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ABSTRACT This paper draws on institutional theory to explain the rise of university patenting in the USA. While observers have traditionally attributed this development to the Bayh-Dole Act of 1980, recent research has shown that university patenting was increasing throughout the 1970s and argued that the Act's impact was less than has generally been assumed. This paper attempts to reconcile these opposing positions by explaining the rise of university patenting as a process of institution-building. Beginning in the 1960s, a skilled actor within the federal bureaucracy created a proto-institution that simplified university patenting and encouraged the development of a community of university patent administrators. In the 1970s, that community in turn allied itself with government proponents of patent policy liberalization and representatives of small business in a successful effort to pass the Bayh-Dole Act. The Act itself should be seen not as creating modern technology transfer, but rather as a final step in a state-driven process of institutionalization that was already well under way by 1980. The case is used to discuss how an institutional approach, which is infrequently seen in STS, can sometimes be useful to it.

Keywords Bayh-Dole Act, commercialization, government, institutional theory, patents, technology transfer, universities

Why Did Universities Start Patenting?

Institution-Building and the Road to the Bayh-Dole Act

Elizabeth Popp Berman

Academic science, once relatively insulated from market forces, has seen the Mertonian ideal of communism partially displaced by an argument that science, in order to be fully applied, must often be privately owned. In keeping with this logic, universities in the USA have been patenting faculty inventions in increasing numbers for the last several decades. University patenting was once considered inappropriate by many, who saw it as transferring a public good into private hands. Today, however, the practice is widely accepted and encouraged on the grounds that private ownership is often required in order to provide sufficient incentive for investment in the development of scientific inventions. A growing body of work examines how universities' patent practices have changed and to what effect (Henderson et al., 1998; Mowery et al., 2001, 2004; Owen-Smith &

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Powell, 2001, 2003; Feldman & Desrochers, 2002; Thursby & Thursby, 2002), but the question of why university patenting increased in the first place has not been fully answered.

The easy answer is: because of the Bayh-Dole Act, the 1980 legislation that made it easier for universities to patent government-funded inventions and encouraged them to do so.[1] Between 1980 and 2004, the number of patents issued to universities in the USA increased from about 350 to about 3300 – roughly tenfold (Henderson et al., 1998; Mowery & Sampat, 2001b; Mowery et al., 2004; Association of University Technology Managers, 2005; US Patent & Trademark Office 2005).[2]

But such an explanation is problematic. First, in the last few years David Mowery and his colleagues have shown that university patenting was on the rise well before Bayh-Dole (Mowery & Sampat, 2001b), and argued that Bayh-Dole alone cannot explain the post-1980 rise in university patenting (Mowery & Ziedonis, 2000, 2002; Mowery et al., 2001, 2004).[3] The number of patents issued to universities each year rose from about 100 in 1968, to about 350 in 1980, to about 1400 in 1992. Thus we can see that patenting increased almost as rapidly in the 12 years leading up to Bayh-Dole (by about 250%) as it did in the 12 years following the Act (by about 300%). Patents issued per research dollar spent also increased substantially in the years leading up to as well as the years following Bayh-Dole (Henderson et al., 1998: 120; Mowery et al., 2004: 48). Such an observation leads us to ask what else besides the Bayh-Dole Act caused university patenting to increase, particularly prior to 1980.

This paper uses an institutional framework to begin to answer this question. I argue that in order to explain the rise of university patenting, it is useful to think of it as an institution: a set of rules (formal or informal) that governs a particular area of social life, which has become legitimate, routine, and taken-for-granted, and which if not actively disrupted tends toward persistence and self-reproduction. The institutionalization of university patenting, then, can be seen as the process through which it became established that patenting is part of what universities do, and through which organizational, legal, and normative structures were built that allowed such activity to persist without undue effort or attention.

From this starting point, I draw on ideas from institutional theory – about social skill, proto-institutions, the creation of collective action, resources, and framing – to construct a theoretically informed narrative about an institution-building project that lasted almost 20 years. I argue that the institution of university patenting was created in three phases. In the first phase, a 'skilled actor' worked relatively independently to develop a proto-institution – an administrative mechanism established in 1968 (called, coincidentally, an Institutional Patent Agreement or IPA) that simplified university patenting of research funded by the National Institutes of Health (NIH). Once the mechanism was also adopted by the National Science Foundation (NSF) in 1973, inventions resulting from almost 80% of federal research funds could, in theory, be patented with relatively little

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red tape. This proto-institution led very low university patent rates to increase somewhat.

The second phase was the creation of a professional community of university patent administrators, which could serve as an infrastructure for the reproduction and spread of patenting and licensing activity. Prior to IPAs, many universities had no individual with specific responsibility for managing inventions. IPAs required universities to assign such responsibility to a particular person and this created a larger pool of university patent administrators. This made possible, in 1974, the organization of a professional association, whose members began actively sharing knowledge with one another about how to patent and license university inventions. The concurrent efforts of the Research Corporation (a nonprofit organization that administered patents on behalf of many universities) to train universities in patent management also assisted the emergence of this community.

The third phase of institution-building was the effort to change government patent policy that would ultimately result in Bayh-Dole. Starting in the early 1970s, a small group of federal administrators who believed that inventors in general should retain patent rights to government-funded research began working on several fronts to make that possible. They pursued their goals with limited success for several years but in 1977 managed to get a bill introduced that would have given broad patent rights to all recipients of government research funding, including for-profit contractors as well as nonprofit grantees. After the bill was killed in committee, the administrators came up with a new strategy: they decided to focus their efforts on giving patent rights to universities, other nonprofits, and small businesses, they reframed their project as being a partial solution to the growing 'technology gap' between the USA and countries such as Japan, and they figured out a way to turn a political setback to their advantage. An alliance with the new community of university patent administrators – who wanted government to make it easier for universities to patent their research – and representatives of the small business community brought resources that complemented those of the federal administrators, and helped to secure the bipartisan sponsorship of powerful Senators Robert Dole (a Republican) and Birch Bayh (a Democrat). This new strategy led to the successful passage of the Bayh-Dole Act in 1980.

The passage of the Bayh-Dole Act marked a deeper institutionalization of university patenting. The legislation made it easier for universities to patent government-funded inventions, and further legitimized the patenting activity that universities had already begun during the 1970s. In many ways, though, the use of IPAs and the increasing organization of university patent administrators had already institutionalized university patenting; it seems likely that patenting would have persisted and even continued to increase had the legislative project failed. Thus while the Act mattered in the creation of today's technology transfer regime, it makes more sense to think of it as a final legitimizing step in a longer project of institution-building than as an independent cause. Such an analysis begins to explain, historically, why universities started patenting, but also helps reconcile the assertions of

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Mowery and his collaborators, about the limited impact of Bayh-Dole with the very persistent popular sense that Bayh-Dole was a watershed moment in the commercialization of the university.[4]

Institutional Theory and Science & Technology Studies

Despite its popularity across a number of social sciences, institutional theory is not frequently used in STS, perhaps because it is seen as heavy-handed and structuralist in a way that is incompatible with much of the field. In sociology, 'new institutionalism' originated in the late 1970s and 1980s as a response to assumptions of individual rationality being made by many social scientists. Because of these origins, the foundational works of neoinstitutional theory were concerned primarily with establishing how existing institutions constrain individual and organizational behavior, particularly by circumscribing rational action (Meyer & Rowan, 1977; DiMaggio & Powell, 1983). Institutionalism's reputation for being a top-down approach is an unintended legacy of these roots.

But for quite some time, institutional theory has also been interested in questions of how institutions are locally created, maintained, and destroyed, and in how individuals shape institutions as well as the reverse (DiMaggio, 1988, 1991; Leblebici et al., 1991; Clemens, 1993; Christensen et al., 1997; Fligstein, 2006; Westenholz, 2006). Work in the last decade has developed a sociological framework for explaining institutional change, including institution-building, which emphasizes (1) the efforts of individuals, (2) the centrality – but also malleability – of their interests, (3) the exercise of power, (4) the deployment of resources, (5) the dynamics of alliance-building and collective action, and (6) the importance of actors' social location with respect to other individuals, organizations, and the larger field (for example Scott et al., 2000; Rao et al., 2003; Hargrave & Van de Ven, 2006).

According to such scholars, institutions are created as solutions to perceived social problems. (In the case of university patenting, the problem was the failure of government-funded inventions to move from the laboratory to the marketplace.) They are established when supporters manage to effect the cognitive, normative, organizational, and/or legal conditions necessary for the institution's self-reproduction. In order for this to happen, enough people with, collectively, sufficient resources to make this a reality must be brought on board the institutional project.

An actor-centered account of institution-building thus begins with the notion of *social skill* (Fligstein, 1997, 2001), or the ability of individuals to induce cooperation in others. Skilled actors bring together diverse groups in support of the institution in several ways. They may *theorize* the problem; that is, explain why the problem *is* a problem and thus why the proposed solution is appropriate (Greenwood et al., 2002). They may build coalitions by *reframing* the problem in a way that appeals to people with a variety of identities and interests (Fligstein, 2001). And they often try a variety of approaches: 'They keep their goals somewhat open ended, and

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they are prepared to take what the system will give' (Fligstein, 2001: 113). Because political alliances and collective action are key to institution-building, successful institution-builders tend to be found in locations 'that have wide legitimacy and bridge diverse stakeholders' (Maguire et al., 2004: 657). They are often situated in *structural holes*, or locations that bridge two groups that bring different sets of resources to the table, where by brokering between the groups they can amplify the groups' collective power or influence (Burt, 1992, 2004; Yang, 2004).

