KNOWLEDGE, COMPETITION AND INNOVATION: IS STRONG IPR PROTECTION REALLY NEEDED FOR MORE AND BETTER INNOVATIONS?†

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I. KNOWLEDGE, COMPETITION AND INNOVATION

However wide the variety of arguments about the relation between innovation and growth, one piece of evidence is indisputable: innovation, be it in products, production processes, political, institutional, or organizational, is the key engine of economic growth. In the most general terms, innovation occurs whenever people invent new recipes (technological, procedural, organizational) to use and (re)arrange ingredients in increasingly more valuable ways. The focus here is on *novelty*: given scarce resources, the issue of growth is not about doing more and more of the same stuff but rather about inventing new "recipes" that generate more economic value per unit of raw resource.

The core of the matter in the current debate is about the value of these new recipes. Some scholars claim that the ideas implemented in the recipe *per se*, i.e. their blueprints, are what makes a recipe effective

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in producing value, so that the real source of value is in ideas irrespective of their being effectively realized and embodied in innovations. Some others claim that the real source of effectiveness is in the implementation *process* rather than in ideas disembodied from their bearer. As we will see, this makes a huge difference: is economic value found in abstract ideas or in ideas as embodied in products and processes?

Whatever position one takes in this debate, it remains true that ideas have to be discovered before they can be used to create economic value, and the discovery or the productive use of new ideas often requires very expensive investments in research and development (R&D). Economic agents will invest their capital, and thus will face risks, whenever they have sufficient incentives to do so and whenever they can be reasonably sure that they will reap at least a substantial part of the profits generated by their investments. Subscribing to the first school of thought entails the belief that the outcome of any innovative process is a non-rival and non-excludable public good that can be easily acquired and exploited by anyone wishing to do so. Quite on the contrary, the latter line of thought suggests that the outcome of any innovative process is a newly acquired competence characterized by a variety of cumulative and partly tacit dimensions that require a whole class of skills and efforts on the part of possible users, thus making free-riding exploitation fairly hard. It then follows that a) the role of "unpriced spillovers" might turn out to be much smaller than the theory predicts and b) the very possibility of appropriating returns from R&D investments will be dependent upon a wide class of factors (which will form part of the core of this Article).

The main questions addressed in this Article are thus: given that growth is a highly desirable phenomenon and that it is primarily spurred by technological innovation, how should society solve the problem of favoring a sufficient level of investments in R&D? In particular, is it necessarily true and always desirable that, independent of any other consideration, society should protect innovators from competition and shelter them in a legally protected and enforced monopoly? Is it true that the real source of economic value of new recipes is only found in the blueprints of ideas that those recipes implement? Is it necessarily true that an unavoidable trade-off exists between the growth rate of an economy and its static level of welfare?

At first glance, one would say that "obvious" and "natural" answers to our questions should focus on the hypothesis that the "unbound Prometheus" of modern capitalism[1] has essentially been driven by profit

1. *See* DAVID S. LANDES, THE UNBOUND PROMETHEUS (1969) (describing in depth the Industrial Revolution as, among other things, a quest for wealth sought through innovation and, in turn, industrialization).

related motivations,[2] though there are indications that economists might have overvalued a relation between monetary incentives and inventiveness that might not be that uniform, monotonic and ubiquitous. As a matter of fact, incentives to innovate stem from the ability to profit from innovative ideas embodied in new products; innovators will primarily appropriate these profits to "keep ahead of the parade"[3] by maintaining their technological competencies and capabilities. As a consequence, competition does not cease to be the most efficient market structure in the case of ideas, innovations, and new recipes. History witnesses that with respect to investments in the production of ideas, capitalistic free market systems have historically shown an unrivalled capacity to promote both the growth of technological knowledge and its transformation into new, better, and more valuable products and cheaper production processes. Capitalism has reached this goal mainly by combining decentralization (and therefore multiplicity and diversity of innovative efforts) with strong incentives for producing innovation, as innovators are rewarded by considerable gains in ways largely independent of the legal protection of monopoly rights.

