Tragedy of the Anticommons? Intellectual Property and the Sharing of Scientific Information

Justin B. Biddle*†

Many philosophers argue that the emphasis on commercializing scientific research—and particularly on patenting the results of research—is both epistemically and socially detrimental, in part because it inhibits the flow of information. One of the most important of these criticisms is the "tragedy of the anticommons" thesis. Some have attempted to test this thesis empirically, and many have argued that these empirical tests effectively falsify the thesis. I argue that they neither falsify nor disconfirm the thesis because they do not actually test it. Additionally, I argue that there is other evidence that actually supports the thesis.

1. Introduction. Since the late 1970s and early 1980s, there has been an increasing emphasis on privatizing and commercializing the results of scientific research, especially in the United States. One indication of this is the dramatic rise of patenting in science. The number of patents issued to US universities has skyrocketed from 434 in 1983 to 3,259 in 2003 (Walsh, Cohen, and Cho 2007, 1184). Patenting in biotechnology has also risen precipitously, from 2,000 in 1985 to over 13,000 in 2000 (Walsh, Cohen, and Arora 2003, 293). This emphasis on commercialization generally, and patenting in particular, has been driven not primarily by the scientific community but rather

*To contact the author, please write to: School of Public Policy, Georgia Institute of Technology, 685 Cherry Street, Atlanta, GA 30332; e-mail: justin.biddle@pubpolicy.gatech.edu.

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by political and economic decisions, including the Bayh-Dole Act of 1980 and the US Supreme Court decision *Diamond v. Chakrabarty* (1980).[1]

While there are a number of potential justifications that could be given for patenting in science, the most plausible one—and the one that is most often given in the policy arena—is consequentialist in nature. On this account, granting intellectual property (IP) rights to the results of scientific research provides incentives to pursue studies that might otherwise be neglected; patenting is thus held to promote scientific progress, which ideally promotes social progress. This is the justification that is implicit in the Bayh-Dole Act, which encourages university patenting by allowing universities (and other entities) to patent the results of federally funded research, and it is implicit in article 1, section 8, of the US Constitution, which grants exclusive rights for a limited period of time to "writings" and "discoveries" in order "to promote the progress of science and the useful arts."

Many philosophers of science argue that the emphasis on commercialization generally, and patenting in particular, is detrimental to both scientific and social progress (Biddle 2007; Brown 2008). More specifically, many have objected to patenting in science on two different grounds. According to one objection, the growing emphasis on patenting is skewing research toward patentable, and away from nonpatentable, solutions to problems (Krimsky 2003; Brown 2008). This trend, if occurring, is both epistemically and socially detrimental, as it unjustifiably restricts the class of examined problems and solutions primarily to those that are potentially profitable. Second, many have argued that the proliferation of patenting and licensing is epistemically problematic because it discourages the sharing of scientific information. This argument is implicit in Robert K. Merton's identification of "communism" as an essential norm of science (1942), and it has been put forward explicitly by numerous recent commentators (e.g., Brown 2000).

A particularly important version of this second criticism is a thesis put forward by Michael Heller and Rebecca Eisenberg, the "tragedy of the anticommons" (1998). According to this thesis, the proliferation of IP rights upstream (i.e., over the results of basic research) creates a series of obstacles to downstream (i.e., applied) research and product development; the result is that upstream patenting not only fails to incentivize the development of innovative products, it also discourages it. Heller and Eisenberg's claims are restricted to the biomedical sciences; nonetheless, the anticommons thesis is a significant one, for if it is true, it completely undercuts the consequentialist justification of upstream patenting in one of the most important areas of contemporary research.

1. See Biddle (2011) for a discussion of these decisions and for an examination of the political and economic theory underlying the emphasis on commercializing and privatizing the results of scientific research.

