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Recommended Citation

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THE PULL OF PATENTS

Brett M. Frischmann*

INTRODUCTION

This Symposium aims to study how intellectual property laws intermediate the relationships between different systems of information production and exchange. The panel for which this essay was prepared specifically focused on the relationships between university and commercial systems. This essay focuses on a particular dynamic: the “pull of patents,” which refers to the manner in which patents facilitate a commercially driven demand pull on university resources.1

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Visiting Professor, Cornell Law School; Associate Professor of Law, Loyola University Chicago School of Law. I thank all of the participants in this exciting Symposium and especially my co-organizers, Jay Kesan and Katherine Strandburg. I also thank participants in two earlier conferences at which I explored some of the ideas in this essay: W(h)ither the Middleman: The Role and Future of Intermediaries in the Information Age, Michigan State University-DCL College of Law, April 7-9, 2005; and the Colloquium on Entrepreneurship Education and Technology Transfer, sponsored by the Karl Eller Center of the University of Arizona and the Ewing Marion Kaufmann Foundation, January 21-23, 2005. For comments on earlier versions of this essay, I thank Julie Cohen, Rochelle Dreyfuss, Ronald G. Ehrenberg, Mark Lemley, Oskar Liivak, Michael Madison, and Spencer Waller. This essay draws from a book chapter, Brett M. Frischmann, Commercializing University Research Systems in Economic Perspective: A View from the Demand Side, in 16 ADVANCES IN THE STUDY OF ENTREPRENEURSHIP, INNOVATION AND ECONOMIC GROWTH, UNIVERSITY ENTREPRENEURSHIP AND TECHNOLOGY TRANSFER: PROCESS, DESIGN, AND INTELLECTUAL PROPERTY 155 (Gary D. Libecap ed., 2005).

1. At the outset, let me make clear: although I focus on patents, patents are far from the only or even the most important institution potentially driving commercialization of university research systems. Grant funding mechanisms and industry sponsorship of university research are two important institutions that significantly affect university science and technology research systems as well. See generally SHEILA SLAUGHTER & LARRY L. LESLIE, ACADEMIC CAPITALISM: POLITICS, POLICIES, AND THE ENTREPRENEURIAL UNIVERSITY (1997) (studying multiple policy instruments and their commercialization impact). In fact, a number of scholars “have argued that much of the increase in commercially oriented university activities, such as patenting and licensing that has occurred since 1980 was driven by contemporaneous shifts in intellectual property laws and regimes for funding academic research.” Scott Shane, Encouraging University Entrepreneurship? The Effect of the Bayh-Dole Act on University Patenting in the United States, 19 J. BUS. VENTURING 127, 129
There are many other important related dynamics to consider when analyzing the role of intellectual property in mediating the relationships between university and commercial systems. For example, there is a substantial, growing literature debating the merits of commercializing university research. The legal and economic literatures in particular focus extensively on university research results and how research results are managed, developed, licensed, transferred, priced, and used. The use of patents within the university research system as a tool to encourage and indeed enable technology transfer, utilization, and commercialization has been lauded by some as a major success and criticized intensively by others. Those who claim success focus on increased rates of patenting, licensing, and commercialization. Patents encourage and enable transactions; they


serve as the focal point for researchers, technology transfer officers, lawyers, venture capitalists, entrepreneurs, engineers, marketers, and other participants in the commercialization process. Without patents, the proponents argue, potentially valuable research would languish underutilized. On the other hand, those who claim failure focus on transaction costs, patent “thickets,” deadweight losses, increased costs to the public, increased secrecy, and shifts in academic norms. Patents, they argue, are unnecessary impediments to widespread, competitive utilization of research results for which the public has already paid.

This debate is by no means resolved. Its resolution will depend upon continued empirical testing of the various types of costs and benefits that each side has highlighted. Moreover, the strength of the arguments offered by each side will vary considerably across research areas (for example, compare computer science, biotechnology, and materials science) and across research result types (for example, compare upstream basic research, midstream research tools, and downstream commercial technology).

In the end, with the exception of some discussion of academic norms, most of the attention in this debate is focused on research results—the outputs from the research process. For purposes of this essay, I would like to shift the focus away from university research results. I do not address the arguments noted


4. See Kieff, supra note 2 (arguing that the primary role of patents is to facilitate commercialization); Bayhing for Blood or Doling Out Cash?, supra note 3.

5. See Eisenberg, Proprietary Rights, supra note 2; see also Eisenberg, Patenting the Human Genome, supra note 2, at 738 (discussing the possible costs and benefits of providing patents for publicly funded research of human genomes); Rai, supra note 2, at 88 (acknowledging that intellectual property rights caused a change in traditional norms of scientific research); Reichman & Uhlir, supra note 2, at 320 (recognizing that increased intellectual property rights discourage traditional sharing of scientific findings).


7. See Dan L. Burk & Mark A. Lemley, Policy Levers in Patent Law, 89 Va. L. Rev. 1575, 1600–15 (2003) (discussing how different theories are more relevant to different industries depending on a particular industry’s needs and capabilities). I should note that the arguments I make in this essay about the pull of patents also vary across fields.

above about whether patents improve or worsen dissemination and use of university research results.

Instead, I explore the manner in which patents might affect the type or nature of the outputs produced, the process of research and other related university-based processes, and most broadly, the university science and technology research system itself. While patent scholars debate the impact of patents on the management of university research, they pay scant attention to potential impacts of patents on the university research system itself.

Given limits in government funding of research—the primary driver of the university science and technology research enterprise—universities have begun to pursue and employ patents aggressively to transfer technology, encourage entrepreneurship, and generate revenues that may support research efforts. While some universities have found tremendous success in pursuing commercial avenues, the vast majority have not. Yet many continue to make participation in the patenting and commercialization process a priority.

Quite frankly, universities face incredibly difficult, complex decisions concerning the degree to which they ought to participate in commercialization of research. As Fumio Kodama and Lewis Branscomb note,

Universities are struggling with the right balance between utilitarianism and independence. How close should the coupling between the academic and commercial worlds? Universities feel they should respond to the opportunity to benefit humanity through commercial realization of new ideas and discoveries (while bringing back to the university some needed unrestricted income). On the other hand, they realize that they are almost uniquely situated to view both the natural and social worlds from a distance, bringing perspective and perhaps vision that would be eroded by being too close to the "customer."
Limited government funds may appear to be the immediate, most visible factor forcing such decisions upon universities. But there may be more fundamental forces at work. For example, in Academic Capitalism, Sheila Slaughter and Larry Leslie present a compelling argument that globalization, changing economic conditions, and other macrolevel factors are increasing pressure on universities on the whole to behave more and more like market actors. The degree to which such pressures are manifest in university science and technology research systems requires continued study.

