
**PATENTS AND UNIVERSITY-INDUSTRY INTERACTIONS IN
PHARMACEUTICAL RESEARCH BEFORE 1962: AN
INVESTIGATION OF THE HISTORICAL JUSTIFICATIONS FOR
BAYH-DOLE**

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Cite as 10 J. HIGH TECH. L. 168 (2010)

I. Introduction

The relationship between academic research and research and development within the pharmaceutical industry has been the focus of recent debates over the justification for the Bayh-Dole Act.¹ This relationship served as a critical prism through which many scholars argued for federal patent policy reform.² Supporters and opponents of patent reform, ultimately codified in the Bayh-Dole Act, presented diametrically opposed views regarding the impact of the patent policies implemented by the Department of Health, Education, and Welfare (HEW) in the late 1960s.³ The Bayh-Dole Act was the embodiment of arguments

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1. Bayh-Dole Act, Pub. L. No. 96-517, 94 Stat. 3015 (1980) (codified as amended at 35 U.S.C. §§ 200-211, 301-307 (2004)).

2. See generally Rebecca S. Eisenberg, *Public Research and Private Development: Patents and Technology Transfer in Government-Sponsored Research*, 82 VA. L. REV. 1663 (1996); see also DAVID C. MOWERY ET AL., *IVORY TOWER AND INDUSTRIAL INNOVATION: UNIVERSITY-INDUSTRY TECHNOLOGY TRANSFER BEFORE AND AFTER THE BAYH-DOLE ACT* (Stanford University Press 2004).

3. See F.M. Scherer, *The Political Economy of Patent Policy Reform in the United States*, 7 J. ON TELECOMM. & HIGH TECH. L. 167, 181-82 (2009). Up to 1962, drug companies routinely screened new organic molecules synthesized by government grants by academic researchers. *Id.* at 181. However, that testing immediately ceased when HEW began imposing new reporting requirements that threatened the exclusivity of drug companies' right to commercialize therapeutically interesting molecules. *Id.* at 181-82. In response, HEW changed its policies to allow pharmaceutical companies exclusive rights to molecules discovered as a result of federal funding. *Id.* at

promulgated by patent reform promoters who asserted that citizens would ultimately lose the benefits of federal funding of biomedical research in the absence of policies facilitating collaboration between academic scientists and pharmaceutical firms.⁴ This collaboration would only be possible if the government protected industrial companies' exclusive rights to any inventions resulting from federally funded research.⁵

Private acquisition of rights in federally funded inventions received support from two reports on current patent policy released in the 1960s as well as the testimony of numerous scientists at congressional hearings.⁶ Many scholars infer from these reports that the collaboration between universities and the biomedical research industry had been mutually beneficial until

182. See also STAFF OF S. SUBCOMM. ON PATENTS, TRADEMARKS, AND COPYRIGHTS OF THE S. COMM. ON THE JUDICIARY, 86th CONG., 2d Sess., AN ANALYTICAL HISTORY OF THE PATENT POLICY OF THE DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE (prepared by Gladys Harrison) (Study No. 27, Comm. Print. 1961), at 16 [hereinafter AN ANALYTICAL HISTORY]. The patent policy imposed by the HEW (at the time, the Public Health Service) contained a "march-in" clause, reserving power to the Surgeon General to grant a non-exclusive royalty-free license. Scherer at 182, *supra*; see AN ANALYTICAL HISTORY at 16 *supra*.

4. See Sara Boettiger & Alan B. Bennett, *Bayh-Dole: If We Knew Then What We Know Now*, 24 NATURE BIOTECHNOLOGY 320, 320 (2006). Boettiger and Bennett discuss a third group of debaters who believe the "increased government investment in biomedical research and the emergence of research-intensive companies" in regards to the Bayh-Dole Act allowed institutions "to actively seek patent protection and to encourage the development of their inventions." *Id.*

5. See *id.* "Fundamentally, Bayh-Dole shifted the incentive structure that governed the research and development path of federally funded inventions by allowing institutions to own inventions resulting from federally sponsored research and to exclusively license those inventions." *Id.*

6. See HARBRIDGE HOUSE, INC., GOVERNMENT PATENT POLICY STUDY, *reprinted in* STAFF OF H.R. COMM. ON SCIENCE AND TECHNOLOGY, BACKGROUND MATERIALS ON GOVERNMENT PATENT POLICIES, Vol. II, 94th CONG., 2d Sess. 1976, at 69-140 [hereinafter, GOVERNMENT PATENT POLICY STUDY]; see also James E. Denny, *Government Patent Policy Study: The Harbridge House Report*, at 27 (1970); see also COMPTROLLER GEN. OF THE UNITED STATES, REPORT TO THE CONGRESS: PROBLEM AREAS AFFECTING USEFULNESS OF RESULTS OF GOVERNMENT-SPONSORED RESEARCH IN MEDICINAL CHEMISTRY (Washington, D.C., 1968), *reprinted in* GOVERNMENT PATENT POLICIES: INSTITUTIONAL PATENT AGREEMENTS, PART I, HEARINGS BEFORE THE SUBCOMM. ON MONOPOLY AND ANTICOMPETITIVE ACTIVITIES, S. SELECT COMM. ON SMALL BUSINESS, 95th CONG. 2d Sess. 1978, at 103-46 [hereinafter COMPTROLLER GEN. REPORT] (summary and analysis of the findings from the Harbridge Report); see also AN ANALYTICAL HISTORY, *supra* note 3, at 16.

the 1960s.⁷ However, knowledge of the history of collaborations between the National Institute of Health (NIH) grantees and industry referred to in such statements is currently very limited. Beginning in 1962, HEW started requiring that NIH grantees and third party laboratories solicited by the grantees (most often pharmaceutical companies and commercial testing laboratories), enter into formal patent agreements.⁸ The terms of the agreements proved unacceptable to pharmaceutical companies, who consequently stopped screening compounds synthesized by academic scientists.⁹ The terms of the HEW-mandated patent agreement did not substantially alter HEW's policy regarding exclusivity terms in the licensing of government-funded inventions.¹⁰ However, the negative response by many researchers to the change in NIH policy underscored the pharmaceutical industry's need for exclusive rights in order to collaborate with NIH grantees in the development of their inventions.¹¹

Two fundamental questions emerge from a study of the critical events in the years leading up to the formulation and enactment of the Bayh-Dole Act. First, how extensively did pharmaceutical firms collaborate with NIH grantees before 1962, and what motivated them to do so?¹² Second, why did reactions to the 1962 patent agreement emphasize the pharmaceutical

7. For example, Rebecca Eisenberg observed that, "[p]rior to 1962, pharmaceutical firms had routinely screened compounds developed by NIH-funded investigators for biological activity, at no charge, without signing any agreements with either the investigator or [National Institute of Health] regarding rights to inventions discovered in the course of screening." Eisenberg, *supra* note 2, at 1682.

8. Bhaven N. Sampat, *Patenting and US Academic Research in the 20th Century: The World Before and After Bayh-Dole*, 35 RES. POL'Y 772, 778 (2006).

9. *See id.*

10. *See id.*

11. *Id.* at 786 (referring to the negative effects of university researchers of "patenting and licensing on open science and on other channels of technology and knowledge transfer").

12. *See* Sampat, *supra* note 8, at 778. In the two decades before 1962, "these pharmaceutical firms had routinely screened compounds developed by NIH-funded university researchers at no charge. In some cases . . . these pharmaceutical firms received exclusive rights to develop and market the compounds." *See* Sampat *supra* note 8 at 778.

industry's need for a guaranteed exclusive license as a *quid pro quo* for collaborating with NIH grantees?¹³

To address these questions, it is important to understand the different perspectives in the debate over federal government patent policy.¹⁴ Additionally, it is critical to provide an historical account of the specific policies adopted by HEW and its predecessor, the Federal Security Agency (FSA).¹⁵ As will become apparent, the formal policies left considerable discretion to the Surgeon General to promote the public interest through the disposition of government-sponsored inventions.¹⁶ The reported collaborations between NIH grantees and industry, from which few patents resulted, combined with HEW's hostility to exclusive licenses on government-sponsored inventions, appear to contradict the pharmaceutical industry's claimed dependence on exclusive licensing arrangements.¹⁷

13. See Sampat, *supra* note 8, at 778 (referring to US General Accounting Office and Harbridge House reports criticizing the 1962 policy changes because pharmaceutical firms stopped screening NIH grant compounds because of concerns that they would lose their intellectual property rights).

14. See Sampat, *supra* note 8, at 777 (describing contentious debates about government patent policy and the "desirability of a 'uniform' patent policy across all federal agencies").