The anticommons thesis has generated intense controversy. Perhaps not surprisingly, many in the biotech industry ridicule the thesis as being terribly naive; a quick glance through biotech industry blogs and trade publications reveals titles such as "The Tragedy of a Bad Idea" and "This Just In: The Anticommons Aren't So Tragic" (Noonan 2010). It is tempting to dismiss such criticisms as little more than industry propaganda. This, however, would be a mistake, as many of the criticisms are based on empirical studies that purport to falsify the anticommons thesis. One of the most commonly cited of these studies is published by the American Association for the Advancement of Science's project on Science and Intellectual Property in the Public Interest (AAAS-SIPPI) in 2007 (Hanson 2007). It surveys thousands of scientists about their experiences acquiring IP-protected material, and one of the primary conclusions is that there is "very little evidence of an 'anticommons problem'" (12). As a result of this and other studies, it is now increasingly common to dismiss the anticommons thesis and to assert that patenting in science is unproblematic, if not beneficial.

The aim of this essay is to argue that such dismissals are unwise. In particular, I examine two of the most important empirical studies of the anticommons thesis, and I argue that these studies do not falsify the anticommons thesis because they do not actually test it—most of the data that they provide are simply not relevant to the anticommons thesis. Additionally, I argue that there is evidence from other studies that we are witnessing anticommons problems in some areas of research—most notably, DNA diagnostics. Finally, I conclude by addressing the question of whether patenting the results of basic research is justifiable, and I argue that how one answers this question depends in part on the solution to an important yet neglected philosophical problem, one that concerns the "social order" of science and its relation to the law.

Before proceeding, there are two qualifications that should be made regarding the scope of this essay. First, it is limited to the effects of patenting and licensing in the United States. The emphasis on commercialization generally, and patenting in particular, is strongest in the United States; as a result, the United States provides a helpful test case for examining the implications of this trend. There are also more data concerning the effects of patenting and licensing in the United States than in other countries. Second, this essay focuses exclusively on the area of biomedical research. Whether patenting is justifiable in other areas of research, such as in computing and information technology, is outside of the scope of this article.

2. The Anticommons Thesis and Its Critics. The phrase "the tragedy of the anticommons" is a play on Garrett Hardin's well-known paper "The Tragedy of the Commons," which argues that many resources, if held in common, will be overused and eventually exhausted by individuals who act

independently and rationally (Hardin 1968). The solution to this problem, he argues, is private appropriation of the commons. The tragedy of the anticommons is, in a sense, the mirror image of the tragedy of the commons; on this account, private appropriation can, under certain conditions, lead to underuse. A "proliferation of intellectual property rights upstream may be stifling life-saving innovations further downstream in the course of research and product development" (Heller and Eisenberg 1998, 698).

One example provided by Heller and Eisenberg in support of this claim is the patenting of concurrent gene fragments. The US Patent and Trademark Office allows the patenting of genes and gene fragments, and at the time of Heller and Eisenberg's writing, it was possible to patent not only genes that are known to correspond to particular proteins but also genes and fragments of genes that have functions that are largely unknown (1998, 699).[2] The ability to patent gene fragments—especially those that have unknown functions—can lead to situations in which the development of a product downstream requires complex negotiations with multiple patent holders. For example, the production of a diagnostic test for a genetic disease often requires access to multiple gene fragments that are patented by a wide array of entities (699). Obtaining access to all of the relevant fragments can require extensive negotiations and can be cost prohibitive; according to the anticommons thesis, these burdensome requirements hinder the development of products and, in some cases, prevent them from being developed at all.

Heller and Eisenberg do not draw a definitive conclusion regarding the patenting of scientific research in their anticommons paper. I interpret them, however, as maintaining that patents on the results of upstream, or basic, scientific research should not be allowed. In the remainder of this article, then, I will attribute to them the following argument: the proliferation of patenting and licensing upstream is discouraging downstream research and product development, and because of this, patents on the results of upstream research should not be allowed.

Before examining the empirical studies of the anticommons thesis, it is important to distinguish between two claims that are often confused:

1. Extensive patenting and licensing in science inhibits the sharing of information.
2. Extensive patenting and licensing in upstream scientific research inhibits downstream research or product development.