If institution-builders can bring together enough people and resources, they may be able to achieve their goal. An institution may emerge relatively quickly (think of something like Wikipedia, which was novel when it was created in January 2001 but which certainly had well-established rules and norms by the time it hit the 100,000-article mark in January 2003), or, as was the case with university patenting, it may be created through a series of steps over a period of time. In the latter case, one may first see a *proto-institution* develop: a weakly established, narrowly diffused way of doing things that has the potential to become further institutionalized (Lawrence et al., 2002). Sometimes success results in a discrete outcome, such as the passage of a law or the creation of an organization, but institutionalization is no less real when it is informal practices or ways of thinking that become established. In the case at hand, both elements can be seen: the machinery that legitimized university patenting and made it routine contained legal, cognitive, normative, and organizational aspects.

While this particular style of institutional analysis has its own limitations, it does avoid rigid structuralism by focusing on what people actually do. And in this focus on actors it has some interesting affinities with actor-network theory (ANT) (Callon, 1986; Latour, 1987, 2005; Law, 1992), as several authors have noted (Lee & Hassard, 1999; Bockman & Eyal, 2002; Carroll, 2003; Czarniawska, 2006; Law, 1992; Lawrence & Suddaby, 2006). ANT seeks to uncover the active work and mediation that must be done to bring a wide variety of actors – including both objects and people – together to form a temporarily stable network that behaves as a single entity – whether that entity is a technology ('computer'), a form of social organization ('bank'), or something else entirely. In this it is not so dissimilar from an explanation of institution-building. Though 'actor-network' and 'institution' are distinct concepts, they share the characteristic of emerging when actors, actions, and ideas are linked together in a way that makes the social construct itself disappear.[5] The theory of institution-building also shares with ANT an understanding of structure as an effect rather than as a cause, and an emphasis on process, not result, as its subject of study (Lee & Hassard, 1999; Lawrence & Suddaby, 2006).[6]

But if ANT, which is widely used in STS, already shows us how to study these sorts of things, why bother introducing a different theoretical framework? I draw on institutionalism not because it is somehow better than ANT, but because it has different goals. First, despite being focused on the process through which institutions are created, a theory of institution-building is ultimately interested in explaining why stability, though never

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permanent, does exist, and where it comes from. ANT, on the other hand, sees stability as, above all, temporary and is primarily interested in the fluidity and movement that always underlie it.

Second, institutional theory tries to identify mechanisms – patterns of behavior that can be seen in a variety of institution-building projects – in order to build theories about why such projects succeed or fail. What kinds of strategies do institution-builders use? What kinds of relationships do they have with others? Why do they do what they do? And can we see these strategies, types of relationship, or motivations in a variety of settings? This is not to say that ANT-oriented research does not show mechanisms through which actor-networks are created. Mort (2001) demonstrates how strategies of disenrollment can make an actor-network more durable by shrinking it. Singleton & Michael (1993) explain how ambiguity both 'sustains and subverts' an actor-network. Law & Callon (1988) identify ways in which the social considerations built into the engineering of an aircraft system shape the final product. The difference is that these accounts were not written with the purpose of looking for patterns that might also be seen in other actor-networks. Because ANT is not particularly interested in generalizability or theory-building, it does not have a language for talking about mechanisms in the way that institutional theory does. And it is institutional theory's way of thinking and talking about mechanisms that has something to contribute to STS.

Literature Review and Sources of Data

Historians have long been aware that university patenting well predates the Bayh-Dole Act (Weiner, 1987; Apple, 1989; Kevles, 1994; Hughes, 2001). But the growing scope of university patenting has spawned a broader body of research in the past decade. A few papers have examined patenting through an STS-compatible lens, looking at how technology transfer offices developed shared meanings around concepts like 'inventor' (Colyvas, 2007), how licensing officers compare disparate technologies (Owen-Smith, 2005) or at the changing discourses used in patent policy debates (Metlay, 2006). Most research, however, has focused on university patenting and licensing as a form of technology transfer: that is, as facilitating the movement of technology created in one environment (universities) to its application in another environment (business). Dominated by economists, such work asks about the relative impact of university patents and how it has changed over time (Henderson et al., 1998; Mowery et al., 2002; Mowery & Ziedonis, 2002), identifies factors that increase the number of patents and their impact (Bercovitz et al., 2001; Coupé, 2003; Owen-Smith & Powell, 2001, 2003; Thursby & Thursby, 2002), and examines whether patents are a necessary incentive for technology transfer (Jensen & Thursby, 2001).

Of this recent work, that of Mowery, Sampat, and colleagues deals most directly with the question of why university patent practices first began to change. Drawing on both quantitative and qualitative historical data, they document the pre-Bayh-Dole increase in university patenting

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and suggest several potential explanations for it: (1) the overall growth in federal support for research and its distribution to a wider range of universities (which presumably increased the total number of inventions); (2) particularly large funding growth in biomedical research, a field which may have produced more patentable inventions; (3) the efforts of Research Corporation to train universities in patent administration; (4) federal funding agencies' creation of administrative mechanisms to make patenting – at the time bureaucratically complex – easier for universities; and (5) the development at Stanford of a new model of managing university patents focused on actively identifying and marketing inventions rather than on their passive legal administration (Mowery & Sampat, 2001a,b; Mowery et al., 2004). Mowery & Sampat highlight the evaluation of the relative impact of these factors as 'an important task for future research' (2001b: 807).

This paper moves in such a direction by analyzing how the efforts of federal bureaucrats and their interaction with an emerging community of university patent administrators helped increase and routinize university patenting prior to 1980 as well as leading to the Bayh-Dole Act. I do not attempt to systematically evaluate the relative importance of different causes of increased university patenting, and some significant factors remain outside the scope of this paper. (For example, the role of the Research Corporation, which I skim over but which is well documented in Mowery & Sampat [2001a]) I do claim, however, that state actors played a critical and relatively unrecognized role in this process, and suggest that the Bayh-Dole Act itself was the culmination of a larger project of patent policy liberalization that was driven by federal administrators.

The main source of data for this paper is primary historical documents, particularly Congressional hearings, government reports, science coverage in popular and professional media, and the publications of relevant professional groups. The paper also draws on the personal records of Norman Latker, former patent counsel for the NIH. These records include internal NIH documents, unpublished reports on federal patent policy, and related correspondence. This research was supplemented with in-depth interviews of six key figures in the policymaking process, and about a dozen less-formal conversations with people involved in the larger technology transfer community.[7] NSF data on federal funding for science have been used for descriptive statistics.

Before Institutionalization Began: University Patenting and Federal Policy before 1965

If by 'institutionalized' we mean legitimate, routine, and taken-for-granted, university patenting was clearly not institutionalized by the late 1960s. While a very small number of schools – primarily the University of Wisconsin and MIT – had active patent programs even before the Second World War (Apple, 1989; Etzkowitz, 2002: 60–65), throughout the 1950s and 1960s patenting was quite infrequent, with fewer than 100 total patents being issued to universities each year (Mowery & Sampat, 2001b).[8]

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Universities were not completely unaware of the possibility of patenting their research – most major schools had a formal patent policy as early as 1948 (Palmer, 1948) – but patenting occurred on a piecemeal basis as individual scientists sought out appropriate channels within the university to patent an invention. Nor was there any uniformity in universities' administration of patents. Since managing patents was seen by many as a commercial activity inappropriate for a university, it was common to allow an outside organization, usually the Research Corporation, to take on this function.[9] Other schools created external foundations such as the Wisconsin Alumni Research Foundation (WARF) to insulate the university's primary roles from the management of patents and royalties. A few, such as the University of California, actually employed a patent attorney; yet other schools gave the responsibility to a faculty committee (Palmer, 1962). At many schools, patenting was so uncommon that no one was responsible for it.

One reason for the limited scope of university patenting in the postwar era was federal patent policy. When the federal government became the primary patron of academic science in the USA in the years following the Second World War, it also became the primary funder of university inventions.[10] Thus federal patent policy, which decides who retains the ownership rights to government-funded inventions and how those rights can be used, has long set the boundaries for what university patent practices are possible.

The debate over what such policy should look like is of long standing.[11] Two main options were discussed in the years following the war: a government-title policy and a government-license policy. A government-title policy would, by default, give the federal government title to all government-funded inventions. The primary argument in favor of this policy was that what taxpayers fund, taxpayers should own. Government-funded research should remain unpatented whenever possible, but if patents were for some reason necessary, they should be owned by the government and used in the public interest. Under such a policy, if a university scientist used a federal grant to invent a better hearing aid, that scientist would have to disclose the invention to the government, which would then decide whether to keep it in the public domain or patent it itself. The scientist and the university would have no further rights to the invention. A government-license policy, by contrast, would keep invention rights with the inventor's organization. The government would reserve only the option of a royalty-free nonexclusive license to use the invention for public purposes if needed. In this case, the university and the scientist would decide whether or not to patent the new hearing aid, and would own any resulting patents. Proponents of a government-license policy argued that giving the government ownership of taxpayer-funded research was actually not in the public interest: the government was not well-equipped to manage patents or encourage the development of inventions, and the invention would be more likely to get into use if the inventor maintained control of it.