In this essay, I explore how university science and technology research systems perform economically as infrastructural capital, explain how these systems generate value, and raise some questions about the impacts of university patenting and commercialization. I explain the subtle demand-side role of patents in the university science and technology research system

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14. See SLAUGHTER & LESLIE, supra note 1; see also DEGREES OF COMPROMISE: INDUSTRIAL INTEREST AND ACADEMIC VALUES (Jennifer Croissant & Sal Restivo eds., 2001); JENNIFER WASHBURN, UNIVERSITY, INC.: THE CORPORATE CORRUPTION OF AMERICAN HIGHER EDUCATION (2005); James Stuart, Comment, The Academic-Industrial Complex: A Warning to Universities, 75 U. COLO. L. REV. 1011, 1042 (2004). Another explanation can be found in the dominant economic mind-set that has emerged in the past few decades. This mind-set focuses on the perceived social benefits of commercialization, privatization, and deregulation, on minimizing government intervention in markets, but ignores market intervention into government and academia. For example, in his book, MIT and the Rise of Entrepreneurial Science, Henry Etzkowitz suggests, reorient[ing]...the universities toward a commercial role was not intervention in the sense of specific government measures requiring targeting of particular areas of R&D for support, as in Japan, or requiring enterprises and research institutes to make research contracts with each other, as in the Eastern European socialist model. Instead, incentives were built into the research-funding system to move the universities closer to industry, in their motivation and structure.

ETZKOWITZ, supra note 2, at 125. Etzkowitz is reassured that the government is not overtly intervening into academia but fails to appreciate fully the risks of industry intervention, which I discuss below. As Paul Krugman recently noted, “Decades of conservative marketing have convinced Americans that government programs always create bloated bureaucracies, while the private sector is always lean and efficient.” Paul Krugman, Op-Ed., Buying into Failure, N.Y. TIMES, Dec. 17, 2004, at A35. Universities often are typecast, like government, in a manner that marginalizes their social and economic contributions and their respective roles in society. Along with a glorified view of the market and a pessimistic view of government, universities are cast as ivory tower havens for (liberal) academics out of touch with reality and the demands of society. Bringing universities “closer to industry” may increase accountability and reduce waste, but according to whom and based on what criteria? This is not the place to develop these arguments fully, but I raise them to suggest that the commercialization question is not unique to the university research context but rather is endemic to evolving notions of modern societal organization in capitalist economies. To grapple with the commercialization question, universities should step back from their immediate context, compare their situation with that of other industries and social contexts, reflect on their role in society, and proceed carefully.
and how the availability of patents, coupled with scarce government funding, may lead to a creeping "system optimization," manifest in a slow and subtle shift in the allocation of infrastructure resources and research priorities. This optimization is not simply an adjustment in incentives, to "better" align researchers' incentives with the commercialization objective and thereby encourage more efficient technology transfer and thus more efficient supply of university-derived technology to commercial markets. While this is part of the dynamic, it is critical that universities take a wider view and both recognize and evaluate the potential demand-side effects of commercialization.

The role of patents in the university research context is not simply to use patent-enabled exclusivity to fix the supply-side problem of underutilization of government-funded research results. It is also to increase connectivity between university science and technology research systems and the demands of industry for both university research outputs (research results and human capital) and the infrastructural capital necessary to generating those outputs.15

The U.S. government has made an explicit policy decision to allow funded entities to obtain patents and thereby encourages their participation in the commercialization of federally funded research. The Bayh-Dole Act16 enables universities to participate in the commercialization process, but it does not obligate them to pursue any particular strategy with respect to federally funded research.17 Universities remain the agenda-setters and must decide carefully the extent to which they wish to participate in the commercialization process.18 As Richard Florida has argued, "[u]niversities need to be more vigilant in managing this process" and should "reconsider their more aggressive policies toward technology transfer and particularly regarding the ownership of intellectual property.”19

The remainder of this essay is organized as follows: Part I discusses university science and technology research systems and explains how they perform economically as a form of infrastructural capital. Part II explains how patents were introduced based on supply-side reasoning without due care for demand-side issues. It then describes how patents may contribute to a demand-pull for optimization created by market-driven incentives in the university research context. Finally, Part III suggests that universities

15. Fumio Kodama and Lewis Branscomb note that industry dependence on innovation outputs from university science and technology research systems "has been accelerating dramatically since the Second World War." Kodama & Branscomb, supra note 12, at 8.
17. Cf. Eisenberg, Public Research and Private Development, supra note 2, at 1700 (noting that university support for the Bayh-Dole Act was in part due to universities’ ability to control their interactions with commercial entities).
may choose among different strategies and must carefully decide on the
degree to which they participate in commercialization.

I. UNIVERSITY SCIENCE AND TECHNOLOGY RESEARCH SYSTEMS

A university science and technology research system is a system of
productive resources aggregated within a university setting and used to
produce a stream of research-related outputs, as well as other important
outputs, e.g., educated citizens. The system is comprised of at least five
different sets of related, complementary resources, including

1. human capital, including complementary networks of
   people such as professors, researchers, students,
   administrators, technicians, and other support
   staff;\(^\text{20}\)

2. governance capital, such as rules, norms, policies and
   other collective constraints that guide system participants' behavior;

3. physical capital, such as land, facilities, and equipment;

4. intellectual capital, such as knowledge, information, and
   ideas;\(^\text{21}\) and

5. financial capital.

Each of these capital resources is an essential component of the system,
although the bundle of such resources and manner in which they are
bundled varies considerably across universities. I have referred to the
various components of the system as capital because, aggregated together
within a university, these resources are used (and reused) collectively and
continuously as inputs into a variety of production processes, including
research, education, training, and socialization, among others.

\(^\text{20}\) Richard Florida focuses on the importance of attracting and aggregating human
capital within the university science and technology system as a means of improving its
performance. He notes that universities must attract the "top talent," referring to academic
research professors, in order to attract the top graduate students. \textit{Id}. Florida emphasizes the
need to shift our myopic focus on research results (e.g., university-derived invention) to
human capital, in terms of both human capital outputs and human capital as a component of
infrastructural capital. \textit{See id.; see also SLAUGHTER & LESLIE, supra note 1, at 10–11
(“Universities are the repositories of much of the most scarce and valuable human capital
that nations possess, capital that is valuable because it is essential to the development of
the high technology and technoscience necessary for competing successfully in the global
economy.”).}

\(^\text{21}\) The intellectual capital category is meant to capture the full range of intangible
products of the human intellect, regardless of whether the product has been fixated in a
tangible medium (e.g., written down) and regardless of whether any particular entity claims
ownership of the intellectual good. Intellectual capital often overlaps significantly with
human capital. For example, the idea residing in the mind of a professor is an intellectual
resource, while the professor himself is a human capital resource.
These production processes yield a wide variety of research-related outputs, which can be grouped into two major categories—intellectual capital and human capital. Intellectual capital outputs are the intangible information goods, essentially the research results, that may or may not be embedded in some artifact (e.g., equipment design), be fixated in some tangible form (e.g., written down), or simply reside in the minds of researchers (e.g., tacit knowledge). Generally, when we refer to “science,”
"research," "invention," "innovation," "technology," and so on, we are talking about various types of intellectual capital that are outputs from some intellectual process. These outputs are public goods with varying potentials to yield positive externalities (or conversely, appropriable benefits) when utilized productively. The types of uses may vary considerably.23

Equally if not more important than pure intellectual capital outputs are human capital outputs—people with (1) higher levels of education, knowledge, experience, and research-oriented skills who are (2) prepared for entry into the research community.24 The importance of human capital outputs is well-understood. Many commentators, such as Richard Florida, have emphasized the critical role of U.S. universities in educating and training (graduate) students—in creating “talent” that fuels the knowledge economy. Education, knowledge, experience, and research-oriented skills must be absorbed by students and consequently often are standardized (in contrast with the cutting-edge nature of the research result outputs). Once absorbed through the processes of research, education, and training, the intellectual capital residing within the university science and technology research system is disseminated and shared. Thus, research-oriented education, knowledge, experience, and skills may be viewed as forms of intellectual capital that are disseminated to students and used productively to augment universities’ human capital.