15. See A Short History of the National Institutes of Health, <http://history.nih.gov/exhibits/history/index.html> (last visited Apr. 27, 2010), archived at www.webcitation.org/5jfNaKvn6. The NIH, an agency of the Public Health Service, was a division of the Federal Security Agency between 1939 and 1952. *Id.*

16. See The NIH Almanac – Historical Data, Legislative Chronology, Jun. 20, 2007, <http://www.nih.gov/about/almanac/index.html> (last visited Apr. 27, 2010), archived at www.webcitation.org/5jfWR1tIF. The Surgeon General's discretion was often exercised by dedicating most inventions discovered by NIH grantees to the public domain through scientific publications. See Sampat, *supra* note 8, at 777 ("allowing contractors to retain patent rights would preserve their incentives to participate in federal R&D projects and to develop commercially useful products based on government-funded research").

17. Wendy H. Schacht, *Patent Ownership and Federal Research and Development (R&D): A Discussion on the Bayh-Dole Act and the Stevenson-Wydler Act*, CONGRESSIONAL RESEARCH SERVICE (2000) available at <http://stuff.mit.edu/afs/sipb.mit.edu/contrib/wikileaks-crs/wikileaks-crs-reports/RL30320.pdf> at 4 (stating the consequence of many agencies "taking title to all inventions made with federal funding while only permitting the nonexclusive licensing of contractor inventions" were only five percent of federally funded patents).

This paper then presents a few approaches to the resolution of this apparent contradiction based on the available evidence. In particular, it will be noted that the large pharmaceutical firms demanded, with great vigor, exclusive rights to government-sponsored inventions after 1962.¹⁸ This was a strategic response to significant changes occurring at that time in the industry's regulatory and competitive environment, and in the role of the government as a sponsor of academic medical research.¹⁹

II. History of the Patent Policy of the Department of Health, Education, and Welfare

The Bayh-Dole Act's overhaul of the federal government's patent policy followed several decades of political wrangling over the proper disposition of intellectual property rights to inventions resulting from publicly funded research.²⁰ Advocates of the "title policy," most notably the HEW, urged the government to acquire full title to federally-funded inventions.²¹ In contrast, the Department of Defense argued for a "license policy," whereby the government would limit itself to retaining a license to use the inventions resulting from government-sponsored research, while leaving the title in researcher.²² The "license policy" came under growing criticism when federal government appropriations for health-related research began to rise during the mid-1950s. At least two studies conducted in the mid-1960s either focused on or criticized the current policies of the department with respect to intellectual property.²³ Both studies suggested that such

18. See Eisenberg, *supra* note 2, at 1682-83 (noting pharmaceutical firms "stopped screening NIH-sponsored compounds" until HEW agreed to grant them "patent rights to universities . . . so that universities could transfer exclusive rights in new compounds to firms for commercial development.").

19. See Eisenberg, *supra* note 2, at 1683 (stating that "[t]he new agreement had a dramatic impact on collaborations between pharmaceutical firms and NIH-funded investigators.").

20. See Eisenberg, *supra* note 2, at 1673-74. One position argued that full title to publicly funded inventions should be given to the government. *Id.* The other position argued that the government should finance the investments of the research rather than offer exclusive licenses for the inventions. *Id.*

21. See Eisenberg, *supra* note 2, at 1674, 1677.

22. See Eisenberg, *supra* note 2, at 1674, 1677.

23. See GOVERNMENT PATENT POLICY STUDY, *supra* note 6, at 69-140;

policies were responsible for the absence of collaboration among industry and academic researchers, thereby negatively affecting the social benefits normally derived from federal support of biomedical research.²⁴ Paradoxically, these reports revealed that the “title policy,” which dictates the results of federally funded research to the public domain, failed to promote the public interest.²⁵ In contrast, the “license policy” depended on the creation of sufficient incentives, including rights of exclusivity, for private pharmaceutical companies to commercially exploit the results of federally funded research.²⁶

The changes in the organization of the various government agencies, including the Public Health Service (PHS) to which the NIH belonged before becoming the umbrella organization as it exists today, necessarily affected the evolution of the NIH’s patent policy.²⁷ When HEW was founded in 1953, it inherited the Public Health Services from the dissolution of the FSA.²⁸ This agency was created in 1939, as an amalgam of units

COMPTROLLER GEN. REPORT, *supra* note 6, at 103-46.

24. See GOVERNMENT PATENT POLICY STUDY, *supra* note 6, at 69-140; COMPTROLLER GEN. REPORT, at 103-46.

25. See Eisenberg, *supra* note 2, at 1680. Commercial utilization of federally funded inventions was very low. *Id.* For example, 23.8% of government-funded inventions were utilized when the third party collaborator held title to the invention, in contrast to 13.3% when the third party collaborator did not hold title. *Id.*

26. See Eisenberg, *supra* note 2, at 1674-75. “Advocates of a license policy sang the praises of the patent system as a stimulus to innovation, new products, and new jobs, and believed that without the promise of title to patents, the best firms would not bid on government contracts, would not bother to disclose the inventions they made with federal funds, and would not invest further in the development of discoveries owned by the government.” *Id.* The Harbridge House study discovered that, only 12.4% of government-sponsored inventions patented from 1957 to 1962 had actually been put to use. *Id.* at 1680. Further, only 2.7% of government-sponsored inventions patented during the same period played a critical role in the commercial products in which they were incorporated. *Id.*

27. See AN ANALYTICAL HISTORY, *supra* note 3 (describing history of patent policies adopted by PHS).

28. See Dwight D. Eisenhower, Special Message to the Congress Transmitting Reorganization Plan of 1953 Creating the Department of Health, Education, and Welfare (Mar. 12, 1953) reprinted in PUBLIC PAPERS OF THE PRESIDENTS OF THE UNITED STATES: DWIGHT D. EISENHOWER 1953 CONTAINING THE MESSAGES, SPEECHES AND STATEMENTS OF THE PRESIDENT JANUARY 20 TO DECEMBER 31, 1953, at 94-98 (US Government Printing Office 1960) “This plan carries out the intention by creating a Department of Health, Education, and Welfare as

concerned with education and health, and was previously affiliated to other agencies within the federal government.²⁹ The PHS in particular has been an administrative unit of the Department of the Treasury since 1912.³⁰

A 1925 Surgeon General memorandum sent to the Secretary of the Treasury describes the long standing PHS policy granting unfettered access to the public, without exception, “new processes in the field of public health developed by officers and employees....”³¹ The Fourth Circuit further sanctioned this policy in *Houghton v. United States*,³² stating that the PHS had no interest in establishing a monopoly over inventions discovered as a result of its funding of research efforts.³³ The court noted that the public has an interest in the products of government-sponsored research.³⁴ Further, the court stated that it was “unthinkable” that an employee of a publicly funded agency be allowed to monopolize an invention for private gain, notwithstanding “levy[ing] a tribute upon the public which has paid for its production [by] merely granting a nonexclusive license for its use to the governmental department in which they were employed.”³⁵ This opinion established the government’s right to assert ownership over inventions by employees during the scope of their employment.³⁶

one of the executive departments of the Government and by transferring to it the various units of the Federal Security Agency.” *See id.* at 94.

29. Mariano-Florentino Cuéllar, *‘Securing’ the Nation: Law, Politics, and Organization at the Federal Security Agency, 1939-53*, 76 UNIV. OF CHI. L. REV. (2009).

30. The PHS initially founded as Marine Hospital Service (1798-1902) to provide for the medical care of merchant seamen, evolved into the Public Health and Marine Hospital Service (1902-1912) before being annexed by the National Institutes of Health in 1949. A Short History of the National Institutes of Health, <http://history.nih.gov/exhibits/history/index.html> (last visited Apr. 27, 2010), archived at <http://www.webcitation.org/5jfNaKvn6>.

31. AN ANALYTICAL HISTORY, *supra* note 3 at 9; Memorandum from the Surgeon General to the Secretary of the Treasury, Feb. 9, 1925 (on file with journal).

32. 23 F.2d 386 (4th Cir. 1928).

33. *Houghton*, 23 F.2d at 391.

34. *Id.* at 391. “The public health service represents the people of the United States. Its interest is their interest. Its investigations and discoveries are made for their benefit.” *Id.*

35. *Id.*

36. *Id.* (stating the invention “was the property of the government” and no

In 1935, the PHS responded to *Houghton* by adopting regulations designed to promote public use of inventions discovered as a result of federal funding rather than restricting it.³⁷ Employees of PHS could request permission from the Surgeon General to apply for a patent on inventions discovered within the scope of employment; such permission, when granted, would be subject to terms providing the government and the public with non-exclusive, royalty-free, rights to use the invention.³⁸ Moreover, the regulations required research grantees to report any inventions to PHS for determination by the Surgeon General of whether to pursue a patent or publish the research, thereby dedicating the invention to the public.³⁹

Arguably, the PHS's commitment to the protection of the public interest lacked effective implementation and posed difficulty for grantee institutions and administrators.⁴⁰ The PHS's rights in any resulting inventions threatened research activities of grantees that received additional funding from non-governmental sources.⁴¹ In 1947, the Surgeon General advisory body made an informal recommendation that grantees be unrestricted in obtaining and administering patents on inventions, subject only to the reservation of a royalty-free license for government purposes.⁴² This approach appeared to conflict, however, with the FSA's mandate to make publicly available information concerning federally-funded research and the practical applications thereof.⁴³

government official was "authorized to give away any interest" of the invention).