After the war, several efforts were made to create a comprehensive federal patent policy that would have legislated one of these options or some compromise between them. But no uniform federal patent policy ever

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became law. As a result, individual science funding agencies developed their own idiosyncratic patent policies, some through statute and some through regulation. The Atomic Energy Commission, for example, with its roots in the Manhattan Project, was very concerned with its ability to control research results, and retained title to almost everything. The Department of Defense, on the other hand, despite having an obvious interest in secrecy, generally left invention rights to contractors. The NIH developed a policy of generally maintaining title to inventions but would sometimes waive title upon request, with the caveat that patent holders could only license inventions on a nonexclusive basis (US Department of Justice, 1947; US Senate Select Committee on Small Business, 1959). By the end of the 1950s, an extremely complex federal patent policy had evolved, complicated by the fact that any inventions that had received funding from more than one federal agency – a common situation – would need to reconcile multiple policies. The Bayh-Dole Act would eventually supersede 22 different federal statutes governing some aspect of patent policy (P.L. 96-517: 35 U.S.C. 210).

Around 1960, Congress experienced one of its periodic waves of concern about patent policy, and between 1959 and 1965 a series of Congressional hearings were held on the issue (US Senate Select Committee on Small Business, 1959, 1960, 1963; US Senate Committee on the Judiciary, 1960, 1961, 1965). Senator Russell Long, chairman of the Select Committee on Small Business's Subcommittee on Monopoly, repeatedly introduced legislation to establish a strong and comprehensive government-title patent policy. But though his voice was loud, in 1963 the Kennedy administration nevertheless reiterated the existing policy of administering patents differently in different agencies ('Memorandum & Statement of Government Patent Policy', 1963). And by 1965 the debate was essentially in the same place it had been since the war, as the Senate Judiciary Committee found itself considering three comprehensive patent policy bills: one proposing a government-title policy, one a government-license policy, and one a policy that would vary from agency to agency (US Senate Committee on the Judiciary, 1965). None of the bills became law.

Any of these bills would have applied to universities, but they were not aimed at universities. Federal patent policy, after all, affects not only universities receiving government grants, but all federal research and development (R&D) contracts, most of which are held by large for-profit companies. In the 1950s and 1960s, less than 10% of all federal R&D spending was going to universities (National Science Foundation, 2002: Table 8). University research funding, however, came disproportionately from a handful of federal agencies, and it was changes in those agencies, beginning with NIH, that would first begin to affect university patent practices.

Though the Department of Defense was the largest government funder of university science in the 1950s, by 1960 the Department of Health, Education, and Welfare (HEW) had outpaced it. That lead would continue to grow until 1974, at which point 55% of federal research funding for universities came from HEW (see Figure 1). The large majority of this money

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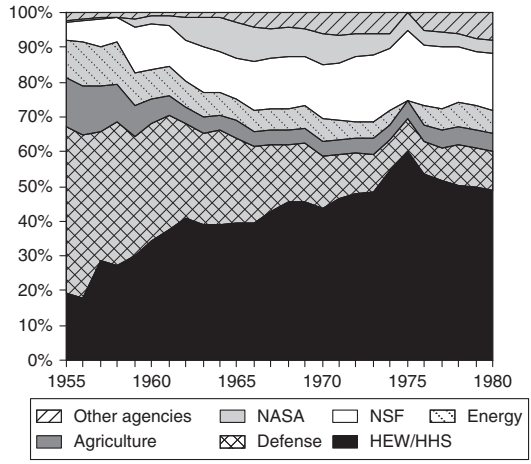
FIGURE 1
University R&D funding by federal agency, 1955–1980[13] (source: National Science Foundation, 1997)



went through NIH, which was housed within HEW.[12] And in the early 1960s, NIH was having patent policy problems of its own.

HEW was one of the federal agencies that had always had a good deal of discretion over its administration of patent rights, since its policy was not governed by statute. But NIH did not employ anyone with patent expertise during the 1950s, and its internal patent policy was incoherent.

At the same time, however, NIH was growing exponentially: its Congressional appropriations increased from $48 million in 1953 to $737 million in 1963 (National Institutes of Health, 2005a,b). Not surprisingly, the research it funded was resulting in a growing number of inventions. By 1962 a high-level administrator was arguing internally that the agency's patent policy was ill considered and required a major overhaul (Endicott, 1962; see also Hiller, 1964; Shannon, 1964). To address these issues, NIH took a step in 1963 that would have long-term consequences on university patenting. It decided to hire a patent attorney to sort things out, and it chose for the job a strong proponent of inventors' rights.

Creating a Proto-Institution: IPAs at NIH

In the 1950s and early 1960s, HEW's official policy was that it would waive title to an invention upon the request of a grantee, provided the grantee could show that it had the administrative capacity to pursue the invention's development. Seeking such a waiver was a significant bureaucratic hurdle for universities, since the application process was complex and could only be done one invention at a time, and even then success was far from assured. As early as the 1950s, the agency tried to cut through this red tape with IPAs. Under an IPA, HEW would form a contract with a particular university under which it would waive title to all HEW-sponsored inventions

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that met certain conditions. Then the university could avoid the time-consuming process of applying for individual waivers. Instead, it would only have to apply once, for an IPA.

The 18 IPAs issued between 1954 and 1958 (Latker, 1978: 4) were not well designed, however. They were not uniform, but varied from university to university, and did not pursue any consistent principles or goals. Far from trying to encourage universities to pursue technology transfer through patenting, some of the IPAs even stated that the university's policy was to dedicate inventions to the public, meaning simply that the university wouldn't patent any HEW-funded inventions.[14] After 1958 the agency became more and more reluctant to waive title to any inventions. No more IPAs were executed, and the existing ones fell into disuse; by 1964, NIH Director James Shannon was writing internally that 'In practice, [patent rights have not been waived] in approximately five years and proposals which have been advanced for Department approval have invariably resulted in decisions to keep title in all reported inventions with the Federal Government' (Shannon, 1964: 1).

This was the situation into which Norman Latker was hired as NIH's first patent counsel in 1963. A young attorney who had moved to NIH from a position in the Air Force, Latker came with strong ideological commitments. Though he had spent his career thus far working for government, Latker inherently distrusted government's ability to manage inventions that it knew little about and believed that the closer an invention could be kept to its inventor the more likely it was that it would someday be used. Ideally, he would have liked inventors themselves to retain title to their inventions. But he far preferred that universities patent faculty inventions than Washington.

Latker had not worked with many university inventions before coming to NIH; most of his work for the Air Force involved the inventions of industry contractors. But after arriving and surveying the situation, he quickly made it clear that he believed the department's patent policy was too heavy-handed, and that it should generally waive title to universities upon request as well as permit exclusive licenses, then completely banned.[15] He also resurrected the idea of the IPA and set about trying to create new and better IPAs.

Latker's views conflicted with actual HEW practice. When universities came to HEW requesting that it waive title to a particular invention, the request would first go to an administrative office that routinely recommended such requests be denied. Then the request would go to Latker for review. Before long, Latker began challenging these denials on the basis that the department had no intention of pursuing development of these inventions itself, and thus that the public's interest was not being served by the department's refusal to waive title. This brought him into open opposition with other offices within HEW. Several years of confrontation ensued, during which Latker pushed for more title waivers and others within the department resisted.[16]

It was public embarrassment that turned the tide in Latker's favor. In 1968, two major studies of federal patent policy were published externally,

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both of which singled out NIH's medicinal chemistry program for negative attention (Harbridge House, 1968; US General Accounting Office, 1968). This relatively small grant program (about US$8 million annually) funded organic chemists, mostly in universities, to do basic research that produced as a byproduct chemical compounds with potential pharmaceutical applications. Because HEW patent policy did not allow for exclusive licenses, however, no pharmaceutical companies were willing to participate in the screening of these compounds with an eye toward their eventual development. The development and testing process in the pharmaceutical industry was even then so lengthy, and the costs of copying a drug already on the market so small by comparison, that there was no incentive for drug companies to look at these compounds without the potential for an exclusive license. The result was that these promising compounds were sitting on the shelf gathering dust.

Both the Harbridge House and the General Accounting Office (GAO) reports recommended that HEW modify its patent policy along just the sort of lines that Latker had been suggesting. The widespread publicity the reports received defused some of the internal opposition to waiving patent rights to HEW-funded inventions. This not only led to more frequent approval of individual waiver requests, but made it possible for Latker to establish a new set of IPAs, uniform across different universities and created with the clear goal of encouraging the development of HEW-funded inventions by allowing universities to patent and license them (Latker, 1978: 11–12). In December 1968, the first round of IPAs was formed with a dozen institutions; by 1971, 37 universities held IPAs (Latker, 1971: 2).[17]

The creation and spread of IPAs marked the first major step in the institutionalization of university patenting. IPAs can be seen as a 'proto-institution': a new practice, rule, or technology that is 'narrowly diffused and only weakly entrenched, but that [has] the potential to become widely institutionalized' (Lawrence et al., 2002: 283). While the IPA mechanism sounds fairly modest – IPAs simply removed some bureaucratic hurdles to patenting for the relatively small number of universities who wanted to pursue it – it had a significant impact on university patent practices for several reasons.[18]

One was simply scope. HEW was, after 1960, the largest federal funder of universities. Any loosening of its patent policies necessarily touched a lot of inventions. In 1963, when Latker arrived, HEW was spending US$350 million on university research, and that amount was rapidly growing (it reached US$677 million in 1968, when IPAs were reestablished, and US$1.2 billion in 1974) (National Science Foundation, 2003: Table B). Not only was HEW the largest federal funder of university research in the 1960s (Figure 1 of the present paper), it provided about one-third of *all* university R&D spending, including not only federal but state, local, industry, institutional, and other sources (see Figure 2 of the present paper).