23. See Frischmann, supra note 2, at 364–67 (examining the importance of variance in uses); see also id. at 365 (“A larger (smaller) variance in the distribution corresponds to a basic (applied) innovation, representing a wider (narrower) range of potential applications and hence greater (lesser) uncertainty as to a specific application.”); see also Brett M. Frischmann, An Economic Theory of Infrastructure and Commons Management, 89 MINN. L. REV. 917 (2005) (discussing infrastructural capital and the importance of variance in uses as a defining characteristic); infra note 26 and accompanying text.

24. It is important to realize that socialization is an important aspect of the university science and technology research system. Students are prepared for entry into the research community, for example, by gaining familiarity with professional norms and ethics and forming relationships with members of the community. Most undergraduate or graduate students have limited real-world experience and very little (if any) experience in dealing with professionals as a member of the professional community. In law school, for example, we place a significant emphasis on the fact that students will be entering a profession, that they will be members of the bar, and that a host of ethical and even less formal community norms apply to members. The law school experience, in part, consists of a socialization process that prepares the students for professional membership. A very similar dynamic exists within the university research setting, although it is less explicit and less formal than in the law school setting. Professor Katherine Strandburg has indirectly touched on this dynamic. She explores the relationships between community norms and academic scientists’ individual preferences. See Strandburg, supra note 8.
Both intellectual and human capital outputs generate value when used productively as inputs. As Figure Two illustrates, productive use of these outputs may entail use in further research (internally or externally) or use in commercialization processes (internally or externally).\textsuperscript{25} For the most part,
then, universities are "vertically integrated" with respect to the production of research systems and research-related outputs; some outputs are consumed internally while others are consumed externally. The manner in which the outputs are used depends, of course, on the nature of the specific outputs.

Viewed as an integrated system of complementary resources that generate value primarily when used to produce various streams of research-related outputs, the university science and technology research system begins to look like other forms of infrastructural capital. Supra note 26

University science and technology research systems are "sharable" in the sense that multiple users may access and use the system resources to engage in productive processes and produce research-related outputs. Supra note 27 Some components of the system have infinite capacity (i.e., are purely nonrival in consumption)—such as intellectual and governance capital—while others have finite capacity (i.e., are rival in consumption)—such as physical, financial, and human capital. It is the scarcity of these latter types of capital resources that drives competition for funding, prestige, and resource allocation decisions. As discussed below, to some extent, rivalrousness within the system is what puts pressure on universities to optimize the system for commercial outputs; the appropriable benefits (revenues)


26. See Frischmann, supra note 23 (discussing different types of infrastructure capital). I describe infrastructural capital according to three criteria:

(1) The resource may be consumed nonrivalrously;
(2) Social demand for the resource is driven primarily by downstream productive activity that requires the resource as an input; and
(3) The resource may be used as an input into [the production of] a wide range of goods and services, including private goods, public goods, and nonmarket goods.

Id. at 956. The first criterion isolates a set of resources that are potentially sharable at low (or at least manageable) marginal cost; the latter criteria focus on the manner in which infrastructure functions as generic (or general-purpose) capital to create social value and further narrows the set to those resources that are more likely to give rise to an assortment of demand-side market failures associated with externalities, high transaction and information costs, and path dependency.

generated by such outputs may provide the resources necessary to sustain the system.

University science and technology research systems, like road systems, basic research, the Internet, and many infrastructures\(^\text{28}\) are socially valuable primarily because of the productive activity they facilitate. In other words, the value created by these research systems is only realized when the research-related outputs are used; essentially, the "value added" is embedded in the outputs. Accordingly, to fully understand social demand for this type of infrastructure and to assess how well demand signals "manifest" in infrastructure markets\(^\text{29}\) it is necessary to evaluate the output markets in terms of the nature of the outputs produced, the extent to which such outputs generate (non)observable and (non)appropriable value, and the manner in which value is distributed—for example, whether value is realized only among consumers or whether there are external benefits to nonconsumers.

Most university science and technology research systems serve mixed commercial, public, and social ends by enabling the production of a wide variety of private, public, and nonmarket goods. As a general matter, university science and technology research systems do not directly yield private goods for commercial markets\(^\text{30}\) although these systems generate human and intellectual capital that may be used externally to produce such goods.

University science and technology research systems produce a wide array of public and nonmarket goods that generate or have the potential to generate significant positive externalities. This should not be a controversial point. It is important to realize, however, that the human and intellectual capital outputs of these systems have varying potentials to yield positive externalities and, conversely, appropriable benefits. This variance can be understood in a few ways. For a moment, put aside human capital outputs\(^\text{31}\) and focus on intellectual capital outputs—research results that are pure public goods. The research results may vary in terms of their genericness—specificity with respect to applications—that is, they may vary along the basic to applied continuum.\(^\text{32}\) The research results also may vary in terms of the classes of applications—for example, commercial, private goods production or noncommercial research.\(^\text{33}\) Both types of

\(^{28}\) Frischmann, supra note 23.

\(^{29}\) I discuss demand manifestation below, see infra text accompanying notes 46–49, and extensively in An Economic Theory of Infrastructure and Commons Management, supra note 23.

\(^{30}\) Except to the extent that one takes the view that human capital outputs constitute rival goods consumed in the labor market.

\(^{31}\) Human capital also may exhibit variance in the potential to generate positive externalities.

\(^{32}\) See Frischmann, supra note 2, at 364–67.

\(^{33}\) Id. Note that there are important distinctions between basic and applied research on one hand, and commercial and noncommercial research on the other. The distinctions are relevant and important for comparative institutional analysis. See id. at 376–92 (comparing intellectual property, tax incentives, government grants, government procurement, and
variance affect the potential for positive externalities and appropriable benefits.

As a general matter, most universities do not allocate their infrastructural capital on the basis of commercial prospects in output markets. Consequently, the range of outputs from university science and technology research systems has not historically been weighted more heavily toward commercial research. This is not to say that universities have not made significant contributions in the realm of commercial research—of course, they have—but rather commercial applications have not generally been a central objective or priority. Put another way, industry demand for commercializable research has not driven universities’ resource allocation decisions—at least historically.