37. See AN ANALYTICAL HISTORY, *supra* note 3, at 10.

38. AN ANALYTICAL HISTORY, *supra* note 3, at 10. PHS also applied this policy to patentable inventions and discoveries made by recipients of PHS research grants. See *id.*

39. AN ANALYTICAL HISTORY, *supra* note 3, at 11. The Surgeon General determined "the manner of obtaining and disposing of the proposed patent in order to protect the public interest." *Id.*

40. See AN ANALYTICAL HISTORY, *supra* note 3, at 11. For example, there was no policy which set standards by which the conditions of patentability would be determined. See *id.* Further, if a patent was granted, there was no guidance on what was necessary to protect the public interest. See *id.*

41. See AN ANALYTICAL HISTORY, *supra* note 3, at 11.

42. See AN ANALYTICAL HISTORY, *supra* note 3, at 11.

43. See AN ANALYTICAL HISTORY, *supra* note 3, at 12.

The need for a clearer policy by the FSA became more pressing during the 1940s, partly as a result of the growth in the research budget administered by the NIH.⁴⁴ Consequently, the FSA formed a committee charged with the task of formulating recommendations for a comprehensive patent policy.⁴⁵ These recommendations were implemented by Agency Order 110 on July 10, 1950, which was partly revised by Agency Order 110-1 on September 15, 1952.⁴⁶ These orders affirmed the FSA's commitment to protecting the public's unfettered access to the fruits of research funded by the FSA's units.⁴⁷ This commitment manifested itself in:

- a) the assertion of government rights in all inventions developed by employees of the Agency;⁴⁸
- b) the use of patents only as a means to protect the public's access to such inventions;⁴⁹
- c) the stated principle according to which the same general objectives governing patent policy on intramural research applied to research grants;⁵⁰
- d) the grantor's retention of the right to determine the disposition of grantees' inventions;⁵¹
- e) the principle according to which the assignment to other entities of patent rights on grantees' inventions would be subject to the condition that these entities would administer such patents so that the underlying inventions

Legally it presented the question of whether such a disposition of inventions, without limiting conditions destined to protect the public interest, could be squared with the explicit directive of section 301 of the Public Health Service Act to make information as to research and its practical application available 'through publication or other appropriate means.' *Id.*

44. See AN ANALYTICAL HISTORY, *supra* note 3, at 12.

45. See AN ANALYTICAL HISTORY, *supra* note 3, at 13.

46. See AN ANALYTICAL HISTORY, *supra* note 3, at 16. The revisions were necessitated by a decrease in funding for patent administration. See *id.* The review function of the Agency Patents Board, previously designed to hear and resolve appeals from matters relating to patentability determinations, was made optional. *Id.* Final determinations were vested with the heads of the operating units of the Agency. See AN ANALYTICAL HISTORY, *supra* note 3, at 16.

47. See AN ANALYTICAL HISTORY, *supra* note 3, at 16.

48. See AN ANALYTICAL HISTORY, *supra* note 3, at 13.

49. See AN ANALYTICAL HISTORY, *supra* note 3, at 13.

50. See AN ANALYTICAL HISTORY, *supra* note 3, at 13.

51. See AN ANALYTICAL HISTORY, *supra* note 3, at 13.

- would be readily available to the public, as would be provided under government ownership;⁵²
- f) the principle according to which patent rights on grantees' inventions resulting from cooperative research that received substantial support from sources other than the Agency could be left to the grantee for assignment to a qualified organization, for a limited period of time, for the purpose of developing and exploiting the invention, as long as reasonable safeguards were in place to protect against unreasonable royalties or repressive practices;⁵³
 - g) the subordination of assignments of rights contemplated at (f) to express approval of the Agency Administrator upon his/her finding that such assignment would be instrumental in making the invention available to the public "more quickly, more economically, in larger quantity or better quality."⁵⁴

Use of exclusive licenses was in fact considered illegitimate for the FSA itself in the absence of explicit legislation by the U.S. Congress.⁵⁵ The assignment of patent rights to grantee institutions was thus a way to allow exclusive licensing terms under specific circumstances.⁵⁶ It appears that the members of the committee were not altogether convinced that granting exclusive control was a desirable default option.⁵⁷ Specifically, the committee was concerned with the difficulty of assessing whether or not an exclusive license was necessary, the dangers inherent in the government's use of exclusive licenses, and the possibility that exclusive licenses could result in strengthening monopolistic positions in particular fields.⁵⁸

52. See AN ANALYTICAL HISTORY, *supra* note 3, at 13.

53. See AN ANALYTICAL HISTORY, *supra* note 3, at 14.

54. See AN ANALYTICAL HISTORY, *supra* note 3, at 14. Thus, the FSA acknowledged the assertion that exclusive control over an invention was sometimes necessary to promote the realization of the public benefits of federally-funded inventions. See *id.*

55. See AN ANALYTICAL HISTORY, *supra* note 3, at 14.

56. See AN ANALYTICAL HISTORY, *supra* note 3, at 14.

57. See AN ANALYTICAL HISTORY, *supra* note 3, at 14.

58. See AN ANALYTICAL HISTORY, *supra* note 3, at 14.

The primary goal of Agency Order 110-1 was the preservation and implementation of the FSA's commitment to the publication of federally-funded research or when a patent was pursued by the dedication of the patent to the public domain through a non-exclusive, royalty-free license.⁵⁹ Furthermore, Agency Order 110-1 explicitly reserved "march-in" rights for the government if the patentee exploited the patent rights in a manner inconsistent with the protection of the public interest.⁶⁰ In response to grantees' objections, Agency Order 110-1 was revised to substitute the "march-in" clause with a provision which did not automatically grant "march-in" rights to the government in cases where the FSA accepts, in advance, a grantee institution's patent policy assuring safeguards against unreasonable royalties and oppressive practices.⁶¹ This provision became the basis for the Institutional Patent Agreements (IPAs) between the PHS and grantee institutions.⁶²

Over the next several years, prior to 1962, eighteen academic institutions were given patent rights to inventions created in the context of publicly funded research.⁶³ The function of the early IPAs was to establish a relationship between FSA, which was transferred to the newly created HEW in 1953,⁶⁴ and the grantee institutions.⁶⁵ Although IPAs made it possible in principle to issue exclusive licenses under specific conditions, their objective was to delegate to universities the task of promoting the public interest in the diffusion of federally funded

59. See AN ANALYTICAL HISTORY, *supra* note 3, at 14-15.

See AN ANALYTICAL HISTORY, *supra* note 3, at 16. Grantee institutions specifically objected to these broad "march-in" rights. See *id.*

61. See AN ANALYTICAL HISTORY, *supra* note 3, at 16.

62. See Elizabeth Popp Berman, *Why Did Universities Start Patenting? Institutions-Building and the Road to the Bayh-Dole Act*, 38 SOC. STUD. OF SCI. 835, 844-45 (2008) (citing correspondence of the NIH Director, James A. Shannon, indicating delays in the NIH processing of waivers' requests by grantees, and unpublished documents of Norman Latker, Patent Counsel of HEW, indicating that IPAs lacked a clear technology transfer orientation).

63. See *id.* at 845. HEW issued eighteen IPAs between 1954 and 1958, and issued no more after 1958. See *id.* The existing IPAs eventually fell into disuse. See *id.*

64. See Reorganization Plan No. 1 of 1953, 5 U.S.C. App. at 124-26 (2000) (transferring all functions of the FSA to HEW in 1953).

65. See Berman, *supra* note 62, at 844-45 (noting HEW contracted with universities).

inventions.⁶⁶ IPAs could relieve HEW staff from processing waivers requests on a case-by-case basis and from the task of applying for patent protection on the grantees' inventions.⁶⁷ This advantage became significant when the Department of Justice stopped accepting administrative responsibilities for patent prosecution from other federal agencies in 1952.⁶⁸ The resulting increase in patent-related workload at HEW prompted the Department Patents Board to make it default policy for HEW that the inventions emanating from grant-supported work be dedicated to the public domain by publication.⁶⁹

For these benefits to be realized, it was essential that the university patent policy conformed to the HEW's emphasis on the protection of the public interest in having access to the results of federally funded research.⁷⁰ Accordingly, one signatory of the eighteen IPAs entered into before 1962 was Harvard University, which specifically indicated in its patent policy that members of the University could not take out patents on therapeutics or medical inventions without explicit consent of its President and Fellows.⁷¹ Harvard University's patent policy also dictated that the University would not take out patents on such inventions except for the purpose of dedication to the public.⁷² Despite the policy, IPAs were entered into with institutions whose patent policies regarded the management of patented inventions as a means to the generation of royalty income for the institution.⁷³

66. See Berman, *supra* note 62, at 844-45 (describing the policy the IPAs enforced on the universities of dedicating the invention to the public).