Reestablishing IPAs did result in universities' patenting and licensing inventions in greater numbers. Between January 1969 and October 1974, 167 patent applications were filed by universities holding IPAs with HEW,

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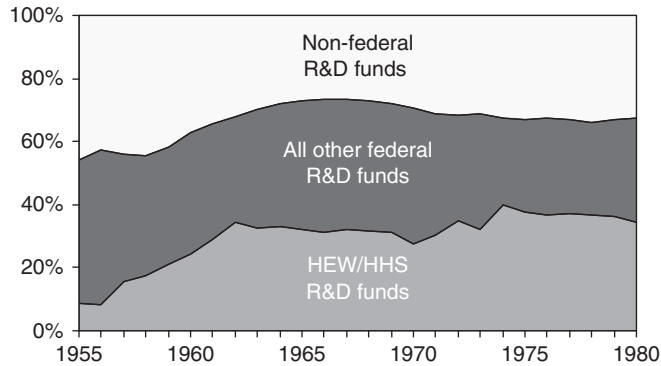
FIGURE 2
HEW/HHS funds as a fraction of university R&D, 1955–1980 (source: National Science Foundation, 1997, 2005)



and between July 1968 and October 1974, 162 petitions for waiver of title were granted to universities not holding IPAs (Latker, 1976: 14, 15). While exact counts do not exist for the period prior to 1968, evidence suggests that requests for title waivers were generally rejected and that almost no university patents were resulting from NIH-funded research (Shannon, 1964; Harbridge House, 1968; US General Accounting Office, 1968; Bremer, 2001: 157; Hammersla et al., 2004: 8). If we estimate that between one-half and two-thirds of those applications and waiver petitions actually became patents (in keeping with the rate at which patent applications are generally approved), that would mean that the change in HEW's patent policy led to an additional 30 to 35 university patents per year. University patenting overall increased from about 100 per year in the 1960s to about 225 per year in the early 1970s (Mowery & Sampat, 2001b: 798). This back-of-the-envelope calculation suggests that about one-quarter to one-third of the additional university patents during this period were directly made possible by changes in HEW policy.

IPAs did not only allow universities to increase their patenting. IPAs also made small but significant steps toward establishing university patenting as legitimate, routine, and taken-for-granted. As a shift in the way federal patent policy was applied, they signaled that patenting was becoming, at least in some quarters of government, a legitimate activity for universities. As an administrative mechanism, their very purpose was to make university patenting more routine by simplifying it. And with decreased administrative requirements, the decision about whether to patent an invention or not moved away from government and toward the university, a shifted locus of control that would soon become taken-for-granted.

As is characteristic of proto-institutions, IPAs were limited in scope and not widely diffused: they were at first maintained by only one agency, even if the largest, and only held with a few dozen universities. From the outset, however, Latker had hopes of convincing other federal agencies to

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adopt the mechanism as well. By about 1970, HEW's shift in patent policy was no longer being contested within the agency. More IPAs were being created each year, and the department now routinely signed title waivers to university inventions. At this point, with his initial goals achieved, Latker turned his focus outside the agency.

The Diffusion of the Proto-institution: NSF and the Limits of IPAs

Though the federal government was handling about 10,000 invention disclosures a year by the mid-1960s (Federal Council for Science and Technology, 1965: 27), until that time the people managing these inventions at each federal agency – the Department of Agriculture, the Atomic Energy Commission, NASA, the Army, and so forth – acted in isolation. President Kennedy's 1963 'Memorandum & Statement of Government Patent Policy', however, directed the Federal Council for Science & Technology (FCST), a body made up of the heads of relevant federal agencies, to begin collecting data on government patent policy and publishing an annual report as a guide to policymaking. As a result, the FCST created a Committee on Government Patent Policy, composed of representatives – primarily patent attorneys – from each of the federal agencies that funded R&D. The meetings of this Committee were the first opportunity for regular communication among the people who actually implemented government patent policy for universities and industry on a day-to-day basis.

Starting in 1967, Latker began working on subcommittees of the Committee on Government Patent Policy (Federal Council for Science & Technology, 1967: 31), and he became increasingly active in subsequent years. Here Latker hoped to find counterparts in other agencies who might be interested in adopting IPAs.

To his disappointment, he discovered that most of them favored a government-title patent policy and had little interest in IPAs. One exception, however, was Jesse Lasken, a patent attorney who was hired by NSF in 1972 to streamline its own cumbersome patenting process. Lasken, like Latker, believed that universities would do a better job of managing inventions than the government, and when the two met on the University Patent Policy Subcommittee they quickly formed a partnership. Lasken was the first person Latker had encountered who was interested in adopting the IPA mechanism, and in 1973, NSF began signing IPAs modeled closely on the ones at HEW.

This was a significant step in the diffusion of IPAs as a proto-institution. While NSF made up a tiny fraction of total federal R&D spending at the time – less than 3% – it was the second-largest funder of university research, after HEW (National Science Foundation, 2003: Table B; see also Figure 1 of the present paper). With both HEW and NSF on board, 68% of federal research funding at universities could be governed by IPAs (see Figure 1 of the present paper). If funding from the Defense Department (which had long had a similar mechanism)[18] were included, by

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1973 universities with the capacity to manage patents had the option of patenting inventions resulting from almost 80% of federal funds (National Science Foundation, 2003: Table B).

But here things stalled. No other agencies were interested in IPAs. There were, to some extent, philosophical differences among the agencies that accounted for this. But there were other reasons for the reluctance as well. Some, like NASA, were governed by statutes that allowed little leeway in the disposition of invention rights (Kraemer, 1999); these agencies could not legally establish IPAs. Bureaucratic inertia certainly played a part in maintaining the status quo, as did the defense of turf – agencies were loath to give up something they controlled, regardless of what it was. Some of the funding agencies employed large numbers of patent attorneys – hundreds in all – who would have nothing to do if the government stopped patenting.[19] And the fact that most of the other agencies' research money did not go to universities gave them a different set of policy considerations.

For all these reasons, IPAs would spread no further. As G. Willard Fornell, patent administrator for the University of Minnesota, put it in 1974:

> Those of us who are in university patent administration would find our lives quite a bit easier if we could operate under IPAs across the board. Of course that is really pie in the sky because there are some agencies that are so far from an IPA, that I am sure that we, our children, nor our grandchildren will ever see one. (National Conference on the Management of University Technology Resources, 1974: 40)

If university patenting were going to become more fully institutionalized, it would have to be through means other than IPAs.

Creating a Political Project: Building Alliances and Gaining Resources

Committee work was only partially successful at disseminating IPAs. But it led to something that, in the long run, would prove to be even more significant: the securing of a powerful ally who would help Latker and Lasken to launch a larger political project of patent policy liberalization. Though vocal, Latker and Lasken held minority views within FCST; in Lasken's words, 'Basically, it was usually me and Norm against the rest.'[20] As midlevel career administrators, it seems unlikely they could have accomplished much more in the face of a recalcitrant bureaucracy without additional resources.

But in April 1973, Betsy Ancker-Johnson, a physicist and herself an inventor and patent-holder, was appointed Assistant Secretary of Commerce for Science & Technology; ex officio, she headed FCST's Committee on Government Patent Policy. As a high-level presidential appointee she had much more clout than Latker or Lasken, and as chair of the Committee on Government Patent Policy she was well placed to affect policy. Ancker-Johnson came to the job with strong opinions about how inventions should be managed. She believed that patents were often a necessary

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incentive to encourage the development of inventions, that they were not just a means of appropriating a public good into private hands, and that inventors were the best people to decide what should happen to an invention, regardless of who funded it. To Ancker-Johnson's mind, opposition to liberalizing government patent policy arose mostly out of ignorance of how patents really worked. She saw her task as chair of the Committee on Government Patent Policy as one of educating other committee members about this process.[21]

Ancker-Johnson quickly allied with Latker and Lasken, and her political position allowed their efforts to take on a larger scope. IPAs were only aimed at research carried out at universities and other nonprofit organizations, which in 1973 accounted for less than 15% of all federal R&D spending (National Science Foundation, 2003: Table B). But these three all believed that an ideal patent policy would go much farther than IPAs – that the best patent policy would be one in which government did not retain ownership of the inventions it funded, regardless of whether those inventions resulted from grants or contracts, or whether they were developed at nonprofit or for-profit organizations.

So they started looking for opportunities to influence patent policy more broadly. One effort, led by Latker and Lasken, involved rewriting relevant regulations to clearly permit IPAs at agencies for which they were not forbidden by statute. Ancker-Johnson provided political protection; others were recruited as allies – FCST executive secretary O.A. Neumann provided support, as did representatives of the Department of Agriculture and the Environmental Protection Agency.