For a long time these have come as almost self-evident facts: profit is the key motivation for technological innovation and competition works equally well with respect to (static) efficiency and to fostering the invention of new technologies and products. In a sense, it sounds like a paradox that a great deal of contemporary economic theory at the very same time praises the virtues of perfect competition as the most efficient market structure and, on the other hand, claims that perfect competition itself is not at all appropriate to provide sufficient incentives for an adequate production level of technological innovation in society. The conclusion being that one has to escape from competition when it comes to "incentives for innovation" and "appropriating returns from innovation." However, as we will discuss at greater length, much depends on what is actually meant by "perfect competition."

Concerns about the determinants of the propensity to innovate by entrepreneurs and business firms come along with the identification of a potentially quite general trade-off underlying the economic exploitation of technological knowledge and requiring, as a general condition, a departure from pure competition. There is a general idea that purely

2. *See generally*, KARL MARX, 1 CAPITAL: A CRITIQUE OF POLITICAL ECONOMY (Penguin Books 1976) (1867); ADAM SMITH, THE WEALTH OF NATIONS (Prometheus Books 1991) (1776); JOSEPH A. SCHUMPETER, CAPITALISM, SOCIALISM & DEMOCRACY (Harper & Bros., 2d ed. 1947).

3. George J. Stigler, Industrial Organization and Economic Progress, Presentation at the University of Chicago (November 10–12, 1955), *in* THE STATE OF THE SOCIAL SCIENCES 273 (L.D. White ed., 1956).

competitive markets cannot generate a stream of quasi-rents sufficient to induce profit-seeking firms to invest resources in the production of knowledge.[4] When considered as an economic good, knowledge can largely be considered a public good and, according to an efficiency perspective, it will not (and should not) therefore be provided privately. Knowledge is neither a rival good, as my consumption of the good does not diminish yours, nor is it an excludable good, as it may be difficult to make someone pay for that good. From the non-rivalrous aspect of knowledge, it follows that the marginal cost of a new user for one unit of knowledge is zero. When there is perfect competition price equals marginal cost, so only knowledge with *no* production costs will be produced, meaning the production of such knowledge will not require any investment. On the other hand, non-excludability implies that once an individual produces knowledge with potential economic value, this knowledge immediately and freely becomes available to everyone. This, unfortunately, means that the innovator will not be able to profit from the knowledge he produced.

This is commonly known as the problem of appropriating returns from innovative efforts. The baseline of the this problem is that competition inhibits innovation: not only will the prices be driven to zero, but the competitive advantage acquired by an innovation will quickly erode as its price declines relative to the industry's marginal cost and its profit decreases to its "normal" level. However, an industry's marginal cost does not include the innovator's sunk costs of R&D. Thus potential innovators would never have the incentive to spend on R&D, knowing that returns to innovation will quickly disappear, and that they will then be out-competed by imitators enjoying lower costs.

Upon closer scrutiny, this argument rests upon a set of either explicit or implicit assumptions, which can be roughly categorized into three groups. The first fundamental assumption is that competition in the real world is correctly (albeit in a stylized manner) described by the economists' model and that, in particular, all market mechanisms should be compared to the ideal of static efficiency of perfect competition. It is noteworthy that the current notion of perfect competition (as formalized in Knightian terms) is strictly related to a fundamentally stationary perspective in which it is analyzed only under the lens of the efficiency in the allocation of resources in a stationary economy (i.e. stationary flows of resources, stationary demand, and fixed techniques). Quite naturally, this implies a radical separation of the theory of competition from the

4. Kenneth J. Arrow, *Economic Welfare and the Allocation of Resources for Invention, in* THE RATE AND DIRECTION OF INVENTIVE ACTIVITY: ECONOMIC AND SOCIAL FACTORS 609 (Richard Nelson ed., 1962).

theory of growth. As a matter of fact, in the technical progress literature one constantly finds this framework in relation to the trade-off between the equilibrium growth rate of an economy and the static level of welfare.