By the same token, again historically, government research funding has not been weighted more heavily toward specific commercial ends. Yet, at

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34. As Philip Auerswald and Lewis Branscomb note, researchers tend to allocate their resources—time, money, graduate student assistance, etc.—according to their “interest in the question posed,” which “contrast[s] sharply with a decision rule based on commercial potential.” Philip E. Auerswald & Lewis M. Branscomb, Start-ups and Spin-offs: Collective Entrepreneurship Between Invention and Innovation, in THE EMERGENCE OF ENTREPRENEURSHIP POLICY: GOVERNANCE, START-UPS, AND GROWTH IN THE U.S. KNOWLEDGE ECONOMY 61, 79–80 (David M. Hart ed., 2003) [hereinafter EMERGENCE OF ENTREPRENEURSHIP]. They also note, “A fundamental challenge involved in taking a project from invention to innovation is accomplishing the shift from decisions based on the criterion of ‘interestingness’ to one based on the criterion of commercial value.” Id. at 80.

35. See, e.g., Henderson, Jaffe & Trajtenberg, supra note 1. As Jerry and Marie Thursby note, “[c]uriosity-driven research can often lead to commercially applicable results by accident.” Jerry G. Thursby & Marie C. Thursby, Patterns of Research and Licensing Activity of Science and Engineering Faculty, in SCIENCE AND THE UNIVERSITY 77, 81 (Paula E. Stephan & Ronald G. Ehrenberg eds., 2007). In their study of Australia, Britain, Canada, and the United States, Sheila Slaughter and Larry Leslie found that “all four countries developed national policies that promoted a shift from basic or curiosity-driven research to targeted or commercial or strategic research.” SLAUGHTER & LESLIE, supra note 1, at 14–15; see also id. ch. 2 (analyzing a host of national policy instruments). On “curiosity-driven research,” see Strandburg, supra note 8.

36. “Historically, a large part of federal R&D spending has been devoted to agencies that have uniquely public missions, in particular national defense. Although the private sector performs much of that work under contract, the government directs such mission-oriented R&D because it, rather than private customers, is the ultimate consumer of any new technologies that might result.” CONGRESSIONAL BUDGET OFFICE, U.S. CONGRESS, FEDERAL SUPPORT FOR RESEARCH AND DEVELOPMENT 3 (2007), available at http://www.cbo.gov/fhpdocs/82xx/doc8221/06-18-Research.pdf. For the past four decades, federal research and development (R&D) spending has been weighted most heavily toward defense. See AM. ASS’N FOR THE ADVANCEMENT OF SCI., FEDERAL SPENDING ON DEFENSE AND NONDEFENSE R&D (2008), available at http://www.aaas.org/spp/rd/histde09.pdf. Within nonddefense research spending, the shares among space, health, energy, general science, and other fields have varied over time. See AM. ASS’N FOR THE ADVANCEMENT OF SCI., TRENDS IN NONDEFENSE R&D BY FUNCTION, FY 1953–2009 (2008), available at http://www.aaas.org/spp/rd/histda09.pdf. The American Association for the Advancement of Science provides excellent guides to the historical data and funding trends. See American Association for the Advancement of Science, R&D Budget and Policy Program: Guide to R&D Funding Data—Historical Data, http://www.aaas.org/spp/rd/guihist.htm (last visited
times, government funding has yielded research with commercial applications, and, as the history behind the Bayh-Dole Act tells us, such research was underutilized. To solve this problem of underutilized government-funded research, intellectual property took on a new role, to which I now turn.

II. THE ROLE OF PATENTS IN UNIVERSITY RESEARCH SYSTEMS

There are many competing theories, justifications, and explanations for the existence of intellectual property law. The dominant economic justification for patents outside the university research context is that granting patents over inventions provides the necessary incentive for private investment in creating the inventions in the first place. Information resources face the well-known supply-side problem, common to public goods: the inability to (cheaply) exclude competitors and nonpaying consumers (free riders) presents a risk to investors perceived ex ante (prior to production of the good), and this risk may lead to undersupply. Essentially, in the absence of patent law, there would be a significant underinvestment in (some types of) inventions because of the risk that competitors would appropriate the value of the inventions. Granting inventors patents lessens the costs of exclusion, raises the costs of free riding, encourages licensing, and, as a result, makes a greater portion of the surplus generated by the invention appropriable by the inventor.

In the university research context, patents have these same effects, but where research is funded by government, the economic justification is quite different. Simply put, awarding patents for government-funded research

Mar. 25, 2009). For a discussion of a range of noncommercial priorities in federal research funding, see DONNA FOSSUM ET AL., VITAL ASSETS: FEDERAL INVESTMENT IN RESEARCH AND DEVELOPMENT AT THE NATION'S UNIVERSITIES AND COLLEGES 2 (2004). Recent studies suggest that federal R&D funds have become increasingly concentrated. Id. at 12 (noting that recent increases in R&D funding to universities and colleges have been highly focused on medical research).

37. See MOWERY ET AL., supra note 2, at 86–93 (providing a detailed historical account).

38. See Eisenberg, Public Research and Private Development, supra note 2, at 1702 (discussing and critiquing the argument that federally funded research was underutilized).


40. For a certain subset of patentable subject matter, trade secrecy or other mechanisms may provide sufficient means for appropriating surplus to attract private investment into production. For this subset, patents may be justified for a variety of reasons associated with disclosure. See Katherine J. Strandburg, What Does the Public Get? Experimental Use and the Patent Bargain, 2004 Wis. L. Rev. 81.

41. I am concerned in this essay with government-funded research. Of course, a significant amount of university research is funded through other means. See Pedro Conceição et al., R&D Funding in US Universities: From Public to Private Support or Public Policies Strengthening Diversification?, in PUBLIC-PRIVATE DYNAMICS IN HIGHER EDUCATION: EXPECTATIONS, DEVELOPMENTS AND OUTCOMES 301 (Jürgen Enders & Ben Jongbloed eds., 2007); Ami Zusman, Challenges Facing Higher Education in the Twenty-First Century, in AMERICAN HIGHER EDUCATION IN THE TWENTY-FIRST CENTURY: SOCIAL, POLITICAL, AND ECONOMIC CHALLENGES 115, 124–27 (Philip G. Altbach et al. eds., 2d ed.)
is premised on the notion that patents are necessary to facilitate postpatent research, development, and commercialization.42 That is, in the absence of patents, government-funded research results would languish underutilized (underdeveloped and undercommercialized) because (1) the researchers and their host institutions lacked the incentives and/or capacity to further develop and commercialize the research or to transfer the research results to industry, and (2) even if transfer was feasible, industry lacked sufficient incentives to invest in development and commercialization without the exclusivity made available by patents in the form of exclusive licenses. Elsewhere I have questioned the strength of these arguments and argued that the classes of research results for which these arguments justify patents may be quite limited.43 Rather than rehash the arguments and counterarguments, which as noted in the introduction are the subject of continued debate, assume for purposes of argument that the federal policy of allowing federally funded researchers to patent the research results is warranted. After all, as noted earlier, the law only encourages and enables, but does not require, university patenting and participation in commercialization.