A second project involved the 1974 creation of the Energy Research & Development Administration (ERDA, later part of the Department of Energy), which replaced the Atomic Energy Commission (AEC). The AEC had taken title to almost all of the inventions it funded (see, for example, Federal Council for Science & Technology, 1976: 414–57); the goal was to make sure ERDA did not end up with a similar policy. Ancker-Johnson had inherited a special assistant named David Eden, who had an understanding of how things got done on Capitol Hill that Ancker-Johnson and the others lacked.[22] Eden took the lead role on this effort; as Ancker-Johnson later recounted:

> [A] handful in Congress … saw an opportunity to impose rigid patent policies upon the fledgling organization. We fought this opposition to a standstill, then turned the tide so that, in the end, ERDA's patent policy was a lot better than that found in many federal programs. (Ancker-Johnson, 1980)

While this coalition did not begin with a clear vision of the legislation that later became Bayh-Dole, it quickly became obvious that in the long run regulatory change would not be enough to achieve their goals. For one thing, much of government patent policy was governed by statute and regulation could not affect it. For another, Ralph Nader's organization, Public Citizen,

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had sued the federal government in the early 1970s on the grounds that an IPA was 'an unconstitutional disposition of property' (Latker, 1977: 2). Though Nader's suit was dismissed for lack of standing, Latker later said that he recognized that Nader had a legitimate legal critique, and that the proponents of change 'knew that we were on relatively weak ground – we tried to make the best arguments we could … [But] we knew that there was a weakness, and the only way you could cure it was by legislation.'[23]

Creating a Collective Actor: The Emergence of a University Patenting Community

Meanwhile, at universities, a second phase of institutionalization was taking place: gradually, a professional community of university patent administrators was beginning to form. Although a handful of universities maintained active patenting programs in the 1960s, it was a small handful, and as discussed earlier, the programs were administered in a variety of ways by different individuals, offices, and organizations. Not surprisingly, then, there was no extensive network of 'patent administrators'. Howard Bremer, longtime patent counsel for WARF (which had what was then the most active patenting program) described the 1960s as being a period of relative isolation.[24] He was only in regular contact with the University of California, Iowa State, Research Corporation, and Battelle Development Corporation: 'About every eighteen months to two years we'd get together and just, in some hotel … discuss happenings and see what developments there were' (Bremer, 2001: 50).[25] There was no professional organization, and even informal social networks were not well developed: 'There were phone conversations and mentoring kind of help, but it was rather limited at that time, because there were just not that many people involved in patenting at universities.'[26]

But in the early 1970s that began to change. After 1968, university patent rates started to increase steadily, which of course increased the need for patents' administration by *someone*. Still, universities could have continued to send most of their patents to Research Corporation, or to keep administering them by faculty committee, as many schools did.[27] That was not what happened, for two main reasons. One was that Research Corporation itself was working to improve universities' handling of inventions, beginning with a visitation program in the mid-1960s that expanded to become 'an ambitious training program' that would 'shift more responsibility for invention evaluation and patent management to client universities'; the organization also supported conferences and educational seminars in the 1970s (Mowery & Sampat, 2001a: 338, 341).[28] These moves helped universities to develop some level of knowledge about patent management, as well as helping to put those doing the managing in touch with one another.

The second was a result of IPAs themselves. By design, before a university could create an IPA it had to make a specific university official

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responsible for managing patents. At many universities, no such person existed before this. Creating a constituency of people in universities whose actual job it was to patent and license faculty research was a prerequisite to the growth of a university patenting community. Many of the university officials who were made responsible for administering IPAs in the late 1960s and early 1970s were the same people who would be instrumental in creating the Society of University Patent Administrators (SUPA) in 1974, and in fighting for Bayh-Dole in the late 1970s. In Latker's words:

> The major part of the institutional agreement was there was an absolute requirement that they identify some office, a person in the office that I could deal with. And frankly, you know, that's how Bayh-Dole got passed [that is, by creating a constituency that would later support such legislation].[29]

The federal proponents of university patenting also played a more direct part in promoting community-building. Early in the process, Latker's role was significant as a person who could connect relatively isolated individuals and act as a node in a newly forming network. In the 1960s and early 1970s most university patent administrators didn't know one another. But they all knew Latker. Many people in the university technology transfer community have acknowledged the important early role he played in helping this community develop (see, for example, Hammersla et al., 2004); Latker himself explains his role in terms of being uniquely positioned to pass information among disconnected university administrators: 'The thing you have to remember is that there was no Internet at this time ... I was the only one that had the central facility, and enough resources to keep everyone together.'[30] Prior to this time, relationships between government agencies and universities around the issue of patenting had been mostly adversarial, but Latker helped change that tone (MacCordy, 1984: 1; Merrifield, 1984).

Other federal officials also supported university patent administrators' efforts to organize themselves. According to at least two attendees, Betsy Ancker-Johnson was the motivating force behind the organization of the first-ever conference on university technology transfer:

> At the 1973 annual meeting of the National Council of University Research Administrators, part of one afternoon was devoted to patents ... The truly significant part of this meeting was the principal luncheon speaker, Betsy A. Johnson, Ph.D. At that time, Johnson held the post of deputy secretary of commerce, and part of her duties included the oversight of the U.S. Patent and Trademark Office. The theme of her speech was astounding. She said that the government's treatment of the universities' inventions was disgraceful, and why did we not get together and do something about it. That was invitation enough. (Hammersla et al., 2004: 20)[31]

The result was an October 1974 meeting at Case Western Reserve University that drew 118 participants representing more than 50 universities and at which Ancker-Johnson was the keynote speaker (National Conference on the Management of University Technology Resources, 1974: 197–204).

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The participants in the 3-day meeting found they had lots to talk about. Attendees shared information with one another about how to organize a patent office, how to improve communication with faculty, how to market university technology, and how to negotiate government patent policies (National Conference on the Management of University Technology Resources, 1974). After hours, George Pickar of the University of Miami suggested to a group of participants that they should form an ongoing organization concerned with university patenting (Bremer, 2001: 178). This resulted in the creation of SUPA, with Pickar as its first president. The association held its charter meeting in Chicago, IL, in February 1975, where it drew 75 attendees representing 40 universities (Sandelin, 2003).[32] Over the next few years, SUPA became increasingly well established, with regular and well-attended meetings.

The creation of a professional association helped the informal social networks that had developed in the early 1970s become more stable. The birth of this professional community marked a second phase in the institutionalization of university patenting. The mere existence of university patent administrators meant that patenting had moved one step closer to becoming routine within universities. Patenting and licensing requires a lot of work. On the one hand one must first identify inventors and inventions and solicit their cooperation, and on the other one must find organizations who might be interested in an invention and try to persuade them to license it. It is easy to see how it might not get done if no one in particular were responsible for it. As patent administration became a job description, and particularly as actual patenting or technology transfer offices were formed, individuals and groups were created who had interests in perpetuating the practice, as well.

The development of a formal professional association was a marker of institutionalization and would soon also serve as a resource for further institutionalization through collective action. By about 1977, this second phase of institutionalization was well underway. Even if patent policy had changed no further, and Bayh-Dole had not been passed, university patenting would not have faded away.

A Broader Coalition and a New Frame: Skilled Action and the Legislative Effort

Around the same time, the federal administrators' patent policy liberalization project reached a turning point. The efforts to shape ERDA's patent policy had been fairly successful; the efforts to redraft government procurement regulations to allow more agencies to create IPAs were still in progress, but going well. But they had also taken on a larger task: a comprehensive patent policy reform bill was being written and was published in 1976 (Federal Council for Science & Technology, 1976: 82–133). This draft bill was sweeping in scope, giving patent rights to all federal contractors and grantees, not just the universities, nonprofits, and small businesses that Bayh-Dole would eventually cover. The following year, the bill's

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authors gained the attention and support of Congressman Ray Thornton, Chair of the House Subcommittee on Science, Research & Technology, and he twice introduced the FCST bill into committee.[33]

But it was just as this crucial step had been reached that the federal administrators experienced a succession of setbacks. First, the Thornton bills quickly died, largely because his committee had no jurisdiction over patents.[34] Worse for their supporters, the bills drew the negative attention of Senator Gaylord Nelson, who saw the proposed government-license patent policy as essentially a giveaway of public goods – he said that government would be 'playing Santa Claus' to private companies by giving them invention rights – and decided to hold hearings of his own (Lovell, 1978: 1666). In December 1977 Nelson brought together some of the longest-standing opponents of a liberalized patent policy, including the Navy's Admiral Hyman Rickover and Senator Russell Long (US Senate Select Committee on Small Business, 1978a).