2. The situation with respect to genes is changing, in part because knowledge of the human genome is becoming more widespread—and hence less novel. Because novelty is a necessary condition on obtaining a patent, it is becoming more difficult to patent genes. Heller and Eisenberg, however, are only using genes as an example; they are concerned about patents on upstream research generally, and their argument does not stand or fall on the basis of this one case.

The former is a general claim about the effects of patenting and licensing in science, while the latter is more specific, asserting that extensive patenting and licensing creates roadblocks at a particular point in the research-and-development process—namely, the link between upstream research and downstream product development. While many critics of patenting in science have asserted claim 1, the anticommons thesis is restricted to 2. The difference between these two claims will prove to be important in our evaluation of the empirical literature on the anticommons thesis.

The anticommons thesis, again, has generated much controversy. A number of empirical studies have been conducted to test the anticommons thesis, and many maintain that these studies have effectively falsified the thesis. One of the main conclusions of the oft-cited AAAS-SIPPI study, again, is that there is "very little evidence of an 'anticommons problem'" (Hanson 2007, 12). How was this conclusion reached? The study surveyed scientists from different backgrounds about their experiences acquiring IP-protected material. Over 8,000 randomly selected members of AAAS, from both academia and industry and from a wide range of fields, were invited to participate, and over 2,000 responded that they had acquired IP-protected material within the past 5 years: 33% of respondents reported that they had experienced difficulties acquiring IP-protected material, including 25% of academic respondents and 40% of industry respondents (Hanson et al. 2007, 24). Of those who reported difficulties, 60% stated that licensing negotiations were "overly complex," and 38% reported a "breakdown of licensing negotiations" (24).

Given these responses, it is at first difficult to understand how the study author could write that there is "very little evidence" of an anticommons problem. These results are extremely worrisome, and they provide strong evidence that patenting and licensing are presenting significant obstacles to scientific research. The basis for the conclusion that there is little evidence for an anticommons problem is that only 1% of all respondents reported abandoning their projects (Hanson et al. 2007, 25, 61); the study author has thus interpreted "anticommons problem" rather narrowly, which is how he could reach the conclusion that he did. In response to difficulties accessing IP-protected materials, the scientists surveyed tended to "circumvent" difficulties in accessing patented materials by "inventing around" patented technologies, changing the geographical location of their studies, changing their project goals, or "working around the problem in some other way" (25). These results do not present a particularly rosy picture of the effects of patenting and licensing, but they do suggest that patenting and licensing is not leading to widespread project abandonment.

Among the other studies that are often cited in response to the anticommons thesis, those of John Walsh, Wesley Cohen, and colleagues are perhaps the most important (e.g., Walsh et al. 2007). One of these surveyed 1,125 ac-

TABLE 1. Reasons for Choosing Projects

Reason for Choosing a Project	Respondents Indicated That the Reason Was Either "Very Important" or "Moderately Important" (%)
Scientific Importance	97
Interest	95
Feasibility	88
Sufficient funding	80
Health benefit	59
Promotion/job	24
Commercial potential	8
Inputs patent free	7
Results patentable	7
Personal income	2
New firm	1

ademic researchers in genomics and proteomics; the results were based on 507 responses. The study focused on these particular areas of research, in order to determine the effects of patenting and licensing in patent-rich fields. There were two primary aims of the study: to determine the effects of patenting on (1) the choice to investigate a particular research problem and (2) the decision not to pursue a project.

In order to determine the effects of patenting on the choice to investigate a particular research problem, the study authors listed a variety of different potential reasons for choosing a project and asked respondents to rate their importance. Table 1 summarizes the results.[3] For the purposes of the study, the important result here is that only 7% of respondents indicated that the patentability of results was either a very important or a moderately important reason for choosing a project.