Most analyses of the role of patents in the university research context focus on the exclusivity of patents: that is, the benefits of exclusivity—increased appropriation of surplus; increased technology transfer, licensing and related transactions; increased commercialization; and so on—and the costs of exclusivity—deadweight losses; increased transaction costs; patent thickets; and so on. It is important to keep in mind that the benefits and costs of exclusivity are felt differently by different constituencies within a university and thus may lead to internal conflicts.

Exclusivity is a supply-side concern that is relevant to assessing how well markets will function. Patents improve exclusion and consequently the supply-side functioning of markets for university research results, as well as those markets for derivative commercial end-products. The reward, prospect, and commercialization theories of patent law take patent-enabled exclusivity as the relevant means for fixing a supply-side problem—

2005); Peter D. Blumberg, Comment, From “Publish or Perish” to “Profit or Perish”: Revenues from University Technology Transfer and the § 501(c)(3) Tax Exemption, 145 U. PA. L. REV. 89, 99–100 (1996).

42. While the prospect and commercialization theories of patent law are technically distinct and have slightly different foci, they share the same theoretical and practical orientation. See Shubha Ghosh, Patents and the Regulatory State: Rethinking the Patent Bargain Metaphor After Eldred, 19 BERKELEY TECH. L.J. 1315, 1353–57 (2004) (noting that prospect and commercialization theories derive from the theoretical work of Harold Demsetz); Kieff, supra note 2 (discussing the commercialization theory); Edmund W. Kitch, The Nature and Function of the Patent System, 20 J.L. & ECON. 265, 276 (1977) (discussing the prospect theory). Some might argue that these theories are not focused on exclusion for the purpose of attracting investment so much as for the purpose of centralizing decision making and control in a property owner. In my view, these purposes overlap considerably and can be tied back to conceptions of how investment decisions are made and concerns over efficient supply chains.

43. See Frischmann, supra note 2.
essentially, the undersupply of private investment in the production of patentable subject matter or in the development and commercialization of patentable subject matter that would occur in the absence of patent-enabled exclusivity. The theories differ largely in terms of where in the supply chain patent-enabled exclusivity is needed and of the degree of control/exclusivity needed.

Patent theories take as a given that the market mechanism will best aggregate information regarding demand for such investment. Put in a slightly different way, the theories are premised on the notion that private investment into the production, development, and commercialization of patentable subject matter will be allocated efficiently on the basis of expected returns in commercial markets, so long as patents are available to provide the necessary exclusivity. This certainly makes good sense, so long as we are talking about private profit-driven investment. But what if investment is not entirely private?

What if demand for research-related outputs and the allocation of infrastructural capital to the production of such outputs is not best determined by the market mechanism on the basis of expected returns in commercial markets? What if demand is assessed more efficiently by nonmarket processes—involving government, nonprofits, or community organizations, for example? What if we are talking about public or community investment rather than private investment?

As noted above, university science and technology research systems produce a mix of outputs, some of which may have commercial application, many of which do not. How, if at all, does the availability of patents in the university research context affect demand for university science and technology research system resources?

In An Economic Theory of Infrastructure and Commons Management, I explain the concept of demand manifestation, which basically concerns how well consumer demand for infrastructure-dependent outputs translates into demand for infrastructure. Markets may underrepresent social demand for infrastructure where output producers fail to observe or appropriate value in

44. Economist Harold Demsetz articulates well the argument that markets efficiently aggregate, process, and respond to information about what people want, and in particular, that the price mechanism provides a remarkably effective signal to producers about where to direct their investments. See Harold Demsetz, The Private Production of Public Goods, 13 J.L. & ECON. 293 (1970); see also Harold Demsetz, Information and Efficiency: Another Viewpoint, 12 J.L. & ECON. 1 (1969); c.f. PAUL GOLDSTEIN, COPYRIGHT'S HIGHWAY: FROM GUTENBERG TO THE CELESTIAL JUKEBOX 178-79 (1994) (making a similar point in the copyright context). Compare Brett M. Frischmann, Evaluating the Demsetzian Trend in Copyright Law, 3 REV. L. & ECON. 649 (2007) (challenging the view that the market mechanism will necessarily aggregate demand information best), with Harold Demsetz, Frischmann's View of "Toward a Theory of Property Rights," 4 REV. L. & ECON. 127 (2008) (suggesting that the market mechanism should be the default unless it can be shown that an alternative (such as the government) would outperform the market).

45. See Benkler, Coase’s Penguin, supra note 27 (comparing market-, state-, and commons-based production as information-processing systems); Frischmann, supra note 23; Strandburg, supra note 8.
output markets. Put another way, the market mechanism exhibits a predictable bias in favor of outputs that generate observable and appropriable benefits; to the extent that infrastructure access or infrastructure capital is scarce, relying on the market mechanism to indicate demand for access or capital may lead to undersupply of socially desired outputs—specifically, public goods and nonmarket goods that yield positive externalities.46

In the past, universities had not directed their resources toward the production of commercial outputs for a variety of reasons—public interest missions, an explicit focus on education of citizenry, the "ivory tower" metaphor and the ideal of insulation from market or government influence, and so on. Of course, the grant-funding process itself has had and continues to have a tremendous influence on how universities direct their resources. Academic norms, reputation, and prestige mechanisms do as well. Yet another important reason may be that universities had not always been able to appropriate the benefits of commercially viable research in the absence of patent protection.

Arguably, the obstacles that patents were introduced to overcome—insufficient incentives and capacity to develop and commercialize research results—may have acted as an important buffer between the university science and technology research system and the marketplace.47 This is not to say that universities and industry did not interact. To the contrary, as David Mowery demonstrates, universities and industry have a long history of interactions.48 Clearly, the buffer has been permeable over time, but (arguably) it may have been sufficient to insulate system management and resource-allocation decisions from the demands of commercial markets.

Although universities were vertically integrated in the sense that they produced both the infrastructure and the outputs, the infrastructure remained generic and the outputs remained mixed because the appropriability of surplus in output markets was not a driving factor in the allocation of infrastructural capital. Introducing patents into the system, along with a host of other initiatives aimed at both enabling and tightening the

46. See Frischmann, supra note 23 (explaining this dynamic); see also Rebecca S. Eisenberg, Patents and the Progress of Science: Exclusive Rights and Experimental Use, 56 U. CHI. L. REV. 1017, 1033 (1989) (discussing a study by Edwin Mansfield that found that private rates of return were almost half that of the social rates of return such that, in hindsight, private firms would not have invested in research and development of the innovation despite the social benefits that were ultimately realized).

47. C.f. Shane, supra note 1 (suggesting that the inability to appropriate returns from certain types of research affected university patenting behavior and that Bayh-Dole led to changes in such behavior at the margin).