The second assumption is that the innovator's advantage quickly vanishes because superior knowledge cannot be effectively appropriated because it is a quasi-public good. This hypothesis, in turn, has two corollaries: that innovative knowledge "naturally" tends to diffuse at a relatively fast rate and that intellectual property rights ("IPRs") are the only effective way to prevent this diffusion and allow appropriation.

The third implicit assumption is that potential innovators must be forward looking enough to anticipate that their advantage will quickly erode. If advantages do erode, but potential innovators are myopic enough to underestimate such erosion, incentives to innovate would be at least partially preserved. We will try to challenge some of the conventional wisdom underlying the first two assumptions. For the time being, however, we will leave aside the third assumption, though some reasonable doubts could be raised on its validity as well, (i.e. the ample evidence supporting the so-called over-confidence bias that "affects" entrepreneurs).[5]

Once we take into account that markets involve more than the static allocation of resources to their most efficient use and that technological knowledge cannot be reduced to freely flowing information in the form of un-priced externalities, our main point is that the economic issues at stake concerning property rights do not just strike a balance between static monopoly dead weight loss and dynamic lack of incentives.

II. THE FAILURE OF MARKET FAILURE

The economic foundations underlying both the theory and the practice of IPRs rest upon a standard market failure argument. There is a proposition that a positive and uniform relation exists between innovation and the intensity of intellectual property protection in the form of legally enforced rights, such as patents. This proposition only holds up under a specific (and highly disputable) representation of markets, their

5. For instance, empirical studies show that the vast majority of new firms do not survive more than a few years. This fact should discourage entrepreneurial entry if entry was based on an accurate estimate of the probability of success. Entry remains consistently high, however, because entrepreneurs are likely over-confident, and believe their entrepreneurial idea is "better" than those of other entrepreneurs. It seems quite reasonable to suppose that innovators are also likely to be subject to the same bias.

functioning and their "failures", on the one hand, and of the nature of knowledge on the other.

This argument falls within the realm of the standard "Coasian" positive externality problem,[6] which can be briefly stated in the following way. There exists a normative set of efficiency conditions under which markets perfectly fulfill their role of efficient allocative mechanisms. The lack of externalities is one of such conditions because positive externalities amount to under-investment and under-production of those goods involved with the externality itself. Facing any departure from efficiency conditions, a set of policies and institutional devices must be put in place with the aim of re-establishing them in order to achieve social efficiency.

Knowledge generation is one of the *loci* of such an externality: since knowledge is (to a large extent) a public good, it will be under-produced, and will receive insufficient investment. Hence an artificial scarcity is created to amend non-rivalry and non-excludability in its use, yielding an appropriate degree of appropriability of returns from investments in its production.

As usual, from a Coasian perspective, the attribution and enforcement of well-defined private property rights is viewed as the key to the solution of an externality problem. But here, the additional problem arises that the object of property rights is, by definition, a resource that is unique and does not have close substitutes. The core of the matter then becomes one of balancing the detrimental effect of the deadweight loss implied by a legally enforced monopoly with the beneficial effect of investments in R&D and, more generally, in knowledge generation. Moreover, under the economic theory of property rights, there a clear asymmetry: the standard tragedy of the commons argument, which is used to affirm the efficiency of private property for land and capital goods, becomes, at most, only half true when knowledge is concerned. If insufficient investment does occur (though in this Article we contend that problem is usually overestimated), in the case of knowledge there is no danger whatsoever of excess exploitation, because, by definition, knowledge cannot be depleted. Instead, it might display considerable increasing returns with use. In this respect, the property right to exclude does not generate efficiency in the domain of knowledge; it produces an artificial scarcity of a good which could be freely allocated to everybody under non-scarcity conditions.

A number of general considerations can be made about this argument which concerns both the idea of the market and the idea of knowledge, upon which it is implicitly based. Let us elaborate on both

6. Ronald Coase, *The Problem of Social Cost*, 3 J.L. & ECON. 1 (1960).

starting from the market. First, the argument fundamentally rests upon the existence of a theoretical (but hardly relevant in terms of empirical and descriptive adequacy) benchmark of efficiency against which policy and institutional interventions should be compared as to their necessity and efficacy. Second, the efficiency notion employed is a strict notion of static efficiency, which brings with it the idea that markets do nothing except (more or less efficiently) allocate resources. Third, a most clear-cut distinction between market and non-market realms is assumed, together with the idea that non-market (policy, institutional) interventions can re-establish perfect competition using purely market-based "tools."