At the same time, an even bigger problem was looming at NIH. With Norman Latker in charge of patenting at HEW, waivers of government patent rights had been granted on a fairly routine basis. But in 1977 the new administration brought with it a new Secretary for HEW, Joseph Califano. Califano strongly disapproved of the idea of giving universities patent rights, and in August 1977 he ordered Latker to start sending all patent waiver requests to the general counsel's office for approval (Broad, 1979b: 476). But the general counsel's office did not actually approve any waivers. Instead, Califano announced that the patent policy was officially under review, and the waiver requests sat there, neither approved nor denied. The months dragged on, and by September 1978 more than 30 inventions were stuck in this bureaucratic limbo (Leshowitz, 1979: 1). The situation was looking quite bleak for proponents of a government-license patent policy.[35]

By early 1978 the proponents of policy change were discouraged and frustrated at the rapid turnaround of events. A critical point had been reached. They wanted to liberalize federal patent policy; they had decided it could only happen through legislation. But given the speed with which the Thornton bill was shot down, it looked like legislation was unlikely to pass, at least given their current tactics. So they exercised what Fligstein calls 'skilled action' (1997, 2001). There was no single interest group with enough power to pass major patent policy legislation of any sort; all kinds of groups had been making such efforts for 30 years. From an institutional standpoint, what the federal administrators needed to do was put together a coalition of supporters who collectively had a lot of resources while at the same time trying to neutralize as much opposition as possible. The group devised a three-part strategy intended to do this: (1) they decided to substantially reduce the scope of their proposed legislation, from covering all government contractors and grantees to focusing only on universities, other nonprofits, and small businesses; (2) they found a way to turn the Califano debacle into a political opportunity; and (3) they reframed the bill as being a solution to growing fears about US economic competitiveness.

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The decision to cut big business out of the bill excluded a group that tended to draw focused criticism yet managed to avoid attracting substantial new opposition. Much of the opposition to the Thornton bill had centered on the issue of it being a 'government giveaway'. In particular, critics were upset that government would be paying big corporations to do R&D for it, and then the corporations were going to end up owning the results of the research anyway, which they could patent and profit from. Excluding big business from the bill defused a lot of this criticism; universities, nonprofits, and small businesses were seen as groups that were working for the public good, or that were deserving of public support. Supporters saw this decision as critical; as Lasken said, 'I think what happened that turned the tide was that we avoided dealing with big business.'[36] Not surprisingly, big business was not happy about being cut from the proposed legislation, but it agreed not to oppose the bill (though it was actively supporting an alternative), perhaps because Latker and many of his associates explicitly stated that they hoped to eventually extend the bill to include all contractors.[37]

Cutting out big business not only helped to reduce opposition to patent policy liberalization. It also directly helped bring in the support of small business, which had a set of political resources that was complementary to those of universities. The small business lobby would not have been a sure supporter of a more comprehensive patent policy bill. Its main concern was that patents were a form of monopoly with which deep-pocketed big businesses could keep small businesses from competing, and thus that allowing big businesses to patent inventions resulting from government contracts would hurt small businesses. In fact, traditionally the strongest opposition to a government-license patent policy had come from the Senate Select Committee on Small Business (see, for example, US Senate Select Committee on Small Business, 1959, 1960, 1963, 1978a). Limiting the scope of the bill helped turn proponents of small business, a significant lobby, from likely opponents to active supporters.[38] And the support of that community brought with it a better chance of turning around the strong historical opposition of the Select Committee on Small Business.

The inclusion of universities in the bill, while never in question, brought a different set of resources to the political project. Not only were the university patent administrators increasingly organized and ready to support policy change, but as representatives of large universities and thus important and geographically diverse constituents, they were in an excellent position to gain the ears of diverse members of Congress one at a time. This is where the unexpectedly positive effects of Califano's decision to halt title waivers began to come into play.

University patent administrators had grown used to routine approval of their requests for title waivers at HEW, and it was a shock when that came to a halt. The blockage of these waivers mobilized them into serious political action for the first time, and they began contacting their representatives with their concerns and complaints. In fact it was Ralph Davis, a patent administrator from Purdue University who had negotiated one of the original IPAs and helped found SUPA, who met with Indiana Senator

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Birch Bayh – along with Howard Bremer of WARF and Norman Latker – and convinced him and his aide Joe Allen that this was a cause worth supporting (Hammersla et al., 2004: 7; Stevens, 2004: 94). Bayh, of course, became one of the bill's sponsors. Other SUPA members targeted members of the Judiciary Committee, which had jurisdiction over patent issues. MIT, for example, focused on Massachusetts Senator Ted Kennedy, then chair of that committee, who initially opposed the bill but eventually became a cosponsor.[39] The most dramatic turnaround was probably that of Senator Nelson. After he convened the December 1977 hearings dominated by opponents of the patenting of government-funded inventions (and which followed by a few months the policy change at HEW), 'the IPA-holders all got together ... The universities themselves bombarded Nelson to the point where he had to set up another hearing [in May 1978] to invite all the people that were in favor of it.'[40] And not only did they gain a hearing, but they eventually won Nelson over. He went from being a potential threat (Graham, 1979: M1), to 'not "actively opposi[ing]" the bill' (Broad, 1979a: 474), to actually signing on as a cosponsor, a reversal which Betsy Ancker-Johnson later referred to as 'Senator Nelson's Damascus-Road conversion' (Ancker-Johnson, 1980).

Another contribution of university patent administrators was that, working through SUPA, they were able to get the major higher education associations to pledge support. The Council on Governmental Relations (COGR, representing university business officers), which worked on regulatory concerns, had long been aware of the issue and became an ally.[41] The American Council on Education, representing all of higher education, lent its support as well. So when SUPA members testified to Congress, they were able to do so on behalf of organizations much larger than their own (see, for example, US Senate Committee on Commerce, Science, & Transportation, 1980). And representatives of universities were heard on many occasions in Congress. Howard Bremer traveled to Washington several times to speak to Congress on behalf of policy change; many others from the university community also testified.[42] He and others saw this collective action, for which the organizational structure had not existed a few years earlier, as decisive in the legislative process: 'The way I like to look at it is finally universities were speaking with a loud single voice in this arena. I think that is ultimately what carried the day' (Bremer, 2001: 181).

The mobilizing power of Califano's decision was one way in which this setback ultimately contributed to the passage of Bayh-Dole. Another was that it proved a rallying cry. Interesting people in patent policy, and in the nuances of an argument about the best incentives for getting new technology into use, was not always an easy project. But when Califano halted approval of waivers, he gave supporters of Bayh-Dole something they could point to very concretely: a list of more than 30 inventions that could be on the market and saving lives, but instead were sitting on a desk at HEW going nowhere (Leshowitz, 1979: 11). As one Congressional staffer said, 'That was kind of like dynamite. Why shouldn't these inventions be given a chance, a chance to go from the laboratory to the marketplace?' This was 'clearly newsworthy'.[43]

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At least as important, Califano's new policy also gained the bill the sponsorship of Senator Bob Dole. This happened somewhat circuitously, when Dole's staffer Barry Leshowitz heard that the waiver process at HEW had essentially shut down. Leshowitz, a professor of psychology at the University of Arizona, was in Washington for a year as Dole's American Association for the Advancement of Science (AAAS) Congressional Fellow. Like Ancker-Johnson, Leshowitz was an inventor as well as a scientist, and thus took a personal interest in the issue. He brought the issue to the attention of Senator Dole, who became convinced of its importance and became a champion of the cause.[44]

The third part of the legislative strategy was the decision to reframe the bill in economic terms. In the past, justifications for such legislation had usually rested on claims that it would lead to better utilization of public spending. The problem it was intended to solve was the unwillingness of business (or for that matter, government) to invest in the development of government-funded inventions so that they could get into broader use. While this argument was fine as far as it went, it was fairly narrow and did not arouse great attention among those not already interested in technology.

So at about the same time that they cut back the scope of the proposed bill, its supporters began 'theorizing' (Greenwood et al., 2002) it differently. Instead of focusing on whether government inventions were being sufficiently utilized, they began emphasizing a problem with much broader resonance: that the USA was losing economic competitiveness to countries such as Japan, and that a large part of this was due to a 'innovation gap' in which the USA was lagging behind. Bayh-Dole, then, was presented as a solution that would help the country catch up technologically by speeding up the process through which inventions got to market.[45] This was a timely argument, as the issue of national economic competitiveness was taking on increasing political salience, and was being explicitly tied to problems with innovation in the popular press (for example, 'Vanishing Innovation', 1978; 'In Technology Race', 1979; Sheils et al., 1979).

In 1978, Senators Dole and Bayh, with the help of the growing array of federal, university, and small business supporters, announced that they were introducing legislation (95 S. 3496) that would establish a broad government-license patent policy, but hew to the new strategy of limiting the bill's scope to universities, nonprofits, and small businesses. The Senators' statement was made at a press conference on 13 September, at which Dole publicly excoriated HEW for 'stonewalling' title waivers on inventions (Broad, 1978; Eskridge, 1978: 605) – causing HEW Secretary Califano to release them to universities the next day (Leshowitz, 1979: 15).[46] The bill did not elicit the same degree of immediate opposition that past efforts had, a fact generally attributed to the exclusion of big business from the bill and 'heightened national concern over the waning of innovation', to which its supporters were successfully managing to tie it (Graham, 1979: M1). The economic frame eventually came to dominate the debate over the Act completely (see, for example, US Senate Committee on Commerce, Science and Transportation, 1980; US Senate Committee on the Judiciary,

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1979), so that it was no longer about whether this was a government giveaway or not, but whether it was an effective means of speeding technological innovations to the marketplace.

Despite having a substantial base of support, Dole and Bayh were not able to get the bill out of the Senate Judiciary Committee in the last months of the 95th Congress. As planned, they reintroduced the bill the following session as the Bayh-Dole Act, S. 414, in February 1979. The bill's passage through the Senate and eventually the House was tortuous, and the details of the political machinations that ultimately led to the final passage of the Act are beyond the scope of this paper.[47] But the supporting coalition and the overall strategy remained constant from this point on, and with intense lobbying efforts, support for the bill gradually coalesced in the Senate. By the time Nelson signed on as a cosponsor in October 1979, he was one of 32 cosponsors. When the bill reached the Senate floor in April 1980, it had 54 cosponsors, and the measure passed 91–4. Ultimately, the Bayh-Dole Act was passed in its final form unanimously by both houses in November 1980. It was signed into law by President Jimmy Carter in the last days of the 96th Congress, on 12 December 1980, when it became Public Law 96–517 and began a new era for technology transfer in universities.