The study authors also inquired into scientists' reasons for abandoning projects.[4] Table 2 summarizes the results.[5] For the purposes of the study, the important result here is that only 3% of respondents indicated that too many patents were either a very important or a moderately important reason for abandoning a project. Note that this result is largely consistent with the result of the AAAS-SIPPI study; that study found that only 1% reported that too many patents were an important reason for abandoning a project, but that

3. See Walsh et al. (2007, 1188) for the entire table.

4. More precisely, they asked the following question: "Please think about the most recent case where you seriously considered initiating a major research project and decided not to pursue it at that time. How important were each of the following in dissuading you from pursuing that project? Please answer on a scale from 1 to 5, where 1 is not at all important and 5 is very important" (Walsh et al. 2007, 1188n11).

5. See Walsh et al. (2007, 1189) for the entire table.

TABLE 2. Reasons for Abandoning Projects

Reason for Abandoning a Project	Respondents Indicated That the Reason Was Either "Very Important" or "Moderately Important" (%)
No funding	62
Too busy	60
Not feasible	46
Not scientifically important	40
Not interesting	35
Too much competition	29
Little social benefit	15
Unreasonable terms	10
Will not help with promotion/job	10
Too many patents	3
New firm unlikely	3
Little commercial potential	2
Little income potential	1
Not patentable	1

study also surveyed scientists from a variety of fields, some of which are patent rich and others of which are not. One might expect that a study of scientists working in a patent-rich field would yield a slightly higher percentage of scientists who abandoned a project due to patents, and this is precisely what Walsh et al. found.

There is an important qualification that the authors make regarding their findings: "Since these results are based on self-reports, one qualification is that academics who are exposed to strong norms that they should be doing their work for reasons of intrinsic interest and scientific importance may be reluctant to acknowledge the importance of commercial motives or the prospect of a patent right as an important incentive, and so these [results] may be biased downwards" (Walsh et al. 2007, 1189). This qualification notwithstanding, however, the study authors conclude that, at the present time, "access to patents on knowledge or information inputs into biomedical research . . . rarely imposes a significant burden for academic biomedical researchers" (1191).

While the above qualification is important, it is not the only one that is potentially relevant. To claim that scientists "may be reluctant to acknowledge the importance of commercial motives or the prospect of a patent right" is to suggest that scientists are aware of these motives; one is not reluctant to acknowledge something if one is completely unaware of that something. It is possible, however, that many scientists are simply unaware of influence of commercial motives on their decisions. For example, it is possible that, for many scientists, such motives work as a kind of unconscious filter on the choice of problems to address; projects that have little commercial potential or little prospect of obtaining a patent are simply never seriously considered.

It is fairly clear from other literatures—for example, the now extensive literature on the effects of financial conflicts of interest on scientific decisions—that financial motives can affect research in subtle, if not unconscious, ways.[6] It would not be surprising if similar unconscious influences were operating with regard to patenting as well. If this is the case, then the downward bias of the study results might be even more significant. In my view, this qualification, in conjunction with that made by the study authors, places the accuracy of the reported results in doubt; for the sake of argument, however, I will assume that these results are at least roughly accurate.

On the assumption, then, that the reported results are accurate, a perplexing question arises: Why is it that, in such patent-rich fields as genomics and proteomics, patents are not playing a more significant role? Some of the data collected by Walsh et al. are relevant to this question, and after analyzing their data, they argue that an important reason is that scientists are simply unaware of patents they might be infringing. The study authors include a question that asks how often scientists believe that they need knowledge or information covered by someone else's patent, and of the 381 scientists who responded, 8% believe that they had, within the past 2 years, used knowledge or information covered by someone else's patent; 19% reported that they did not know; and 73% believe that they did not require access in order to conduct their research (Walsh et al. 2007, 1189). Given the extensive amount of patenting in genomics and proteomics, the percentage of scientists who believe that they used patent-protected knowledge or information is very low. The main reason for this seems to be that only 5% of respondents report that they regularly check to see whether the information they are using is patent protected (1189). Given how extensive patenting activity is in these fields, and given how few scientists actually check to see whether the information they are using is patent protected, it is hard to avoid the conclusion that patent infringement is widespread. If it is true that patents are not creating significant obstacles to research in these fields, then the apparently routine practice of infringement would provide an important reason for why this is the case.