If we question the proposition that markets solely allocate resources, and that the only criterion under which they can be analyzed is therefore static efficiency, we may begin to consider them as performing a wider set of activities, such as being the places where "novelty" is (imperfectly) produced, (imperfectly) tested, and (imperfectly) selected. From that point, we can investigate their inherently dynamic properties. In particular, we will focus upon two issues. First, IPRs in a Coasian perspective are only a way to internalize externalities and solve a misallocation problem. In this respect, Coase himself has shown that the allocation of IPRs is, in principle, immaterial to the efficiency of the final allocation, as IPRs only provide the correct incentives to induce agents to achieve it. Thus the implicit underlying assumption is that an entire range of *independent* technological opportunities are available, and the only issue is the need to provide firms with the correct cost-benefit structure to induce them to reap good opportunities and discard bad ones.

However, if we consider a richer picture in which technological opportunities have to be constructed by firms and are not generally independent, but present complementarities, interdependencies and path-dependence, then IPRs are no longer immaterial to the direction of technological progress. They do not only provide incentives, but also set opportunities and constraints for the directions of technological advances and market testing. In particular if technological opportunities are not mutually independent, it is clear that by foreclosing some firms' research in some directions, patents can, on the whole, hinder research rather then stimulate it. Cumulative, sequential, or complementary technological progress has already been addressed in the literature showing that, in these cases, patents can, in the long run, deter innovation and give rise to such hold-up phenomena as the so-called patent thickets and the tragedy of the anti-commons.[7]

7. James Bessen & Eric Maskin, *Sequential Innovation, Patents and Imitation* (MIT Dept. of Econ., Working Paper No. 00-01, 2000); Michael Heller & Rebecca Eisenberg, *Can*

All in all, the institutional attribution of property rights (whether efficient or not from a static allocative perspective) may strongly influence the patterns of technological evolution in directions which are not necessarily optimal or even desirable. In this sense, any question about the appropriate level of IP protection and degree of appropriability, issues on which the theory of allocative efficiency is rather silent, would be better grounded on a theory of innovative opportunities and productive knowledge.[8]

A second point related to the role of markets is that a growing share of innovations are product innovations whose main purpose and effect is to create sub-markets which only loosely compete with one another.[9] The perfect competition benchmark seems therefore more and more inappropriate as a description of the actual mechanisms of technological competition because it describes an irrelevant, steady state of processes which are upset by pushing competition elsewhere. Again, the pace and directions of the creation of submarkets may be highly influenced by the definition and attributions of IPRs, and this effect—we will argue—might be more important than their effect upon a hard-to-reach static efficiency. An alternative perspective shows that the effect of an increase in competition with respect to profits, while strong for successful innovators, will be much worse for unsuccessful innovators.[10] Firms will thus try to innovate correctly to escape competition and therefore produce a positive overall effect on the rate of innovation.[11]

Finally, viewing markets as embedded and dependent upon an ensemble of non-market institutions allows one to appreciate the fact that technological innovation is highly dependent on a variety of complementary institutions (e.g. public agencies, public policies, universities, communities and, of course, corporate organizations with their rich inner

Patents Deter Innovation? The Anticommons in Biomedical Research, 280 SCIENCE 698 (1998); Suzanne Scotchmer, *Standing on the Shoulders of Giants: Cumulative Research and the Patent Law*, 5 J. OF ECON. PERSP. 29 (1991); Carl Shapiro, *Navigating the Patent Thicket: Cross Licenses, Patent Pools, and Standard-Setting*, in 1 RESEARCH ON INNOVATION POLICY & THE ECONOMY 1 (Adam B. Jaffe, Josh Lerner & Scott Stern eds., 2000).