48. David Mowery shows that the trend of increased patenting behavior by universities occurred prior to 1980 and the passage of Bayh-Dole. He also suggests that, while the relationship between universities and industry may have evolved (been transformed) in the past few decades, transformation should not be attributed to the Bayh-Dole Act itself. See David Mowery, The Bayh-Dole Act and High-Technology Entrepreneurship in U.S. Universities: Chicken, Egg, or Something Else?, in UNIVERSITY ENTREPRENEURSHIP, supra note 8, at 39.
relationship between universities and industry, may change allocation decisions. While this essay focuses on patents, these other intermediating institutions also may exert significant pressure on the allocation of university infrastructural capital.

Demand for university-produced commercial research manifests in market-driven transactions made possible by patents (e.g., licenses) and critically, through other university-industry relationships, such as industry sponsorship of research. This creates a demand-pull that may lead to the optimization of the infrastructure. In a realm of limited, scarce resources and robust competition for prestige, students, and funding, university decisions about how to allocate infrastructure capital may shift and gradually become biased toward output markets that generate appropriable returns at the expense of those that generate positive externalities (i.e., social returns in excess of private returns).

49. See Michael S. Mireles, An Examination of Patents, Licensing, Research Tools, and the Tragedy of the Anticommons in Biotechnology Innovation, 38 U. MICH. J.L. REFORM 141, 144–45 (2004) (discussing industry sponsorship of research and noting this effect); Strandburg, supra note 8 (same); see also Reichman & Uhlir, supra note 2, at 341–43 (noting that commercial exploitation of university research may pressure universities to "hoard" and protect information).

50. As I argue at greater length elsewhere, the market mechanism exhibits a bias for outputs that generate observable and appropriable benefits at the expense of outputs that generate positive externalities. This is not surprising because the whole point of relying on exclusivity—whether provided by traditional property rights or patents—is to enable private appropriation and discourage externalities. The problem with relying on the market mechanism is that, in certain contexts, potential positive externalities may remain unrealized if they cannot be easily valued and appropriated by those that produce them, even though society as a whole may be better off if those potential externalities were actually produced. See Frischmann, supra note 23; Frischmann & Lemley, supra note 6 (explaining the benefits of letting the spillovers flow). The market mechanism exhibits other biases as well. For instance, because private discount rates tend to be higher than social discount rates, markets tend to be biased toward the short term. Among other things, the divergence between private and social discount rates can lead to overinvestment in applied research and commensurate underinvestment in basic research. Further, incumbent market actors may act strategically to preserve their market positions or to control the direction of innovation. These two biases introduce further dynamic complications associated with path dependence and the costs of changing directions once a path has been taken. Others have noted the possibility of such shifts. See, e.g., Frischmann, supra note 2; Phillip G. Pardey, Bonwoo Koo & Carol Nottenburg, Creating, Protecting, and Using Crop Biotechnologies Worldwide in an Era of Intellectual Property, 6 MINN. J. L. SCI. & TECH. 213, 225 (2004) (noting how a shift in emphasis may occur away from basic research to applied research as universities look for more financially rewarding research); Arti K. Rai & Rebecca S. Eisenberg, Bayh-Dole Reform and the Progress of Biomedicine, LAW & CONTEMP. PROBS., Winter/Spring 2003, at 289; Reichman & Uhlir, supra note 2, at 342; David C. Hoffman, Note, A Modest Proposal: Toward Improved Access to Biotechnology Research Tools by Implementing a Broad Experimental Use Exception, 89 CORNELL L. REV. 993, 1025 (2004) ("As the biotechnology industry has diversified and become economically viable, the financial incentive provided by patents has motivated many academic scientists to shift their emphasis from basic to applied research." (citing Michele Svatos, Biotechnology and the Utilitarian Argument for Patents, in SCIENTIFIC INNOVATION, PHILOSOPHY, AND PUBLIC POLICY 113, 122–24 (Ellen Frankel Paul et al. eds., 1996))). Notably, the empirical evidence does not confirm or refute claims that a shift from basic to applied research has occurred. See Mowery et al., supra note 1, at 117 ("[T]he shifts
As noted previously, university science and technology research systems are inputs into the production of a wide variety of research-related outputs that are used externally and internally to produce value (which may actually involve internal cycling for continued use in the university science and technology research system). There is a risk that the biases of the market mechanism will "work their way upstream" and affect university science and technology research systems. The most obvious manner in which this dynamic can be expected to operate is simply by way of (infrastructure capital) resource allocation—in a world of scarce resources (particularly, physical, human, and financial capital), it should not be surprising to see an emerging preference for self-supportive activities that yield appropriable benefits that are fed back into the system.

It is very difficult to gauge this type of institutional change, but there are some indications that the Bayh-Dole Act has had impacts on the management of university science and technology research systems. The Economist, which in 2002 heralded the Bayh-Dole Act as "[p]ossibly the most inspired piece of legislation to be enacted in America over the past half-century," more recently concluded,

Many scientists, economists and lawyers believe the act distorts the mission of universities, diverting them from the pursuit of basic knowledge, which is freely disseminated, to a focused search for results that have practical and industrial purposes. Whether that is a bad thing is a matter of debate. What is not in dispute is that it makes American academic institutions behave more like businesses than neutral arbiters of truth.52

in these universities’ post-1980 research activities cannot be characterized as a shift from basic to applied research." (emphasis added)); Bart Van Looy et al., Combining Entrepreneurial and Scientific Performance in Academia: Towards a Compounded and Reciprocal Matthew-Effect?, 33 RES. POL’Y 425, 428–29 (2004) (surveying empirical literature and noting that "the empirical evidence on this problem appears to be mixed,["] with some evidence showing increased applied research and some evidence suggesting that increases in applied research "[do] not necessarily imply a trade off with basic research"); id. at 436–38 (finding no evidence of skewing in their study); see also Shane, supra note 1, at 128 ("[T]he Bayh-Dole Act led to a shift in university patenting at the margin towards fields in which licensing is an effective mechanism for acquiring new technical knowledge.").

51. Opinion, supra note 3, at 3.
52. Bayhing for Blood or Doling Out Cash?, supra note 3, at 109 ("For example, a study published in 2003 by Jerry and Marie Thursby, of Emory University and the Georgia Institute of Technology respectively, showed that more than a quarter of the [licenses] issued by universities and research institutes include clauses allowing the business partner in the arrangement to delete information from research papers. Almost half allow them to insist on publication being delayed."); Reichman & Uhlir, supra note 2, at 341 ("Under Bayh-Dole, universities have moved away from policies that favor pure research, both for its own sake and as a tool for advancing higher education. As the costs of education skyrocket, and government funding fails to keep up in many areas, universities have aggressively sought to exploit commercial applications of research results, with an eye toward maximizing returns on investment."). See generally Keser, Transferring Innovation, supra note 10 (collecting sources).
Despite various expressions of concern about these types of impacts, the empirical evidence is rather light, in part because institutional change may be slow, subtle, and difficult to measure empirically.