Discussion and Conclusions

The passage of the Bayh-Dole Act, which gave universities, other nonprofits, and small businesses the right to retain title to government-funded inventions, marked the end of a third phase in the institutionalization of university patenting. When it became law, university patenting was further legitimized in the most literal sense. Bayh-Dole's streamlining of federal patent policy's complexity also allowed university patenting to become more routine by making it administratively easier. Bayh-Dole almost certainly encouraged universities to increase their pursuit of patenting for both of these reasons. But the passage of a significant piece of legislation with the intended goal of increasing university patenting leads easily to the assumption that later increases in patenting were directly caused by it. Bayh-Dole's character as a point of demarcation in the history of technology transfer has resulted in a tendency to overemphasize its impact as a piece of legislation.

Thinking about the rise of university patenting as an institution-building *process*, however, allows us to acknowledge the effects of Bayh-Dole without ignoring what came before it. This third phase of institutionalization, the legislative effort that resulted in the Act, was in many ways dependent on the first two phases. Without an organized community of university patent administrators, the bill wouldn't have benefited from their effective lobbying. Without IPAs and the efforts of federal officials to support university patenting in the 1960s and early 1970s, there well might not have been an organized university patenting community.

Yet these earlier stages were more than just necessary organizational precursors to the eventual passage of legislation. Each phase was itself an independent step toward institutionalization. Both the creation and dissemination

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of IPAs and the development of a professional community increased university patenting and helped to make it more legitimate, routine, and taken-for-granted. Had the institution-building project ended after either of these phases, university patenting would already have been taking place with more frequency than it was in the mid-1960s, and the infrastructure would have been in place for it to reproduce itself at this new level and perhaps even continue to increase. And even the third phase had institutionalizing effects that resulted from the process of seeking legislation as well as the legislative outcome: the argument that Bayh-Dole was a contribution to US economic competitiveness continued to be deployed after 1980 in universities and other contexts, and the process of organizing in support of the Act helped cement SUPA, until then 'kind of muddling along' (Bremer, 2001: 179) as an organization.

What Does an Institutional Approach Gain Us?

From a purely historical perspective, this papers begins to explain the pre-Bayh-Dole increase in university patenting by showing some of the causes of that increase: the creation of IPAs, the work by federal administrators to liberalize federal patent policy, the development of a professional community of university patent administrators. In particular, it highlights the multiple ways in which state actors shaped the development of university patenting, not just through support of the Act itself but also by encouraging such patenting in various ways well before that time. In so doing, this analysis also helps to explain the passage of the legislation itself, since the same factors that contributed to the pre-Bayh-Dole rise in patenting also contributed to the success of the legislative effort.

Doing this specifically through an institutional lens gains us at least two things. The first is that it can help us reconcile the broad sense people have – even, or perhaps especially, people working in technology transfer today – that the Bayh-Dole Act mattered, with the growing historical awareness that university patent practices in the USA were already being transformed in the 1970s. Thinking of university patenting as a project of institution-building in which Bayh-Dole was a culminating step allows us to see why this might be. In many ways, the Act was the endpoint of the same political project of patent policy liberalization that began as early as the mid-1960s. Particularly in retrospect, the Act can seem like the inevitable result of 15 years of work to change federal policy. For this reason, it has always been easy to collapse this long process of political effort into its easily identifiable result, the Act itself.

But there were many steps leading to the institutionalization of university patenting – not only the legitimization bestowed by the Bayh-Dole Act, but also earlier processes of making patenting simpler for universities to undertake, of gradually creating a community of university patent administrators who would work to increase it, of creating new arguments that could make university patenting more broadly appealing. Focusing on the specific ways in which these efforts made patenting more legitimate,

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routine, and taken-for granted helps us separate the changes caused by the Act from those already occurring prior to it. Yet such an approach also means that we do not have to argue that the Bayh-Dole Act was unimportant, either. Instead, we can understand it as inextricably bound with a larger political project that well predated it.

The second thing we gain from this institutional approach is a better explanation of why these efforts to increase university patenting worked. Institutional theories are based on the observation of many different kinds of institutions in many contexts, and while they cannot systematically explain that x, y, and z caused a particular institution to form, they do identify patterns one sees in many cases of institution-building, whether those be characteristics successful institution-builders tend to have or strategies skilled actors frequently use in such processes. These theories focus our attention in particular ways that would not necessarily be obvious without them.

The small group of federal administrators who drove the political project of patent policy liberalization that eventually led to Bayh-Dole provide one example. They were not, on the surface, the most likely source of such a project. While the involvement of someone with the authority of an Assistant Secretary of Commerce was an obvious asset, the others were not highly placed in government, did not have much experience changing policy, and as career employees of the federal government, were legally barred from partisan political activity.

An institutional lens, however, highlights other, less obvious characteristics of these administrators that contributed to their success. One of these is that successful institution-builders are often people whose social position allows them to bridge diverse groups with complementary resources (Burt, 1992, 2004). Federal administrators were in just such a position. By virtue of the interagency committees on patent policy, they interacted with one another, and by virtue of their jobs, they interacted both with a variety of university administrators and representatives of small business. Thus they were well positioned to bring university and small business supporters of a changed patent policy into an alliance with themselves.

The usefulness of the administrators' social position can be seen by considering an alternate scenario. Imagine that such a project originated with the university sector. If university patent administrators had independently created a professional community and decided they wanted to pursue legislative change, but no complementary project existed among federal administrators, how would they possibly have achieved such a goal? On their own, they would have lacked the knowledge of Congress of a David Eden, the connections to small business of a Jesse Lasken, the political power of a Betsy Ancker-Johnson. If such a project were to emerge successfully from universities, it could only have been through a very different path.

This is just one example of how an institutional approach can help answer the question of 'why'. Others can be found throughout this story as well: why Norman Latker was in a good position to create a proto-institution; why the establishment of IPAs helped a professional community of university

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patent administrators to emerge; why reframing legislation as being about economic competitiveness rather than just about improving the development of inventions was a successful strategy. In each of these cases, an institutional framework explains something beyond what we could figure out using common sense alone.[48]

Finally, beyond its usefulness in this specific case, this approach to studying institution-building may have the potential to speak to STS more generally. In recent years a number of scholars have been arguing that STS should pay closer attention to the effects of political-economic and organizational factors (Kleinman, 1998, 2003), power and resources (Klein & Kleinman, 2002; Goven, 2006), formal organizations (Vaughan, 1999), institutions, networks, and power (Frickel & Moore, 2006), and political economy (Mirowski & Sent, 2007) on science and technology. We might call these approaches broadly 'structural', in their emphasis on the way that social conditions external to the individual affect both what individuals can do and what they choose to do. The study of institution-building fits with such a trend. Empirical studies written from such a perspective are still fairly few in number, and to date most have focused on the impact of structural conditions *on* science; that is, how factors like organizations, politics, and economics shape the practice of science (Kleinman, 1998, 2003; Vaughan, 1999; Hyysalo, 2006; Parthasarathy, 2005). But this paper, which tries to understand the creation of a practice external to the laboratory that shapes what happens within it, focuses on a slightly different piece of the puzzle: how one of those structures *itself* is produced.[49]

Ideally, such methods might help counter a common criticism of focusing on political, economic, and organizational issues. As many of the above authors acknowledge, a political-organizational approach runs the risk of explaining what goes on in the laboratory in terms of social structures that are 'pre-existing, fixed, and sovereign' (Wynne, 1992: 577, quoted in Kleinman, 2003: 62), with the result that unpredictable human actors are turned into socially constrained automatons. Perhaps the diachronic approach taken here can be useful in thinking about how institutions that begin outside the lab end up affecting it, but in a way that varies across time and space. Can understanding institutions as effects help us understand the effects of institutions?

In its focus on local mechanisms and its orientation toward building theories (in the sense of identifying common patterns) of how institutions are created and when institution-building projects are likely to fail or succeed, institutional theory may provide tools complementary to those of ANT in cases where the topic of interest is not the constant effort that goes into producing and reproducing temporary social stability, but in explaining in a detailed way why certain social patterns sometimes *do* become obdurate. Understanding how the social structures that shape science emerge, develop, and change can be a step toward understanding in a nuanced way how they actually affect the production of science.