8. *Compare* Sidney G. Winter, *An Essay on the Theory of Production*, *in* ECONOMICS AND THE WORLD AROUND IT 55 (Saul H. Hymans ed., 1982) (presenting a theory of production), *with* JOSEPH STIGLITZ, WITHER SOCIALISM (MIT Press 1994) (presenting a theory of allocative efficiency).

9. Steven Klepper & Peter Thompson, *Submarkets and the Evolution of Market Structure* (Fla. Int'l Univ., Dept. of Econ., Working Paper No. 303, 2005), *available at* http://www.fiu.edu/orgs/economics/wp2003/03-03.pdf; Tor Jakob Klette & Samuel Kortum, *Innovating Firms and Aggregate Innovation*, 112 J. OF POL. ECONOMY 986 (2004); JOHN SUTTON, TECHNOLOGY AND MARKET STRUCTURE 267–78 (1998).

10. Philippe Aghion et al., *Competition, Imitation and Growth with Step by Step Innovation*, 68 REV. OF ECON. STUD. 467 (2001) (considering innovators' incremental profits, i.e. the difference between the profits of an innovative firm and those of a non-innovative firm).

11. *Id.*

structure) which can hardly be called "markets" and can not be regulated by pure market incentives. It is precisely this institutional embedding of innovative activities that makes it very unlikely that a "market failure" approach can provide any satisfactory account of the relationship between appropriability and the propensity to innovate.

We now turn our focus to technological knowledge. The standard implicit assumption is that the nature of "knowledge" is totally captured by the notion of "information" thus technological knowledge may be institutionally treated in uniform ways. This assumption neglects any dimension of knowledge which relates to its "non public good" features. According to this perspective, the transformation of the public good "knowledge" into the private good "patent" will perfectly set incentives for its production by way of legally enforced conditions and possibilities of appropriability.

Knowledge can be misleadingly identified with information. When this occurs, there is a deletion of any reference to cognitive and procedural devices, whose role is to transform raw information into "useful knowledge," and which are largely tacit and embedded in organizations. Such misidentification makes one forget that processes through which new knowledge is generated are strongly dependent on the specificities of each technological paradigm, which hardly can be reduced to "information" categories.

One question which seems to be rarely asked (or answered) in precise terms is: "what is the increase in the value of an innovation, if any, realized by patenting it?" A straightforward answer to this question would be: in a perfectly competitive market, any innovation has no value (i.e. its price equals to zero), as its marginal cost of reproduction equals zero. As a consequence, the sole value of an innovation comes from the patent. Under this perspective, one is forced to conclude that a straightforward positive relationship exists between innovative activities and patents. In such a relationship, patents are the one and only source of value of technological innovations (given perfect competition), and are thus the only way of profiting from technological innovation.[12]

Under more careful scrutiny, however, this argument is subject to a series of limitations and counter-examples. One class of counter-arguments arises from the many innovations that have produced considerable streams of economic value despite the innovator's failure to obtain a patent or, alternatively, the acquisition of a patent under a very weak patent regime. Relevant examples can be drawn from those technologies forming the core of information communications technology

12. David J. Teece, *Profiting from Technological Innovation: Implications for Integration, Collaboration, Licensing and Public Policy*, 15 RES. POL'Y 285 (1986).

("ICT"). For instance, the transistor, while patented by Bell Labs, was liberally licensed as a consequence of antitrust litigation and pressure from the U.S. Department of Justice. Its early producers nonetheless obtained enough revenue to grow a whole industry.[13] Another example is the early growth of the semiconductor industry, which was driven to a large extent by public procurement in a weak IP regime. The software industry, which is obviously quite profitable, similarly emerged under a weak IP regime. Additionally, until the 1990s, the telecom industry was largely operated by national monopolies which were also undertaking a good deal of research, and IPRs played little role in the rapid advance of technology in that industry. Mobile telephony also emerged under a weak IP regime (until the late 1980s).

We therefore suggest that strong IPRs did not play a pivotal role in either the emergence of ICT or as a means of value generation. Rather, in the early stage of those sectors it might have been the very weakness of the patent regime that spurred their rapid growth. Conversely, the strengthening of the IP regime in recent years (soon after the ICT boom in the late 80's) might well have been (in terms of political influence) a consequence rather than a cause of the fast pace at which the ICT sector expanded.