67. See Berman, *supra* note 62, at 845 (noting in 1964, the director of the NIH stated patent rights were not waived in five years and title of all reported inventions were kept with the federal government).

68. See AN ANALYTICAL HISTORY, *supra* note 3, at 18.

69. AN ANALYTICAL HISTORY, *supra* note 3, at 18.

70. See Berman, *supra* note 62, at 845 (noting the HEW did not waive patent rights because of the policy to devote federally funded university inventions to the public).

71. See ARCHIE PALMER, SURVEY OF UNIVERSITY PATENT POLICIES: PRELIMINARY REPORT 75 (National Research Council 1948). The patent policy of Harvard University specifically stating that "[n]o patents primarily concerned with therapeutics or public health may be taken out by any member of the University, except with the consent of the President and Fellows." *Id.*

72. See *id.* at 75 (stating "nor will such patents be taken out by the University itself except for dedication to the public").

73. See Berman, *supra* note 62, at 842. One such institution was the

Up until 1962, HEW allowed its own grantees to interact with third parties, most notably, pharmaceutical firms and testing laboratories, in the course of their sponsored research without prior formal agreements.⁷⁴ NIH grantees developed a common context for these interactions in the screening of molecular compounds at pharmaceutical and commercial labs.⁷⁵ This practice came under scrutiny in 1962 when NIH began requesting that when grantees intended to avail themselves of the services of external organizations, the latter be made to sign an "amended patent agreement."⁷⁶ By the terms of this agreement, the grantee and the pharmaceutical company agreed that:

- a) the pharmaceutical company would not disclose the results of testing for twelve months unless all parties agreed to an earlier term;
- b) the pharmaceutical company would provide all information about utilities and new uses of the compound to the grantee for use by the PHS in connection with patent applications that PHS might choose to file;
- c) the pharmaceutical company would have rights to patent new uses of the compounds when these were developed

University of Wisconsin, which had long embraced the practice of assigning patents on its scientists' inventions to the Wisconsin Alumni Research Foundation (WARF), whose management of university patents aimed at generating royalty income in support of the University's future research activities. See Howard W. Bremmer, *University Technology Transfer: Evolution and Revolution*, in 50TH ANNIVERSARY – JOURNAL OF PAPERS (Council on Governmental Relations ed. 1998), archived at <http://www.webcitation.org/5jpszgNiyY>. While the University of Wisconsin did not enter an IPA with HEW until 1968, it appears to have benefited repeatedly from HEW's waivers of patenting rights on a series of inventions by one scientist, Morris Kupchan. *Id.*

74. See Eisenberg, *supra* note 2, at 1682 (describing the HEW regulations that granted "broad authority to determine the disposition of patent rights in inventions arising from sponsored research").

75. See Eisenberg, *supra* note 2, at 1682-83 (noting in 1962, NIH started to require pharmaceutical firms to sign patent agreements before the firms could screen compounds developed with NIH funds).

76. See HEARINGS BEFORE THE SUBCOMMITTEE ON PATENTS, TRADEMARKS, AND COPYRIGHTS OF THE SENATE COMMITTEE ON THE JUDICIARY, 89TH CONG., reprinted in GOVERNMENT PATENT POLICY, Part II, at 628 (1965) [hereinafter GOVERNMENT PATENT POLICY, Part II] (statement of Dean W. Lewis Nobles, Graduate School, University of Mississippi) (describing the reluctance of pharmaceutical firms in signing NIH's patent agreement because of concerns over its scope).

at the company's own expense, without any form of assistance or contribution from the grantee, and when the new use patent did not hamper, impede, or infringe upon the intended use of the compound, or fall within the field of research work supported by the grant;

- d) the pharmaceutical firm would reserve a non-exclusive, irrevocable, royalty-free license to the government on any new use patent at point (c), with power to sublicense for all governmental purposes.⁷⁷

Pharmaceutical firms viewed the terms of these supplementary patent agreements negatively, and their refusal to sign on paralyzed the flow of compounds from the grantees' laboratories at non-profit institutions to the pharmaceutical firm's laboratories.⁷⁸ In 1967, HEW removed the provision that the development of new uses of a compound falling within the field of research supported by the grant could not be patented even if carried out without grantee's contribution, in the first revision of this patent agreement.⁷⁹

Another revision was carried out in 1968 in the context of the reformulation and standardization of the IPAs.⁸⁰ The 1968 version of the IPAs with HEW indicated that grantees had to obtain a supplementary patent agreement from all third parties (contractors) carrying out any part of the work covered by the grant.⁸¹ These agreements extended to the contractor the

77. See GOVERNMENT PATENT POLICY, Part II, *supra* note 76, at 628-29.

78. See HEARINGS BEFORE THE SUBCOMMITTEE ON PATENTS, TRADEMARKS, AND COPYRIGHTS OF THE SENATE COMMITTEE ON THE JUDICIARY, 89TH CONG., *reprinted in* GOVERNMENT PATENT POLICY, Part I, at 201, 211-20 (1965) (statement of Dr. Austin Smith, President, Pharmaceutical Manufacturers Association) [hereinafter GOVERNMENT PATENT POLICY, Part I] (reproducing the opinion of academic chemists on government patent policy in response to a letter of the Associate Director of Research and Development at Smith Kline & French Laboratories).

79. David C. Mowery & Bhaven N. Sampat, *University Patents and Patent Policy Debates in the USA, 1925-1980*, 10 INDUS. AND CORP. CHANGE 781, 795 (2001).

80. See Eisenberg, *supra* note 2, at 1683.

81. *The Ownership of Inventions Resulting from Federally Funded R&D, Hearings Before the Subcomm. on Domestic and Int'l Scientific Planning and Analysis, H. Comm. on Sci. and Tech.*, 94th Cong. 2d Session, 582, 584 (1976) (specifically discussing the supplementary patent agreements).

reporting obligations imposed on the grantee, and it required that contractors assign to the grantee the patent rights in all inventions conceived while performing the contracted work.⁸² Thus, the revised agreement reduced significantly the scope of rights asserted by the government on the inventions of the grantees' contractors.⁸³

Another important step toward resolving the perceived obstacles to university-industry collaboration in the field of biomedical research was the determination of criteria according to which grantee institutions could award exclusive licenses on HEW-supported inventions.⁸⁴ While adhering to the principle that the grantee was to administer the inventions in the public interest and thus making them available on a non-exclusive and royalty-free or reasonable royalty basis to applicants, the IPAs gave the grantee the discretion to license on an exclusive basis for a limited time (no more than three years after first commercial sale or eight years from license date).⁸⁵ This discretion was based upon a determination that development of the invention would not be forthcoming without the privilege of exclusivity.⁸⁶

After their revision in 1968, IPAs became a more favorable instrument regulating the relations between HEW and institutions carrying out grant research.⁸⁷ A total of seventy-one

82. *Id.*

83. *Id.* at 582-600 (text of the revised Institutional Patent Agreement governing grants and awards from the HEW).

84. *Id.* at 587. "Exclusive licenses should be issued only after reasonable efforts have been made to license on a nonexclusive basis, or where the grantee has determined that an exclusive license is necessary as an incentive for development of the invention or where market conditions are such as to require licensing on an exclusive basis." *Id.*

85. *Id.* at 586-87.

86. *Id.* "...[N]onexclusive licensing will not be effective in bringing about such inventions to the commercial market in a satisfactory manner." *Id.*

87. See *Institutional Patent Agreements, Part I, Hearings Before the Subcomm. on Monopoly and Anticompetitive Activities, S. Select Comm. on Small Bus.*, 95th Congress 2d Session, 15, 48 (1978) (Statement of Norman Latker, Patent Counsel, Department of Health, Education and Welfare, Government Patent Policies) (comparing the number of IPA's issued in 1954-1958 and with those issued in 1978).

agreements were signed by the middle of 1978.⁸⁸ However, concerns over the escalating costs of health care brought the practice of exclusive licensing of government-funded inventions under scrutiny in 1977 by HEW's new secretary, Joseph Califano.⁸⁹ Califano's decision to temporarily halt the approval of title waivers mobilized universities and other R&D contractors of the federal government in support of the Bayh-Dole Act, which is widely credited for making its passing possible in 1980.⁹⁰

III. Empirical Evidence on University-Industry Collaboration Before the Introduction of the 1962 Patent Agreement

Three dimensions of FSA/HEW's patent policy played a critical role in shaping the interactions between universities and pharmaceutical firms. These are: (1) whether or not the grantee could assert ownership rights to government-sponsored inventions;⁹¹ (2) whether or not the grantee could issue exclusive licenses on those government-sponsored inventions;⁹² and (3) whether or not NIH formally restricted the interaction between NIH grantees and their research collaborators.⁹³ By reference to

88. *Id.*

89. See BJ Culliton, *Healthcare Economics: The High Cost of Getting Well*, 200 Sci. 883,880-90 (1978); see also Berman, *supra* note 62, at 854.