While there have been plenty of empirical studies of university patenting behavior and the performance of technology transfer offices, there has been less attention paid to the allocation of infrastructural capital. Specifically, empirical study of the allocation of infrastructure capital resources of the types identified would be quite helpful in evaluating changes in university science and technology research systems. Among other things, the datasets that would be useful include time spent by faculty and graduate students on different types of projects; the role of patenting and related behavior in hiring, promotion, and tenure of faculty across different departments; and the allocation of physical capital such as labs and equipment to general-purpose or dedicated commercial projects. It would be helpful to analyze such allocations over time and to identify and track policy changes—such as adjustment in tenure criteria to encourage patenting or commercialization.

Moreover, it would be helpful to examine who allocates infrastructural resources within university science and technology systems and how such decisions are made. Of course, there are many different entities with


54. Of course, this may be a very difficult dataset to obtain. Some evidence suggests that the "overwhelming majority of university inventions are so embryonic that commercial application requires not only further development but also faculty cooperation in that development." Thursby & Thursby, supra note 35, at 78—79 (emphasis added) (citing Ajay Agrawal & Rebecca Henderson, Putting Patents in Context: Exploring Knowledge Transfer from MIT, 48 MGMT. SCI. 44 (2002); Jerry G. Thursby et al., Objectives, Characteristics and Outcomes of University Licensing: A Survey of Major U.S. Universities, 26 J. TECH. TRANSFER 59 (2001); Jerry G. Thursby & Marie C. Thursby, Who Is Selling the Ivory Tower? Sources of Growth in University Licensing, 48 MGMT. SCI. 90 (2002)). The point is that commercializing embryonic inventions takes considerable time and effort on the part of academic researchers and thus may reflect a shift in allocation of that critical resource.

55. W. Ronnie Coffman and his coauthors, for example, report that a faculty panel at Cornell University concluded that the "University could better serve its internal and external responsibilities by placing a greater emphasis on the development and commercialization of university inventions" and recommended changes in university policy, including, among other things, that the University (1) "[r]ecognize the issue of a patent on an invention as an academic contribution similar to the publication of a refereed journal article for promotion and tenure purposes," and (2) "[p]rovide additional and, particularly, more rapid financial support (including for research) to inventors." W. Ronnie Coffman et al., Commercialization and the Scientific Research Process: The Example of Plant Breeding, in SCIENCE AND THE UNIVERSITY, supra note 35, at 94, 102; see also Scott Jaschik, A Tenure Reform Plan with Legs, INSIDE HIGHER ED, Jan. 5, 2006, http://www.insidehighered.com/news/2006/01/05/tenure (discussing how University of Rochester engineering professors seek to have patents used in evaluating tenure applications); Sara Lipka, Texas A&M Will Allow Consideration of Faculty Members' Patents in Tenure Process, CHRON. HIGHER EDUC., May 30, 2006, available at http://www.utsystem.edu/news/clips/dailyclips/2006/0528-0603/HigherEd-CHE-Tenure-053006.pdf.
different roles, positions, values, incentives, and needs within the university—including university administrators, department heads, various committees, academics, graduate students, technicians, and so on. (Welcome to the world of academic politics.) This line of inquiry is beyond the scope of this essay, but I raise it to emphasize the complex array of actors involved in university resource-allocation decisions and also to question reliance on academic norms alone to safeguard researcher autonomy.

The role of patents in university research systems may reflect a changing conception of the role of universities in an innovation-driven economy. Many have observed, chronicled, and evaluated this transformation. As it has become clearer that innovation is the engine driving the economy, we should expect pressure to optimize various institutions to support innovation policy. Should universities be optimized to supply innovation? Even if universities should be optimized to supply innovation, what exactly does that mean? How would such an objective be accomplished? Assuming that promoting innovation were our sole policy objective, it is not clear what the optimal role of universities would be. The current trend reflects one of many possibilities. Specifically, the current trend envisions universities as active participants in the postpatent commercialization process, and, critically, in the part of the process that bridges the gap between invention and innovation. Bridging this gap is critical to the commercialization process, and, as Philip Auerswald and Lewis Branscomb have argued, a bridge may be collectively built by university researchers, entrepreneurs, venture capitalists, and other interested parties in a sort of collective entrepreneurship. Of course, building bridges consumes (capital) resources. Perhaps universities would

56. In The Uses of the University, Clark Kerr described the university as a “multiversity” struggling to serve many different interest groups while retaining its autonomy. See Washburn, supra note 14, at 2.

57. Professor Katherine Strandburg suggests that researchers themselves exhibit significant autonomy; she focuses on the preferences of basic researchers and the differences between homo economicus and homo scientificus; and she argues that the peer review process serves the important function of manifesting and responding to the preferences of basic researchers for “interesting” science. See Strandburg, supra note 8; see also Auerswald & Branscomb, supra note 34, at 79–80. Professor Strandburg’s inquiry raises a number of important questions: whether basic researchers truly are making allocation decisions autonomously, how their preferences are formed, the degree to which academic scientists (and their preferences) adapt and evolve, and whether changes in the university research environment lead to slow subtle changes in the “species” of university researchers. These are difficult questions that require further study. See Thursby & Thursby, supra note 35, at 80 (discussing a few papers that explore scientists’ preferences and how they may change with incentive structures and lifecycle).

58. This may also be reflected in the grant-funding process.

59. See, e.g., Bok, supra note 2; Capitalizing Knowledge, supra note 2; Degrees of Compromise, supra note 14; The Emergence of Entrepreneurship Policy, supra note 34; Etzkowitz, supra note 2; Industrializing Knowledge, supra note 2; Slaughter & Leslie, supra note 1.

60. I am doubtful as a matter of general public policy.

61. See Auerswald & Branscomb, supra note 34, at 79–80.
better serve innovation policy by focusing on the wide variety of inputs necessary for innovation, including both intellectual and human capital.

As a general matter, I agree with Richard Florida's argument that an inordinate focus on innovation "misses the larger economic picture": 62

Universities have been naively viewed as "engines" of innovation that pump out new ideas that can be translated into commercial innovations and regional growth. This has led to overly mechanistic national and regional policies that seek to commercialize those ideas and transfer them to the private sector. Although there is nothing wrong with policies that encourage joint research, this view misses the larger economic picture: 

"Universities are far more important as the nation's primary source of knowledge creation and talent. Smart people are the most critical resource to any economy, and especially to the rapidly growing knowledge-based economy on which the U.S. future rests." 63

III. STRATEGIES FOR UNIVERSITIES

Some seem to believe that university commercialization is simply inevitable. In Capitalizing Knowledge, for example, Henry Etzkowitz claims that the "function of the university" has "irrevocably changed," that "[t]here is likely no return to an earlier era," and that "the university is changing its organization and ideology to accommodate its new role in economic development." 64 Similarly, in Entrepreneurial Science: The Second Academic Revolution, Henry Etzkowitz and Andrew Webster claim that "universities are undergoing a 'second revolution.'" 65 Not only do I disagree, but I find such assertions somewhat hyperbolic. Universities, like any other organization, must adapt and evolve with changing economic and social conditions, but each university must determine its own "ideology" and mission and decide on the manner and extent to which it should participate in commercialization, entrepreneurship, and economic development.