Returning now to our opening question, it is worth noting how (some) economists have been cautious with respect to the adoption of the patent system as the only means to foster innovative activity and to its uniform effectiveness. According to Fritz Machlup:

> If we did not have a patent system, it would be irresponsible, on the basis of our present knowledge of its economic consequences, to recommend instituting one. But since we have had a patent system for a long time, it would be irresponsible, on the basis of our present knowledge, to recommend abolishing it.[14]

Similar doubts are expressed by Paul David, who argues that IPRs are not necessary for new technologies, and suggests that different institutional mechanisms more similar to open science might work more efficiently.[15]

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13. Ove Grandstrand, *Innovation and Intellectual Property Rights*, *in* THE OXFORD HANDBOOK OF INNOVATION 266 (Jan Fagerberg, David C. Mowrey & Richard R. Nelson eds., 2005).

14. FRITZ MACHLUP, SUBCOMM. ON PATENTS, TRADEMARKS, & COPYRIGHTS OF THE S. COMM. ON THE JUDICIARY, 85TH CONG., AN ECONOMIC REVIEW OF THE PATENT SYSTEM 80 (Comm. Print 1958).

15. Paul David, *Intellectual Property Institutions and the Panda's Thumb: Patents, Copyrights, and Trade Secrets in Economic Theory and History*, *in* GLOBAL DIMENSIONS OF INTELLECTUAL PROPERTY RIGHTS IN SCIENCE & TECHNOLOGY 19, 54–57 (Mitchel B. Wallerstein, Mary Ellen Mogee & Roberta Schoen eds., 1993); Paul David, Does the Economy Need

Of course, the cautious economist is well aware that even from a purely theoretical point of view, the innovation/patent relation is by no means a simple one. And similarly tricky from a policy point of view is the balance between the gains and losses of any system of intellectual property protection.

On the one hand, the intellectual property monopolies afforded by patents or copyrights raise prices above unit production costs, thus diminishing the benefits that consumers derive from using protected innovations. On the other hand, the standard argument claims that the same rights provide a significant incentive at producing new knowledge through costly investments in innovative research. However, such a purported trade-off might well apply at the micro level as well. Whether or not a firm has the profitability of its own innovations secured by IP rights, its R&D behavior and its IPR enforcement strategies cannot be unaffected by the actions of other firms acquiring and exploiting their own IP rights. The effect of firms exploiting IP rights is increased costs incurred by other firms when trying to access and utilize existing knowledge. Similar dilemmas apply to the effects of a strong IP system on competition process. Static measures of competition may decrease when a monopoly right is granted, but dynamic measures could possibly increase if this right facilitates entry into an industry by new and innovative firms.

Are these trade-offs general features of the relationship between static allocative efficiency and dynamic/innovative efficiency? There are good reasons to think that such trade-offs might not even theoretically appear in a dynamic world, as shown by Winter.[16] On the grounds of a simple evolutionary model of innovation and imitation, Winters compares the properties of the dynamics of a simulated industry with and without patent protection to the innovators. The results show that, first, under the patent regime the total surplus (that is the total discounted present value of consumers' and producers' surplus) is lower than under the non-patent one.[17] Second, and even more interestingly, the non-patent regime yields significantly higher total investment in R&D and displays higher best practice productivity.[18]

More generally, a dynamic interpretation of the relationship between appropriability and innovation is based on the premise that no model of

All the Old IPR Institutions? Digital Information Goods and Access to Knowledge for Economic Development, Address at the Wider Conference on The New Economy in Development (May 11, 2002).

16. Sidney G. Winter, *Patents and Welfare in an Evolutionary Model*, 2 INDUS. & CORP. CHANGE 211, 211–231 n.2 (1993).

17. *Id*.

18. *Id*.

invention and innovation and no answer to patent policy questions is possible without a reasonable account of inventive and innovative opportunities and their nature.

The notion of a technological paradigm, in this respect, is precisely an attempt to account for the nature of innovative activities.[19] There are few ideas associated with the notion of the paradigm worth recalling here.