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Notes

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1. Also known as the Patent and Trademark Law Amendments Act or the University and Small Business Patent Procedures Act, P.L. 96-517.
2. These and other patent figures are approximate; exact numbers vary depending on how one counts.
3. Although this debate is not completely settled; Shane, for example, has recently argued that the Bayh-Dole Act did have its intended effect of 'increas[ing] patenting in those fields in which licensing is an effective mechanism for acquiring technical knowledge' (Shane, 2004: 127).
4. Although in recent years most academic specialists have worked with an understanding that university patenting was already increasing before Bayh-Dole, non-specialists writing for both popular and academic audiences still casually attribute great influence to the Act. 'Innovation's Golden Goose' (2002), a frequently cited *Economist* article, calls the Act '[p]ossibly the most inspired piece of legislation to be enacted in America over the past half-century' and claims that following its passage, 'Overnight, universities across America became hotbeds of innovation.' More recently, an anti-Bayh-Dole article in *Fortune* (Leaf, 2005) suggested that the legislation not only 'spawned the biotech industry' but also that as a result, '[w]hat used to be a scientific community of free and open debate is now a litigious scrum of data-hoarding and suspicion'. Also see Agres (2005), Washburn (2005), and Wysocki (2004). Work by scholarly non-specialists also still offhandedly attributes the post-1980 rise in university patenting to the legislation itself (see, for example, Debackere & Veugelers, 2005: 323; Tassey, 2005: 288; Waguespack et al., 2005: 1572), though usually with much less hyperbole.
5. I owe this idea to Law (1992), though he expresses it somewhat differently. Law cites 'a well-managed bank' (p. 385) as one example of a disappearing actor-network.
6. I am setting aside some other obvious differences between theories of institution-building and ANT; particularly the centrality of nonhuman actors to actor-networks, which institutional theory does not generally recognize, and the fact that ANT seeks to explain the creation of knowledge, which institutional theory does not try to do.
7. The in-depth interviews were held with Betsy Ancker-Johnson, President Nixon's Assistant Secretary of Commerce for Science & Technology (22 April 2005), Howard Bremer, patent counsel for the Wisconsin Alumni Research Foundation (21 December 2004), Jesse E. Lasken, an administrator at the National Science Foundation (7 March 2005), Norman J. Latker, who held various positions as a patent attorney for the Department of Health, Education and Welfare (21, 24, and 28 January and 6 April 2005), Sheldon Steinbach, general counsel for the American Council on Education (31 March 2005), and a Congressional staffer (28 February 2005). Additional conversations were held with representatives of the Department of Commerce, of the university technology transfer community, and university faculty.
8. A few other schools had one big 'hit' patent (for example, the klystron at Stanford in the 1930s and stannous fluoride at Indiana in the 1950s) but did not pursue patenting systematically.
9. Research Corporation was a nonprofit organization that undertook patent management for universities. Founded in 1912, by the late 1960s it had invention management agreements with some 200 universities (Mowery & Sampat, 2001a). This did not mean, however, that the organization was being flooded with inventions; during the

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1955–1965 period, Research Corporation received about 250–400 invention disclosures per year, of which perhaps 10% would eventually result in patents (p. 331).

10. In 1953, when NSF began collecting data, the federal government already provided 54% of university R&D expenditures; that percentage steadily increased to a peak of 73.5% in 1966 (National Science Foundation, 2005: Table 1).
11. See Eisenberg, 1996 for a comprehensive history of federal patent policy beginning in 1941, and Kleinman, 1995 for a detailed discussion of the post-Second World War debate over federal science policy, including patent policy.
12. In the years 1967–78 (for which data are most readily available), between 71% and 81% of HEW's total R&D spending went through NIH (National Science Foundation, 2003: Table 2).
13. The Department of Health, Education & Welfare (HEW) was renamed the Department of Health & Human Services (HHS) with the creation of the Department of Education in 1979.
14. Interview with Norman J. Latker, 6 April 2005.
15. See Latker & Wylie (1965) for a contemporary argument in favor of granting exclusivity in some cases. This and other historical documents support Latker's recent recollections of what his views were during the 1960s and 1970s.
16. These paragraphs draw on interviews with Norman J. Latker held 21, 24, and 28 January 2005, and 6 April 2005.
17. The first IPAs were signed on 1 December 1968 by Caltech, Cornell, Florida State, Illinois, Iowa State, Kansas, MIT, Michigan State, Minnesota, Mount Sinai Hospital, Ohio State, Princeton, Purdue, Utah, the University of Washington, Washington State, and Wisconsin. (List from the personal papers of Norman Latker.) As early as 1966, 33 requests for IPAs were pending; by 1978, 72 IPAs had been executed (Latker, 1978: 10, 14).
18. The Department of Defense was already using a mechanism similar to IPAs in the 1960s: it maintained a list of institutions, published in Defense Procurement Circular No. 65, to which it would routinely waive title upon request (National Conference on the Management of University Technology Resources, 1974: 39). Though the Defense Department list was established in 1964, and though the department was a significant funder of university research, people I spoke with did not suggest that its creation had much impact on university patenting, perhaps because the Defense Department had been very liberal with title waivers even before it issued the list. This may be an issue worth exploring further.
19. In January 1977 the Department of Defense employed 193 patent attorneys, the Energy Research and Development Agency (later the Department of Energy) employed 60, and NASA employed 32 (figures from the personal files of Norman J. Latker).
20. Interview with Jesse E. Lasken, 7 March 2005.
21. Interview with Betsy Ancker-Johnson, 22 April 2005.
22. Conversation with a Department of Commerce staffer, 21 February 2005; interview with Norman Latker, 6 April 2005.
23. Interview with Norman J. Latker, 6 April 2005.
24. Interview with Howard Bremer, 21 December 2004.
25. Battelle Development Corporation was a nonprofit organization that assisted universities with patent management, but on a much smaller scale than Research Corporation.
26. Interview with Howard Bremer, 21 December 2004. According to Bremer, the Licensing Executives Society, which was established in 1965, was originally started 'as a university-oriented organization', but quickly became oriented toward 'private practice and industry' (Bremer, 2001: 50).
27. In a 1973 survey of a non-random sample of 50 major research universities, 27 reported using a patent committee of faculty or administrators to decide whether to pursue a patent application (National Conference on the Management of University Technology Resources, 1974: 19).

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28. Research Corporation's efforts were not entirely separate from those of the federal proponents of patent policy liberalization: its 1970s patent awareness program was partly supported by the NSF and the Department of Commerce (US Senate Select Committee on Small Business, 1978b: 82).
29. Interview with Norman J. Latker, 21 January 2005.
30. Interview with Norman J. Latker, 6 April 2005.
31. Bremer also said that Ancker-Johnson 'fomented' the Case Western meeting. Interview with Howard Bremer, 21 December 2004.
32. Bremer (2004: 12–13) lists others who were critical supporters of SUPA in its early years. See Hammersla et al. (2004), for more on the history of SUPA.
33. As H.R. 6249 in April 1977, and H.R. 8596 in July 1977.
34. Interview with Norman J. Latker, 6 April 2005.
35. The reformers did have one limited success around this time: the regulations that would permit IPAs more widely were finally published in March 1978 (Smith, 1978).
36. Interview with Jesse E. Lasken, 7 March 2005.
37. Interview with Norman J. Latker, 6 April 2005. Provisions of the Act were indeed eventually extended to large businesses by executive memorandum in 1983 (Eisenberg, 1996: 1665).
38. According to several people I spoke with, two of the most critical figures on the small business side were Milt Stewart, the Small Business Administration's Chief Counsel for Advocacy, and Eric Schellin, patent attorney for the National Small Business Association.
39. Interview with Jesse E. Lasken, 7 March 2005.
40. Interview with Norman J. Latker, 21 January 2005. For the second Nelson hearings, see US Senate Select Committee on Small Business (1978b).
41. Interview with Sheldon Steinbach, 31 March 2005. COGR had had a patent committee (chaired by Howard Bremer) since the early 1970s.
42. See, for example, US Senate Committee on Commerce, Science, & Transportation, 1980; US House of Representatives Committee on Science, Space, & Technology, 1977; US Senate Committee on the Judiciary, 1979; US Senate Select Committee on Small Business, 1978b.
43. Interview with a Congressional staffer, 28 February 2005. Ancker-Johnson, too, said later that Califano's 'excesses helped our cause tremendously, turning otherwise neutral parties to our side' (Ancker-Johnson, 1980).
44. Interview with a Congressional staffer, 28 February 2005. While Leshowitz was a university professor and an inventor, he had no previous ties to the SUPA community.
45. Norman Latker was explicit about this ordering of events: when asked how much the economic situation and the issue of economic competitiveness mattered in passing the bill, he said, 'That was an issue that came up after the fact that we could use to support the bill' (interview with Norman J. Latker, 6 April 2005). The timing of the introduction of economic arguments is compatible with that assertion.
46. Latker, however, was summarily dismissed from HEW in December for his efforts, though he was later reinstated with the support of Dole and Bayh and publicity calling his firing retaliation against a whistleblower (Graham, 1979: M1).
47. See Stevens (2004) for a detailed account of the legislative wranglings of 1978–1980 and Eisenberg, 1996: 1689–95 for the legislative history of both Bayh-Dole and competing proposals.
48. The application of an institutional framework to university patenting also has the potential to make some refinements to institutional theory, though a detailed discussion of such is beyond the scope of this paper. These would include: (1) a fuller explanation of the process of 'theorizing' institutional change (Greenwood et al., 2002; see also Suddaby & Greenwood, 2005); (2) additional mechanisms through which proto-institutions (Lawrence et al., 2002) can work, and particularly how they can serve as a resource for further institutionalization; and (3) a demonstration of how framing can be important in gaining political supporters even when the frame is not necessary for aligning the most directly interested groups (Fligstein, 2001).

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49. There have been a few studies that look at the dynamics *within* the social structures that shape science. See, for example, Guston (1999), Goven (2006), and Kinchy & Kleinman (2003).

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