As noted earlier, the U.S. government has made an explicit policy decision to allow funded entities to obtain patents and thereby has encouraged participation in the commercialization of federally funded research. Nonetheless, universities still must decide on the extent to which they wish to participate in the commercialization process. As a general

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63. Id. at 67–68 (emphasis added).
64. Henry Etzkowitz, Andrew Webster & Peter Healey, Introduction to Capitalizing Knowledge, supra note 2, at 1, 16.
65. Henry Etzkowitz & Andrew Webster, Entrepreneurial Science: The Second Academic Revolution, in Capitalizing Knowledge, supra note 2, at 21, 21. Universities (and society more generally) should seriously evaluate such developments (and attendant claims of inevitable revolution). See Jennifer Croissant & Sal Restivo, Introduction to Degrees of Compromise, supra note 14, at xi, xi–xii ("From the early 1980s through the present, commercialization of research has been a consensus policy: Not a . . . natural 'evolution' of research and development practices, but a conscious reprioritization by a broad coalition of actors.").
matter, universities are not required by law to create technology transfer offices, delay or withhold publication of research results, patent research results, issue exclusive licenses, or be entrepreneurs. The Bayh-Dole Act enables universities to participate in the commercialization process, but it does not obligate or constrain them to pursue any particular strategy with respect to federally funded research. Universities remain in the driver’s seat and may decide which road to take and at what speed.

There is no uniform answer for universities to the commercialization question. The extent to which universities should actively participate in patenting and commercializing research and to which a university research system should be directed toward patentable research outputs will vary considerably across universities. Some universities may have sufficient resources to resist pressure to optimize the university science and technology research system for commercial outputs; other universities may not. Some universities may in fact prefer to optimize, perhaps because of a particular university mission, a vision of the university role in the modern economy, or strategic reasons related to faculty recruitment, student recruitment, prestige, or public image. In the end, with respect to patent policy, technology transfer, commercialization, and entrepreneurship, universities have choices and face competing incentives. How to proceed depends upon the particular university’s objectives for its science and technology research system.

I envision robust competition among universities operating on different models and pursuing different strategies, missions, and ideologies. Some universities may actively engage in the commercialization process without affecting their science and technology research systems. Other universities may need to choose whether to optimize their science and technology research systems for commercial research outputs or to sustain a mixed system. In the various markets that universities compete—markets for faculty, students, government funds, etc.—different strategies may be successful.

Those universities that wish to preserve the integrity of their research systems and resist the pressure to optimize need affirmatively to take steps to manage conflicts of interests, to insulate decisions regarding infrastructural capital allocation (i.e., decisions that impact the allocation of the five types of aggregated capital resources to particular types of productive activities) from the demands of the marketplace, and ultimately to minimize (or eliminate) dependence upon commercial revenues for sustaining the research system. Those universities that wish to optimize their research systems for commercial outputs should do so explicitly with a full awareness of the risks and rewards.

66. See Kodama & Branscomb, supra note 12, at 14 (emphasizing the need to recognize variance across universities).

67. As Katherine Strandburg notes, many of the concerns in this context stem from scarce public funding. See Strandburg, supra note 8.
Over the past decade, universities have paid more attention to these issues and begun to develop nuanced positions on how to proceed with patenting, participation in research commercialization efforts, and collaboration with industry. In 2006–2007, for example, several universities and the Association of American Medical Colleges considered various issues pertaining to university licensing practices and issued a White Paper, *In the Public Interest: Nine Points to Consider in Licensing University Technology*. The White Paper sets forth principles to consider in context when engaged in licensing of various research outputs, and some of the principles bear on the university science and technology system. For example, point one—*Universities should reserve the right to practice licensed inventions and to allow other nonprofit and governmental organizations to do so*—reflects an understanding of both the internal feedback loops as well as external use by other noncommercial users. Similar understanding is reflected in many of the other principles. Moreover, the White Paper repeatedly emphasizes university mission, academic norms, public interest, and social welfare. The White Paper has gained considerable attention and garnered support among many universities. This is a welcome development in my view, though I must note that it does not alleviate the concerns I have raised in this essay, and if anything, makes them more salient.

**CONCLUSION**

This essay aims to make two related contributions. First, it introduces the concept of “patent pull” to highlight an underexplored demand-side perspective on patents. Patents “pull” (private and public) investment to productive activities that would be less attractive in the absence of patents. Exploring the role of patents from the demand side reveals that beyond affecting traditional capital investment decisions, patents can have more

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69. In addition to the universities and associations that originally endorsed the White Paper (California Institute of Technology; Cornell University; Harvard University; Massachusetts Institute of Technology; Stanford University; University of California; University of Illinois, Chicago; University of Illinois, Urbana-Champaign; University of Washington; Wisconsin Alumni Research Foundation; Yale University; and the Association of American Medical Colleges), the Board of Trustees for the Association of University Technology Managers (AUTM) has endorsed the nine points, as have many additional universities. See Association of University Technology Managers, Endorse the Nine Points to Consider, http://www.autm.net/source/ninepoints/ninepoints_endorsement.cfm (last visited Feb. 15, 2009) (listing current signatories).
subtle and perhaps pervasive impacts on organizations and institutions, including but not limited to universities. This essay focuses on university research systems; further research into the role of patents in other systems where government and other nonmarket processes may fare well in manifesting and processing societal demand is needed. That patents are introduced into the “normal” market setting to create distortions is well understood, but the impacts of such distortions upon priorities and the allocation of infrastructural capital in nonmarket settings warrants further study.  

Second, this essay examines how university science and technology research systems perform economically as infrastructural capital and raises some questions about the impacts of university patenting and commercialization. The examination is preliminary and intended to support further exploration and empirical study. It also aims to make a conceptual connection with other areas of infrastructure policy. The issues surrounding commercialization of university research systems are similar to those surrounding the commercialization of mixed infrastructure, such as the Internet. These resources are similar in terms of the manner in which they generate social value and in terms of the significant pressures they face to evolve to serve commercial ends. In some cases, such as the Internet, technological design creates a buffer that resists optimization and protects the generic nature of the infrastructure. In other cases, the law may create a similar buffer. In the case of university research systems, traditional buffers between universities and the market seem to be eroding. In this essay, I argue that this ought to be of concern to universities and society more generally because it may lead to an optimization of university research systems for commercializable outputs—a slow and subtle shift in the allocation of infrastructure resources, priorities, relationships, norms, and so on driven by the demands of commercial markets.  

I do not argue that commercialization of research results is inherently bad or undesirable. To the contrary, such commercialization ought to be pursued when possible. My concern is with the commercialization of university science and technology research systems.

70. I mean to use “distortion” in a neutral manner to suggest an induced shift in the allocation of resources that would otherwise obtain. See Frischmann, supra note 44, at 670–72 (comparing externality-induced and property-induced distortions).

71. Slaughter and Leslie have referred to this as an aspect of “academic capitalism.” See SLAUGHTER & LESLIE, supra note 1.