First, note that any satisfactory description of "what technology is" and how it changes must also embody the representation of the specific forms of knowledge on which a particular activity is based and cannot be reduced to a set of well-defined blueprints. It primarily concerns problem-solving activities involving—to varying degrees—tacit forms of knowledge embodied in individuals and in organizational procedures. Second, paradigms entail specific heuristics and visions on "how to do things" and how to improve them, often shared by the community of practitioners in each particular activity (engineers, firms, technical societies, etc.). In other words, paradigms entail collectively shared cognitive frames. Third, paradigms also often define basic templates of artifacts and systems, which are progressively modified and improved over time. These basic artifacts can also be described in terms of some fundamental technological and economic characteristics. For example, in the case of an airplane, the basic attributes are described not only in terms of inputs and production costs, but also on the basis of some salient technological features such as wing-load, take-off weight, speed, distance it can cover, etc. Interestingly, technical progress seems to display patterns and invariances in terms of these product characteristics. Hence the notion of technological trajectories associated with the progressive realization of innovative opportunities underlying each paradigm emerges. In turn, one of the fundamental implication of the existence of such trajectories is that each particular body of knowledge (each paradigm) shapes and constrains the rates and direction of technical change, in a rough approximation, irrespective of market inducements and, thus, irrespective of appropriability conditions.

III. OPPORTUNITIES, CAPABILITIES, AND GREED

There are some basic messages from the foregoing discussion of the theory and empirical evidence of the relationship between degrees of IPR protection and rates of innovation.

19. Giovanni Dosi, *Technological Paradigms and Technological Trajectories: A Suggested Interpretation of the Determinant and Direction of Technological Change*, 11 RES. POL'Y 147 (1982).

The obvious premise is that some private expectation of "profiting from innovation" is and has been, throughout the history of modern capitalism, a necessary condition for entrepreneurs and business firms to undertake expensive and time-consuming search for innovations. That was already quite clear to classical economists, and has been quite uncontroversial since.

As we discussed recently, however, there are neither strong theoretical reasons nor strong empirical evidence suggesting that changing the appropriability mechanisms of innovations in general, and the appropriability by means of IPR in particular, would have any robust effect upon the resources which private self-seeking agents devote to innovative search or upon the rates at which they discover new products and new production processes.[20] As pointed out by Adam Jaffe, ". . . there is so little empirical evidence that what is widely perceived to be a significant strengthening of intellectual property protection had significant impact on the innovation process."[21]

Note that any tightening of IPRs is bound to result in a fall in "consumer surplus." By making use of such a static tool for welfare analysis, it follows that, as producers' rents and prices on innovation grow, the former must fall. Conversely, on the producers' side,

> . . . to the extent that firms' attention and resources are, at the margin, diverted from innovation itself toward the acquisition, defense and assertion against others of property rights, the social return to the endeavor as a whole is likely to fall. While the evidence on all sides is scant, it is fair to say that there is at least much evidence of these effects of patent policy changes as there is evidence of stimulation of research.[22]

But if IPR regimes have, at best, second-order effects upon the rates of innovation, what are the main determinants of the rates and directions of innovation?

Our basic answer, as argued above and elsewhere,[23] is that the fundamental determinants of observed rates of innovation in individual industries/technologies appear to be nested in levels of opportunities that

20. Giovanni Dosi, Luigi Marengo & Corrado Pasquali, *How Much Should Society Fuel the Greed of Innovators? On the Relations Between Appropriability, Opportunities and Rates of Innovations*, 35 RES. POL'Y 1110 (2006).

21. Adam Jaffe, *The U.S. Patent System in Transition: Policy Innovation and the Innovation Process*, 29 RES. POL'Y 531, 540 (2006).

22. *Id*. at 555.