Walsh et al. conclude that access to patented materials does not, at least at present, impose significant obstacles to biomedical research and that one of the reasons for this is that scientists are often unaware of patents that they might be infringing. An important secondary conclusion, however, is that access to tangible materials is becoming a significant obstacle: 75% of respondents report that they had requested at least one tangible material, such as a cell line or tissue, within the past 2 years; 18% of their requests to academic scientists were not fulfilled; and 33% of their requests to industry scientists

6. See Bekelman, Li, and Gross (2003) for a review of the literature on the effects of financial conflicts of interest in biomedical research.

were unfulfilled (Walsh et al. 2007, 1191). As a comparison, the authors cite an earlier study, covering the years 1997–99, that found that only 10% of requests to academic researchers for tangible materials were not fulfilled (1191). Finally, the authors find that approximately one project is abandoned for every nine researchers as a result of problems in acquiring tangible materials (1192).

One can explain the reported differences in problems of access to patented materials versus tangible materials in terms of a simple cost-benefit analysis (Walsh and Cohen 2008). A scientist who seeks access to someone else's intellectual property, especially when the patent is over an item of basic research, has almost nothing to lose by patent infringement. Obtaining access to the item is easy, and the burden of enforcing property rights, which is placed on the patent holder, is typically not worth the transaction costs. In some situations—for example, if the patent is over a technology that is likely to be highly profitable in the near term—it might be in the interest for the patent holder to undertake the transaction costs of enforcement. But in most other situations, it is simply not worth the time, effort, or money. A researcher who seeks access to a tangible material, however, must request that material from its holder, and enforcement of the holder's property right simply requires the holder to deny the request. In this case, access is difficult, and enforcement is easy.

3. A Tragedy of the Anticommons? What should these empirical studies lead us to conclude regarding the plausibility of the anticommons thesis? Very little, for the data obtained in these studies are to a large extent irrelevant to the anticommons thesis. Recall that the anticommons thesis states that a proliferation of patenting and licensing upstream will inhibit downstream research or product development. The data provided by these studies, however, concern either the extent to which patenting inhibits the sharing of information upstream or the extent to which patenting inhibits information that is undifferentiated and unclassified; the data are not relevant to whether patents on upstream research inhibit downstream research and product development.

The distinction between (1) patents on upstream research inhibiting the sharing of information upstream and (2) patents on upstream research inhibiting downstream research or product development is a significant one, especially given the cost-benefit analyses discussed at the end of the previous section. Most scientists who are engaged in basic research have little incentive to enforce patent protection, so long as the knowledge covered by those patents is far from the point of commercialization. This is the situation that is covered by 1—and it is this situation to which much of the data obtained in the previously discussed empirical studies are relevant. For example, all of the scientists surveyed by Walsh et al. are engaged in academic research, as

opposed to product development, and over 75% of respondents reported doing basic research (Walsh et al. 2007, 1086).[7] The AAAS-SIPPI study focuses on research scientists; the study did not ask which patented materials were being acquired or how these materials were being used (Hanson et al. 2007, 19). While it is likely that most of the scientists surveyed were engaged in basic research, the study does not ask for this information. The study author is, in some sense, correct in concluding that the study provides little evidence of an anticommons problem, but this is only because the evidence that it provides is largely irrelevant to the anticommons thesis.[8]