90. Berman, *supra* note 62, at 855-56. The suspension of approving title waivers caused over 30 inventions with market potential to sit on a desk at the HEW. Berman, *supra* note 62, at 855-56. The blockage of title waivers motivated university patent administrators to contact their representatives with complaints. Berman, *supra* note 62, at 855-56.

91. See Eisenberg, *supra* note 2, at 1667-68 (referring to "intellectual property rights in the results of government-sponsored research").

92. See Berman, *supra* note 62, at 845-46 (contrasting HEW's pre-1968 policy that did not allow for exclusive licenses with its latest modified patent policy, which more frequently approved individual waiver requests for licenses and established more IPAs); AN ANALYTICAL HISTORY, *supra* note 3, at 14. Exclusive control of patent licensing may be permitted and members of the committee recognized the "dangers inherent in any action by a Government agency giving preference to any private interest in inventions financed even in part by the Government." See *id.*

93. See AN ANALYTICAL HISTORY, *supra* note 3, at 14 (noting "[t]he possible strengthening of a monopolistic interest in a particular field by organizations already controlling patents in that field"). See Sampat, *supra* note 8, at 778 (referring to firms that screened compounds that were required to sign formal patent agreements "that prevented the firms from obtaining patents on any technologies that resulted from NIH funding").

these dimensions, the evolution of FSA/HEW patent policy on sponsored research results can be summarized as follows.

Until 1962, grantees could only assert rights to inventions originating from sponsored research with the explicit consent of the relevant unit of FSA/HEW.⁹⁴ Such consent could be sought through individual requests for waivers of the agencies' rights to the inventions, or through the establishment of an IPA.⁹⁵ Exclusive licenses could be issued by grantees (but not by the government) only upon approval of the agency when doing so was necessary in order to promote the further development of the invention for the public benefit.⁹⁶ The policies of this phase allowed the interaction between grantees and their contractors or outside collaborators to occur without an explicit agreement over the assertion of patent rights on inventions.⁹⁷

This was the focus of the most important policy change from 1962 to 1967.⁹⁸ HEW's requirement that research collaborators of NIH grantees sign a patent agreement significantly restricted the scope for contractors' assertion of patent rights on inventions conceived while working not only on the sponsored research, but also on other "neighboring" research programs.⁹⁹ While IPAs were not formally repealed, they began

94. See Sampat, *supra* note 8, at 778 (noting in 1962, HEW "notified universities that firms screening compounds must sign formal patent agreements that prevented the firms from obtaining patents on any technologies that resulted from NIH funding or that were in the "field of research work" supported by the NIH grant").

95. See Berman, *supra* note 62, at 845-46 (noting that HEW frequently approved individual waiver requests after 1968).

96. See AN ANALYTICAL HISTORY, *supra* note 3, at 14 (noting the agency's recognition of patenting an exclusive control necessary for the value of some inventions for the public benefit).

97. See William Kingston, *Antibiotics, Invention and Innovation*, 29 RES. POL. 679, 694 (2000) (referring to the role of outsiders and their influence on the technological community).

98. See Sampat, *supra* note 8, at 778 (indicating 1962 to 1968 as integral years to the HEW).

99. See GOVERNMENT PATENT POLICY, Part II, *supra* note 76, at 628-29 (noting that any pharmaceutical company that would have agreed to NIH's patent agreement would have been donating its services without hope of compensation). The patent agreement prevented pharmaceutical companies from obtaining new patent rights from compounds developed at their own expense when the new patent would hamper, impede, or infringe the intended

to fall into disuse in 1968.¹⁰⁰ Not only were additional IPAs not executed, but also grantees' requests for HEW's waivers of government rights were routinely denied until the release of the reports by Harbridge House and the Comptroller General brought about a less restrictive stance.¹⁰¹

Beginning in 1968 and ending with the congressional approval of the Bayh-Dole Act in 1980, the industry witnessed the diffusion of a new standardized form of IPAs that embraced explicitly the goal of promoting the patenting and licensing of NIH grantees' inventions by their academic institutions.¹⁰² Moreover, exclusive licensing was explicitly accepted as a means to enable the development of inventions that would otherwise fail to produce any benefit for the public.¹⁰³ In addition, HEW weakened the restrictions imposed by the supplemental patent agreements on the grantees' contractors, so that contractors only needed to agree to assign to the grantee any rights on inventions conceived while working on the sponsored research.¹⁰⁴

This summarizes the formal rules governing the relationships between FSA/HEW on one side and their grantees and contractors on the other. In practice, policy was oriented toward the use of publication as the dominant means for dedicating the results of sponsored research to the public at least

use of the invention covered by the product application or where such new use "within the field of research work supported by the grant." GOVERNMENT PATENT POLICY, Part II, *supra* note 76, at 629.

100. Berman, *supra* note 62, at 845-46.

101. Berman, *supra* note 62, at 845-46. University requests to waive title were routinely denied by the HEW's administrative office. Berman, *supra* note 62, at 845. "The widespread publicity of the reports...led to more frequent approval of individual waiver requests." *Id.* at 846.

102. See Sampat, *supra* note 8, at 778 (stating in a 1968 report that the establishment of IPAs gave universities "approved technology transfer capability" and the right to "retain title to agency-funded patents").

103. See AN ANALYTICAL HISTORY, *supra* note 3, at 14 (emphasizing that only through patenting, at least for a period of time, the values of some inventions are realized for the public benefit).

104. See Berman, *supra* note 62, at 846. Greater acceptance of exclusive licensing of government-sponsored inventions by the NIH grantees would have reduced in all likelihood the concerns of NIH grantees' collaborators with the specific terms of the patent agreement. See *id.*

until the mid-1960s.¹⁰⁵ It is worth recalling that the Department of Justice stopped handling the patent applications for the FSA in 1953, and transferred the backlog of prospective and pending patent applications to HEW.¹⁰⁶ The administrators in charge of handling these cases decided that prosecuting patent applications on most inventions was an inappropriate use of HEW's limited resources.¹⁰⁷ Dedication to the public through publication became the preferred way to carry out the statutory obligation to promote the public interest.¹⁰⁸

An internal study of inventions resulting from PHS's extramural grants and awards indicates that 1,173 inventions were reported by grantees between 1946 and 1966, most of them after 1958.¹⁰⁹ During the same time period, only forty-six patents were issued on such inventions.¹¹⁰ Twenty-nine were issued before 1963, therefore these inventions presumably relate to research carried out before HEW began requiring grantees and their collaborators to sign patent agreements.¹¹¹ Many of these patents were assigned to grantees' academic institutions, and in a few cases to grantees themselves.¹¹² Specifically, seventeen patents were granted to institutions holding IPAs with PHS.¹¹³

105. See AN ANALYTICAL HISTORY, *supra* note 3, at 18 (noting an adequate justification for continuing "patent applications at Government expense" was that publication protected the public interest).

106. AN ANALYTICAL HISTORY, *supra* note 3, at 18.

107. See AN ANALYTICAL HISTORY, *supra* note 3, at 18. Even if HEW increased the staff of attorneys, this would not have made up for the withdrawal of the Department of Justice resources. See *id.*

108. See AN ANALYTICAL HISTORY, *supra* note 3, at 18 ("...dedication by publication...has become the standard policy of the Department.").

109. See Katharine A. Parent, Inventions Resulting From Public Health Service Extramural Grants and Awards, 81 PUB. HEALTH REP. 659, 662 (1966). EALTH REP. 659, 662 (1966).

110. See *id.* at 660-61 (listing twenty-nine government-owned patents issued from 1951-1966 on inventions resulting from PHS grants and awards and seventeen patents issued from 1957-1966 on inventions resulting from PHS grants and awards under institutional agreements with the Surgeon General). Very few inventions were reported in the early years of the PHS grant program; the number increased steadily after 1958. See *id.* at 662.

111. See *id.* at 660-61 (referring to nineteen government-owned patents issued and ten patents issued on inventions resulting from PHS grants and awards before 1963).

112. See *id.* at 662 (noting the patents authorized by the Surgeon General that are owned by grantee institutions rather than the grantees themselves).