23. *Cf.* Giovanni G. Dosi, *Source, Procedures and Microeconomic Effects of Innovation*, 26 J. ECON. L. 1120 (1988); Giovanni Dosi, Luigi Orsenigo & Mauro Sylos Labini, *Technology and the Economy*, *in* THE HANDBOOK OF ECONOMIC SOCIOLOGY 678 (Neil Smelser & Richard Swedberg eds., 2005); Dosi, *supra* note 20.

each industry faces. "Opportunities" capture the width, depth and richness of the sea in which incumbents and entrants go fishing for innovation. In turn, such opportunities are partly generated by research institutions outside the business sector, from the very search efforts undertaken by incumbent firms in the past, and they partly flow through the economic system via suppliers/users relationships.[24] Given whatever level of innovative opportunities associated with a particular technological paradigm, there seems to be no general lack of appropriability conditions deterring firms from going out and fishing in the sea. Simply, appropriability conditions and modes of appropriation of returns from R&D vary a lot across sectors and across technologies. As these "dominant" modes of appropriation of the returns from innovation vary across activities, the "packets" of winning strategies and organizational forms should also vary. However, the theory is totally mute with respect to the enormous variability across firms, even within the same sector and under identical IPR regimes, in terms of rates of innovation, production efficiencies and profitabilities.[25]

A priori, an explanation of the striking differences across firms, even within the same line of business, in their ability to both innovate and profit from innovation ought to include firm-specific features. These features should be sufficiently inertial over time and only limitedly "plastic" to strategic manipulation so that they can be considered, at least in the short term, "state variables" rather than "control variables" for the firm.[26] In fact, an emerging *capability-based theory of the firm* identifies a fundamental source of differentiation across firms in their distinct problem-solving knowledge yielding different abilities of "doing things"—searching, developing new products, manufacturing, etc.[27] Successful corporations derive competitive strength from their above-average performance in a small number of capability clusters where they can sustain a leadership.[28] Symmetrically, laggard firms often find it hard to imitate perceived best-practice production technologies because of the difficulty

24. See the detailed inter-sectoral comparisons in Alvin Klevorick, Richard Levin, Richard Nelson & Sidney Winter, *On the Sources and Interindustry Differences in Technological Opportunities*, 24 RES. POL'Y 185 (1995); Keith Pavitt, *Sectoral Patterns of Innovation: Toward a Taxonomy and a Theory*, 13 RES. POL'Y 343 (1984).

25. Dosi, *supra* note 23 (discusses variability across firms).

26. Sidney G. Winter, *Knowledge and Competence as Strategic Assets, in* THE COMPETITIVE CHALLENGE: STRATEGIES FOR INDUSTRIAL INNOVATION AND RENEWAL 159, 162–64 (David J. Teece ed., 1987).

27. *See generally* THE NATURE AND DYNAMICS OF ORGANIZATIONAL CAPABILITIES (Giovanni Dosi, Richard Nelson & Sidney Winter eds., 2000) (collecting a variety of discussions on the different approaches of different firms).

28. *Id*.

of identifying the combinations of routines and organizational traits which make a company good at doing something.

Such barriers to learning and imitation, it must be emphasized, have very little to do with any legal regime governing access to the use of supposedly publicly disclosed, but legally restricted, knowledge such as that associated with patent-related information. Much more fundamentally, it relates to collective practices, which, in every organization, guide innovative search, production and so on. Given the opportunities for innovation associated with a particular paradigm (which approximately determines the ensuing industry-specific rates of innovation), the winners and losers amongst firms operating within that industry depend on both the adequacy of their strategic choices and on the type of idiosyncratic capabilities that they embody. In our earlier metaphor, while the "rates of fishing" depend essentially on the size and richness of the sea, idiosyncratic differences in the rates of success in the fishing activity itself, depend to a large extent on firm-specific capabilities. Moreover, idiosyncratic differences also fundamentally affect the ability to "profit from innovation." Conversely, if we are right, this whole story has very little to do with any change in the degrees to which society feeds the greed of the fishermen in terms of prices they are allowed to charge for their catch. That is, out of metaphor, the tuning of IPR-related incentives is likely to have only second-order effects, if any. Opportunities, combined with the capability of seeing them, however, are likely to be the major drivers of the collective "unbound Prometheus" of modern capitalism, and will likely shape the ability of individual innovators to benefit.