been preoccupied with static rather than intertemporal concerns. Despite important recent developments, it is informed by naive theories of the innovation process, and in particular is insensitive to the organizational needs of innovation. U.S. antitrust scholars still harbor suspicion of cooperative agreements among competitors, and do not appreciate the benefits. This suspicion fuels uncertainty about how the courts would view interfirm arrangements to promote technological progress and competition.

The policy changes we advance are certainly no panacea for the severe problems U.S. high technology industry is currently experiencing. But in bringing American policy closer to Europe and Japan, we will at least purge dogma that no longer deserves a place in U.S. industrial policy. In time, reduced antitrust exposure will help clear the way for beneficial cooperation, thereby reducing incentives for mergers and acquisitions.

The 1990 centennial of the Sherman Act would be a good occasion to set things right. The economics profession, which in the past has had a significant impact on the law of vertical restraints, can provide the intellectual leadership necessary to propel adjustments in the horizontal area, thereby helping to align U.S. policies with the technological and competitive realities of today's global economy.

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19As Richard Nelson (1990) notes, a wide variety of new kinds of organizational arrangements is emerging to support innovation. He predicts, and we concur, that some will succeed, and some will not. Our concern is that because the requirements of innovation are not well understood in mainstream economics and in contemporary antitrust analysis, there is significant danger that the performance of U.S. firms will be impaired by outdated antitrust law.
References