113. See *id.* at 661 (listing specific patents from PHS grants and awards).

Twenty-nine inventions were assigned to the United States Government—typically, through the agency of FSA or HEW.¹¹⁴ The other patents were assigned to universities, corporations, or were owned by the inventors themselves.¹¹⁵ The Surgeon General dedicated 148 inventions to the public through publication between 1963 to 1964.¹¹⁶

This evidence plays an important role in the evaluation of the contrast between a pre-1962 “golden age” of university-industry collaborations and their post-1962 freeze.¹¹⁷ Such contrast cannot be understood as the result of the sudden shift in HEW policies regarding the concession of exclusive licenses.¹¹⁸ Exclusivity terms were not admissible on government-owned patents, and by extension, on patents owned by academic institutions whose patent policies were approved insofar as they conformed to that of the agency.¹¹⁹ Indeed, the president of the Pharmaceutical Manufacturers Association, Dr. Austin Smith, explained in 1965 that the Association would support a reform of HEW patent policy inspired by three principles, namely: (a) that exclusive rights be always granted to an industrial developer of

114. See *id.* at 662 (stating twenty-nine of the one hundred and ninety four inventions pertaining to PHS were patented by the United States Government).

115. See Parent, *supra* note 109, at 662 (referring to the seventeen PHS sponsored inventions that were patented under grantee institutional agreements). Twelve of these patents were accounted for by only two scientists, affiliated with the University of Notre-Dame and the University of Wisconsin. See *id.* at 660. See e.g. U.S. Patent No. 2,705,489 (filed Apr. 5, 1955) (assigned to the University of Notre-Dame); U.S. Patent No. 3,009,917 (filed Nov. 21, 1961) (assigned to the University of Wisconsin).

116. See Parent, *supra* note 109, at 662 (noting that the Surgeon General made the one hundred and forty eight inventions public by publication in scientific journals during 1963 to 1964).

117. See Eisenberg, *supra* note 2, at 1671 (stating that “the past half century reveals no golden age [in patent policy] in which the results of government-sponsored research were un-controversially dedicated to the public domain”).

118. See Eisenberg, *supra* note 2, at 1673-74 (contrasting the debate over government-owned patents made available to the public through non-exclusive licensing which finances further research compared to the fear of allowing the government to have too much ownership of patent rights leading to a concentration of economic power).

119. See Eisenberg, *supra* note 2, at 1680 (noting that before the HEW policy shifted, “12.4% of a sample of government-sponsored inventions that were patented in the years 1957 and 1962 had actually been put to use, and only 2.7% of such inventions were playing a critical role in commercial products in which they were incorporated”).

government-sponsored inventions; (b) that patent rights be asserted by the government when it was the sole or prime developer of the invention; and (c) that patent rights be left with the contractor when government was not the sole or prime developer.¹²⁰ These principles opposed both the implications of the 1962 patent agreement on the scope of government's rights of ownership, and the long standing opposition to the granting of exclusive licenses.¹²¹

The structure and collaborations between academic scientists and industry laboratories cannot be precisely formulated. The description of the nature of university-industry collaboration provided by industry representatives in congressional hearings leaves crucial details in the dark. For example, the then vice president of research and development of G.D. Searle & Co., Dr. Thomas Carney, answered questions from Senator McClellan during the 1965 Hearings before the Subcommittee on Patents, Trademarks, and Copyrights.¹²² At the end of a prolonged, and yet inconclusive exchange, Senator McClellan asked Dr. Carney about the terms under which a pharmaceutical firm would take on the task of testing for therapeutic properties a molecular compound developed by a grantee of the PHS.¹²³ Dr. Carney selected, among the three alternatives presented by the Senator, the one according to which the pharmaceutical firm would "simply take it with the idea that if you can develop something out of it, you will have a product that you can market."¹²⁴ Dr. Carney failed to explain what he meant by "can market", which could mean either the lack of any patent rights on the compound, or the assertion of their existence by pharmaceutical firms or by others (including the grantee's

120. See GOVERNMENT PATENT POLICY, Part I, *supra* note 78, at 205 (statement of Dr. Austin Smith, President, Pharmaceutical Manufacturers Association).

121. Compare GOVERNMENT PATENT POLICY, Part I, *supra* note 78, at 205 with GOVERNMENT PATENT POLICY, Part II, *supra* note 76, at 628-29 (referring to the contrasting debate on exclusive licenses).

122. GOVERNMENT PATENT POLICY, Part I, *supra* note 78, at 236 (questioning the investment made by pharmaceutical firms in testing chemical compounds for academic institutions).

123. GOVERNMENT PATENT POLICY, Part I, *supra* note 78, at 235-36.

124. GOVERNMENT PATENT POLICY, Part I, *supra* note 78, at 235-36.

institution or government).¹²⁵ Instead, he emphasizes how pharmaceutical firms would make their testing facilities “available as a general policy to anybody in an academic institution. The objective, of course, was hoping that some active compounds would result, and obviously the man who submitted the compounds to us would feel a little more kindly to us for having tested those compounds.”¹²⁶ Pressed by the Senator to explain what monetary incentives pharmaceutical firms would have to make their facilities and resources available for this testing work, Dr. Carney stated: “If an active compound comes out of this, a marketed product, our compensation comes from marketing the product, and the compensation for the research man comes from getting a royalty on a marketed product.”¹²⁷

Neither these nor other statements on this topic provide sufficient details about the particular legal framework within which the collaboration between academic and industry scientists took place.¹²⁸ Note instead the contrast between the sentiment that academic scientists would have for the pharmaceutical firms that helped out with the testing, and the presumption that academic scientists would be in a position to receive a royalty payment on the sales of the marketed compound.¹²⁹ In order to reconcile these statements, one would have to presume that the background for these interactions was one wherein grantees’ institutions could routinely assert patent rights on the government-sponsored inventions, and grant exclusive licenses to the firm that collaborated in the invention. The problem with this interpretation is that while both FSA and HEW recognized in theory the possible use of exclusive licenses, the evidence reviewed above suggests that in practice exclusive licenses could not be held as a norm for the interactions of NIH grantees with industry.¹³⁰ These problems lead to the formulation of two alternative conjectures.

125. GOVERNMENT PATENT POLICY, Part I, *supra* note 78, at 235-36.

126. GOVERNMENT PATENT POLICY, Part I, *supra* note 78, at 236.

127. GOVERNMENT PATENT POLICY, Part I, *supra* note 78, at 236.

128. See PALMER, *supra* note 71, at 32-33 (describing collaboration between the University of Illinois and industrial manufacturers for sharing patents).

129. GOVERNMENT PATENT POLICY, Part I, *supra* note 78, at 236.

130. See Eisenberg, *supra* note 2, at 1667-68; see also Berman, *supra* note 62,

First, it is possible that the statements refer to grantees' collaborations with pharmaceutical firms whose inventive output was not reported to PHS as grantor. Contemporary analysts observed that FSA and HEW were not particularly zealous in enforcing the grantees' obligation to report all the inventions conceived while working on the research grant.¹³¹ Grantees' widespread reluctance in reporting inventions or enabling the timely and adequate disclosure of relevant scientific results might have made it possible for academic scientists and their industrial partners to collaborate on the development of promising compounds outside of the regulatory framework of NIH grants and awards.¹³² Pharmaceutical firms could then retain—at least temporarily—exclusive control over the development process, securing if necessary the continuing cooperation of academic scientists through consulting agreements or industry-sponsored grants subject to exclusive licensing rights on any forthcoming invention.¹³³

Second, it is possible that the description of university-industry collaborations presented above refers to general patterns of interactions between academic scientists and industry-based collaborators, rather than to a hypothetical interaction between a randomly selected NIH grantee and a randomly selected pharmaceutical firm. Even though NIH funding of academic research grew rapidly during the 1950s, a significant share of the funding for academic science came from industry sources and corporate foundations.¹³⁴ In addition to supporting academic science through research grants, industry had long since tapped the scientific knowledge of universities

at 845-46; *see also* AN ANALYTICAL HISTORY, *supra* note 3; *see also* Sampat, *supra* note 8, at 778.

131. *See* Parent, *supra* note 109, at 659 (arguing that inventions were reported at irregular intervals on the initiative of grantees until Mar. 1, 1962).

132. *See* Parent, *supra* note 109, at 662 (describing that very few inventions were reported after 1946 but the number increased steadily beginning in 1958). *See also* Mowery & Sampat, *supra* note 79, at 801.

133. Sampat *supra* note 8, at 774 (discussing the reluctance of universities to become involved in patenting and licensing activities).

134. *See* Berman, *supra* note 62, at 843-44 (discussing the growth of funding and research under the NIH during the 1950s and 1960s).

through consulting arrangements with faculty.¹³⁵ The breadth of university-industry collaborations imply that at least some of the NIH research grants were concerned with scientific and technical problems defined in earlier collaborations between academic and industry scientists. In the context of such well-established collaborative relationships, the willingness of pharmaceutical firms to screen compounds on behalf of the NIH grantee “at no charge” is not surprising.¹³⁶ The value of such collaboration did not depend on the expectation of an exclusive license on each government-sponsored invention, but rather on a broader flow of scientific and technological information.¹³⁷ It bears repeating that the 1962 patent agreement that caused the freeze in university-industry collaborations weakened the rights of the NIH grantees as a result of restricting the flow of collaborative information.¹³⁸

Evaluating these conjectures will require substantially more information on the patterns of collaboration between pharmaceutical firms and academic scientists during the late 1940s and 1950s. Neither of these conjectures places much weight on the proposition that a pharmaceutical firm would not undertake the development of a promising molecular compound without the expectation of an exclusive license.¹³⁹ Nevertheless, the criticism of HEW policy by academia and industry documented in the congressional hearings of the mid-1960s did not focus only on the provisions of HEW’s 1962 patent agreement, but also on HEW’s general opposition to exclusive terms of licensing.¹⁴⁰ To the extent that NIH grantees and pharmaceutical firms had collaborated in the past, it follows that

135. See Sampat, *supra* note 8, at 773 (describing the outputs of university research varying over time including consulting relationships between university faculty and firms).