In addition to the fact that the discussed empirical studies neither confirm nor disconfirm the anticommons thesis, there is evidence from other studies that supports the conclusion that we are witnessing anticommons problems, at least in some areas of research. The most important of these areas is DNA diagnostics. In their survey of 132 directors of diagnostic laboratories, Mildred Cho et al. found that 75% of respondents held patent licenses, 65% had been contacted by a patent or license holder regarding potential infringement, 25% had stopped performing a clinical genetic test as a result of a patent or license, and 53% had decided not to develop a new clinical genetic test as a result of a patent or license (Cho et al. 2003, 5). This is precisely the sort of problem anticipated by the anticommons thesis, and in at least this one area of research, there is concrete evidence of its existence. Why are we witnessing an anticommons problem in this particular area of research? The answer to this is not yet clear, but it seems plausible that the reason is because DNA diagnostics is an area of research that straddles the line between upstream research and downstream product development. A significant part of the research is isolating genes and determining their functions in disease processes, but once this is done, one is not far from having a marketable product—namely, a test for the gene(s) in question. The anticommons thesis, again, concerns the effects of upstream patenting and licensing on downstream research or product development; given this, areas such as DNA diagnostics would seem to be ideal test cases for the thesis—better test cases, in fact, than purely basic research.

The fact that the empirical studies that purport to falsify the anticommons thesis do not provide much evidence that is relevant to it, in conjunction with the fact that we are witnessing anticommons-type problems in at least one area of research, shows that those who criticize the emphasis on commercial-

7. This is one of the many reasons why Walsh et al. never claim that their study falsifies the anticommons thesis. Rather, they claim that at the present time, access to patents "rarely imposes a significant burden for academic biomedical researchers" who are engaged in basic research (2007, 1191). Others have claimed that Walsh's studies falsify the anticommons thesis, but the study authors themselves are more careful than this.

8. This point is also made by Eisenberg (2008, 1069).

izing the results of science—and more specifically, patenting the results of scientific research—have some justification for their criticisms. While the issues involved in this debate are not yet settled, there is reason for concern, and we should monitor closely the effects of patenting and licensing on both scientific and social progress.

4. Conclusion. The primary conclusion of this article is that we still have reason to worry about a tragedy of the anticommons in biomedical research. Can we draw any other conclusions—for example, that patenting the results of basic biomedical research should be prohibited? At this point, I do not believe that we can, and this is for two reasons. First, patenting takes place within a complex web of norms, laws, and policies, and there is a multiplicity of different ways of solving the problems that the system brings. Eliminating patents is one way, but another way would be to change some of the laws or policies that govern the use of patents or licenses. The current patent system is leading to problems (e.g., in DNA diagnostics); determining the most effective way of solving these problems requires further research.

But there is another important philosophical problem that is implicit within the argument of this article, concerning what one might call the "social order" of science and its relation to the law. One of the primary reasons why Walsh et al. conclude that patenting is not currently inhibiting the sharing of information in academic research is, again, that patent infringement is widespread. Moreover, it is probably safe to conclude that the current patent system can survive only on the condition of widespread infringement. Imagine that, if every time a scientist used a DNA microarray—a chip containing thousands of genes that is used to probe for the effectiveness of particular chemical compounds—she had to perform an exhaustive search for patents and then enter into licensing negotiations with all of the different patent holders. If scientists actually had to do this—that is, if they actually had to do what the law requires—then research would come to an abrupt halt. Heller and Eisenberg seem to think that this constitutes a reductio ad absurdum for our current patent system; on their view, in order for a particular social order to be acceptable, it must be the case that one can maintain that order by following the letter of the law. Walsh et al., however, leave open the possibility that a system might be perfectly adequate, so long as it is stable—whether or not following the letter of the law is consistent with maintaining that stability. Following Ellickson (1991), they write, "the 'law on the books' need not be the 'law in action,' particularly if the 'law on the books' contravenes a communities norms and interests" (Walsh et al. 2007, 1200). If one sides with Heller and Eisenberg on this issue, then one has a strong reason for concluding that the current patent system is seriously flawed and that patents on the results of upstream research (and perhaps other patents as well) should be banned. If, however, one sides with Walsh

et al., then the current situation does not look quite so bleak. This question regarding the relation between the social order of science and the law has important implications for the debate over patenting in science, and it deserves much more attention than it has thus far received.

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