136. Eisenberg, *supra* note 2, at 1682.

137. Eisenberg, *supra* note 2, at 1683 (noting that when pharmaceutical firms stopped screening NIH compounds there was a restriction of shared information and materials between the NIH and the firms).

138. Eisenberg, *supra* note 2, at 1683.

139. Berman, *supra* note 62, at 846. “[T]here was no incentive for drug companies to look at these compounds without the potential for an exclusive license.” *Id.*

140. See GOVERNMENT PATENT POLICY, PART I, *supra* note 78, at 16.

HEW's unwillingness to offer exclusive licenses on government sponsored inventions was not a prohibitive obstacle to collaboration.¹⁴¹ The next section will argue that the pharmaceutical firms' insistence on the need for exclusive rights as a condition for the development of government-sponsored inventions grew in the 1960s as a result of changes in the industry's competitive structure and regulatory environment.

IV. Regulatory Change and Patents in Pharmaceutical Innovation

Holding of exclusive intellectual property rights were not as important for pharmaceutical firms during the period ending in the mid-1960s. Patents, or exclusive licenses on others' patents, incentivize pharmaceutical firms' R&D.¹⁴² While the prospect of exclusivity implicit patents or exclusive licenses were constrained legally and technologically early on in the industry's history, these constraints did not stop pharmaceutical firms from investing in R&D, and doing so with growing intensity.¹⁴³ During the late 1940s and 1950s, multiple firms supplied either identical or therapeutically similar innovative drugs because of those constraints.¹⁴⁴ While patents were not per se a solid basis for the monopolization of markets, other characteristics of the pharmaceutical industry since the late 1930s ensured that innovative firms could profit—in some cases, handsomely—from the introduction of new ethical drugs.

141. See GOVERNMENT PATENT POLICY, PART I, *supra* note 78, at 17-18 (emphasizing the frustration of the policy to Government sponsored research).

142. Edwin Mansfield, *Patents and Innovation: An Empirical Study*, 32 MGMT. SCI. 173, 175 (1986) (reporting results of a survey indicating that pharmaceutical firms would have not developed around two thirds of the inventions developed in 1981-1983 if patent protection could not have been obtained); Wesley M. Cohen, Richard R. Nelson, and John P. Walsh, *Protecting Their Intellectual Assets: Appropriability Conditions and Why U.S. Manufacturing Firms Patent (or Not)* 2-3 (NAT'L BUREAU ECON. RES. Working Paper 7552, 2000) (reporting results of a survey of manufacturing firms indicating that pharmaceutical firms rate patents to be an important aspect of appropriability conditions in the industry).

143. See Peter Temin, *Technology, Regulation, and Market Structure in the Modern Pharmaceutical Industry*, 10 BELL J. OF ECON. 429, 431 (1979) (reporting that R&D intensity in the pharmaceutical industry had risen from four per cent in 1950 to eight per cent in 1960).

144. See Kingston, *supra* note 97, at 701 (referring to collaborative research between industrial and university laboratories).

In order to understand the role of patents in the evolving structure of the industry, it is useful to begin by noting that important questions related to the patentability of pharmaceutical substances were resolved during the early post-war period. First, whereas many pharmaceutical preparations could not be patented as they represented natural substances, the granting of Selman Waksman's patent on streptomycin in 1946 signaled that suitably modified substances could be patented.¹⁴⁵ Second, the 1952 Patent Act established the "non-obviousness" requirement for patentability, which indicated that the routine method of discovery employed in the search for new pharmaceuticals, was not a bar to their patentability.¹⁴⁶ It also allowed the granting of patents for new uses of existing pharmaceuticals.¹⁴⁷ Not only did these events cement the role of patent rights in the context of pharmaceutical firms' innovative activities, they also set the U.S. more clearly apart from the large number of countries around the world whose national patent laws rejected the patentability of drugs as a matter of protecting and promoting public health.¹⁴⁸ Such laws resembled the

145. See Kingston, *supra* note 97, at 696. If the United States Patent Office had considered that streptomycin was nothing more than a product found in nature, it could not have granted a patent. *Id.* They instead held that the modifications amounted to the production of a "new composition of matter" as required by the Patent Act. *Id.*

146. See Kingston, *supra* note 97, at 697.

147. 35 U.S.C. §101 (1952). "Whoever invents or discovers any new and useful process, machine, manufacture, or composition of matter, or any new and useful improvement thereof, may obtain a patent, subject to the conditions and requirements of this title." *Id.* See also Rajendra K. Bera, *Patentable Subject Matter under the US Patent Act, 1952: cases*, 95 CURRENT SCI, 1421, 1422 (2008) (discussing the subject matter of patents on naturally occurring products).

148. William Comanor, *The Drug Industry and Medical Research: The Economics of the Kefauver Committee Investigations*, 39 J. OF BUS. 12, 13 (1966) (comparing the inventive record of firms and research institutions in countries allowing patent protection on pharmaceuticals with the corresponding record in countries without patent protections for drugs in what came to be called the 'battle of the lists' during the hearings of the Kefauver Commission in 1962). See also DAVID SCHWARTZMAN, *THE EXPECTED RETURN FROM PHARMACEUTICAL RESEARCH: SOURCES OF NEW DRUGS AND THE PROFITABILITY OF R&D INVESTMENT* (Washington DC, American Enterprise Institute for Policy Research, 1975) (arguing that the comparisons failed to recognize that access to the U.S. market and to U.S. patents provided incentives for innovation to firms based in countries without patent protection).

restrictions that could be found in the patent policies of many academic institutions where inventions related to the health of human kind were explicitly pledged to the public domain.¹⁴⁹

Even after these legislative reforms expanded the domain of patentable pharmaceutical inventions, several factors constrained the competitive significance of patents. An important factor concerned the narrow scope of protection afforded to molecular compounds.¹⁵⁰ Rival firms pursued the identification of variants of patented molecules.¹⁵¹ The development of similar (“me too”) drugs, together with more clearly innovative developments, contributed to the entry by multiple firms in most markets defined in terms of therapeutic purpose.¹⁵² The overlap across the research programs of firms in the industry led often to near-simultaneous inventions and filings with the patent office.¹⁵³ The resulting interferences delayed patent applications and reduced their effectiveness as a means to deter entry.¹⁵⁴ Even in cases where there were no interferences among rival firms’ applications, delays accumulated in the processing of patent applications at the U.S. Patent Office.¹⁵⁵ As a result, drugs reached the market before the underlying patents were granted, so that—in the words of a Vice President of the Research and Development Division of Smith, Kline & French—the “*hard-fought-for patent loses much of its value.*”¹⁵⁶

149. See Sampat *supra* note 8 at 773 (describing the outputs of university research varying over time including consulting relationships between university faculty and firms).

150. See Comanor, *supra* note 148, at 18.

151. See Comanor, *supra* note 148, at 13. “[T]here appears to be a large effort to invent around existing patents.” *Id.*

152. See Comanor, *supra* note 148, at 14 (referring to effort to invent around existing patents, resulting in the introduction of “new drugs whose therapeutic effect is quite similar to that of products already on the market”).

153. See Comanor, *supra* note 148, at 12-13 (noting to highly duplicative industry research regarding new drugs).

154. See W. Furness Thompson, *Pharmaceutical Research and Patents*, 41 J. PAT. OFF. SOC’Y 70, 71 (1959) (stating a “welter of patent applications, interferences and appeals” were due to the exponential increase in pharmaceutical research).

155. See *id.* (noting delays at the USPTO were due to the exponential increase in pharmaceutical research and applications).

156. *Id.* at 71-72.

Pharmaceutical firms often addressed the interference proceedings that frequently marked the introduction of new classes of similar drugs during the 1950s through complex licensing or cross-licensing agreements.¹⁵⁷ Arrangements of this kind ensured that most or all of the firms would be able to continue operating in the relevant markets even after the U.S. Patent Office awarded the patent to one of them.¹⁵⁸ These agreements also restricted entry by rival firms, particularly small firms, into the markets for dosage forms, the most lucrative market segment.¹⁵⁹ These exclusionary strategies relied upon restrictions on the licensees' bulk sales of the relevant substances.¹⁶⁰ Absent these bulk sale restrictions, a small pharmaceutical firm could purchase the drug in bulk and produce dosage forms for sale in the downstream markets.¹⁶¹ The entry of small firms threatened to bring price competition to these markets, and therefore to disrupt the profitable pattern of non-price competition that large pharmaceutical firms had established.¹⁶²

Thus, while patent rights were not sufficient to establish monopolistic positions in specific therapeutic markets, they

157. See Herbert D. Miller Jr., *Patent License Restrictions in the Prescription Drug Industry*, 53 VA. L. REV. 1283, 1293 (1967) (detailing the "propensity of patent applicants to settle interferences among themselves").

158. See *id.* (noting that "once a new product is placed on the market, competitors must reach a license agreement or risk loss of the market entirely").

159. *Id.* at 1306-07 (referring to the "use of bulk sales restrictions to prevent entry by small, 'irresponsible' drug firms, and hence to retain the price stability advantages of an oligopoly" resulting in a damaging effect to small firms).

160. See *id.* (noting the bulk sales and restrictions on licensees).

161. See Miller, *supra* note 157, at 1306-07 (contrasting price restrictions, which only control the "prices at which licensees can sell" and do not prevent competitors from reselling, with bulk sale restrictions, which totally eliminate competition from smaller firms); see also Henry Steele, *Patent Restrictions and Price Competition in the Ethical Drugs Industry*, 12 J. INDUSTRIAL ECON. 198, 206 (1964) [hereinafter Steele, *Patent Restrictions*] (describing firms that restricted sales to "finished forms" to prevent bulk shipment to non-licensed competitors who could use the "uncontrolled supply" to introduce price competition into the market).

162. See Miller, *supra* note 157, at 1306-07 (indicating the purpose of bulk sales restrictions is to prevent price competition, but price restrictions merely control the price that licensees can sell and does not actually prevent competitors from entering the market).

provided large pharmaceutical firms with another instrument for managing competition.¹⁶³ The pattern of non-price competition that characterized the markets for innovative products was more strongly influenced by structural features of the pharmaceutical industry that had evolved since the late 1930s in response to changes in the regulatory regime and the transformation of the process for drug development.¹⁶⁴

A key aspect of these changes is represented by the 1938 Federal Food, Drug, and Cosmetic Act, which sanctioned the emergence of a division between the prescription and over-the-counter drug markets.¹⁶⁵ It also created a regulatory approval process which required pharmaceutical firms to submit evidence to the FDA demonstrating that the new drug was safe to use for humans.¹⁶⁶ As a result of these reforms in the commercialization of drugs, physicians became responsible for the decisions about the administration of prescription drugs on behalf of patients, an event widely held among economists to have caused a substantial decrease in the price elasticity of demand for pharmaceuticals.¹⁶⁷

The potential profitability of the prescription drug market had two consequences on the strategy and structure of innovative pharmaceutical firms. First, this profitability halted licensing by other pharmaceutical firms for the production and sale of innovative drugs, both in bulk and in formulations.¹⁶⁸ The industry had firmly established this practice starting in the 1940s, as the firms profited from their innovations either directly or by receiving royalties from their non-exclusive licensees.¹⁶⁹

163. See Miller, *supra* note 157, at 1306-08 (discussing bulk sale restrictions and limiting competition of pharmaceuticals).

164. See Miller, *supra* note 157, at 1310 (arguing that small firms would be unable to gain market share even in the absence of market protection).

165. Temin, *supra* note 143, at 434.

166. Temin, *supra* note 143, at 434 (giving the FDA the opportunity to prevent unsafe drugs from appearing on the market).

167. See generally Temin, *supra* note 143, at 436.

168. Temin, *supra* note 143, at 436 (describing pharmaceutical firms that stopped licensing in lieu of retaining a "monopoly over the production of their new drugs").

169. Temin, *supra* note 143, at 435-36 (noting three developments affecting the way new antibiotic drugs were introduced in the 1940s, including firms exercising their monopoly over their inventions and licensing exclusively for

The introduction of a prescription requirement raised the profit reward for firms that succeeded in restricting price competition by reducing the price elasticity of demand.¹⁷⁰ While firms could have profited by raising the royalty rate on licensees, doing so would have increased royalty rates well above the industry's historical norm.¹⁷¹ The mark-up of profit maximizing prices over production costs under monopolistic conditions has been estimated well in excess of four hundred percent.¹⁷² Even at this minimum estimate, royalty rates would have had to rise to about eighty per cent of sales revenues for the innovative firm to earn the monopoly profits while pursuing a non-exclusive licensing strategy.¹⁷³ Such royalty rates heavily exceeded industry norms, normally under five-percent, so pharmaceutical firms halted licensing exclusive production and higher prices.¹⁷⁴

Second, realization of the prospect of greater profits in the prescription drug market required firms to protect themselves from the competitive threat of therapeutically equivalent drugs, including existing (patented and non-patented) products and future similar drugs. Because the demand for prescription drugs came from prescribing physicians, there were powerful incentives for firms to increase their marketing expenses such as securing the loyalty of the prescribing physicians to their own products.¹⁷⁵ Marketing expenses rose rapidly in the pursuit of

royalty payments).

170. See Temin, *supra* note 143, at 434-35, 437 (indicating customers' ignorance on the drug costs made the demand for prescription drugs inelastic combined with the FDA regulation which decreased the elasticity of demand even further).

171. See Temin, *supra* note 143, at 437 (referring to the "newness and effectiveness of the 'wonder drugs,' the elasticity of demand might have been less than one and one fourth which indicates a decrease in profit maximizing royalties").

172. See Temin, *supra* note 143, at 436-37 (noting the price is five times the competitive price, which translates to a four-hundred percent increase from the original price).

173. See Temin, *supra* note 143, at 437 (requiring a royalty of eighty percent of sales to meet elasticity of demand at one and one quarter at the monopoly price).

174. See Temin, *supra* note 143, at 436-37 (referring to the elasticity of demand as less than one and one fourth).

175. See Henry Steele, *Monopoly and Competition in the Ethical Drugs Market*, 5 J.L. & ECON. 131, 132-33 (1962) [hereinafter Steele, *Monopoly and Competition*] (arguing that the actual relevant market as defined by

this goal, based on a strategic mix of brand names, mass advertising, and an army of detailers whose goal was to drum up physicians' interest and prescriptions for branded products.¹⁷⁶ The adoption of these strategies constrained price competition in those markets where multiple patented drugs were available.¹⁷⁷ They also often succeeded in reducing price competition in markets where non-patented drugs were available under their generic name from—typically small—pharmaceutical firms that did not invest in R&D, nor spend vast resources on advertising and marketing their products.¹⁷⁸ In pursuit of this goal, pharmaceutical firms found useful support from the general acceptance by prescribing physicians and the general public of allegations about the low quality of drugs available from smaller firms.¹⁷⁹ As came to light during the congressional hearings of the Kefauver Commission, many specific drug markets exhibited wide and persistent price differentials among therapeutically equivalent products, and were therefore highly lucrative for the branded drugs manufacturers.¹⁸⁰

The growth in industry's marketing expenses together with the rising R&D investment might have contributed to the dissipation of at least some of the monopolistic rents that could be obtained in the pharmaceutical market.¹⁸¹ There is no doubt

prescribing physicians and individual demand was altered by "direct-mail advertising, medical journal advertising, and by the insistence of itinerant salesman or 'detail-men' employed by the major drug firms").

176. See *id.* at 133.

177. See *id.* at 141. "The result of this volume of selling effort on the structure of the market has been to eliminate price competition except in the hospital and government bidding markets, and to substitute product differentiation and brand preference." *Id.*

178. See *id.* at 142 (discussing the lack of price competition where generic name products are sold in competition with brand name products). The most important reason is that large pharmaceutical firms seek to criticize and belittle the products of the small firm competitors. *Id.*

179. Steele, *Monopoly and Competition*, *supra* note 175, at 139 (minimizing the effect of competition by large firms convincing physicians "that all lower priced drugs are of dangerously poor quality").

180. See Steele, *Monopoly and Competition*, *supra* note 175, at 139 (discussing an overview of the pattern of market competition in specific therapeutic areas, elaborating on the empirical findings of the Kefauver Commission).

181. For different views on the profitability of the pharmaceutical sector, see Temin, *supra* note 143, at 430-433 (arguing that the profitability of the sector

however that the continuing capacity to hold prices well above marginal production costs became a key strategic concern for those firms that invested heavily in R&D and marketing.¹⁸² The most serious threat came from the competition of smaller firms whenever they could enter, or continue to operate, in specific product markets with either generic versions of off-patent drugs, non-patented compounds, or compounds available for licensing on a non-exclusive basis.¹⁸³ Sharing this concern, innovative firms found it in their mutual interests to exclude smaller firms from their licensing and cross-licensing agreements, conduct that motivated several analysts to describe the industry as dominated by a cartel.¹⁸⁴

The suppression of price competition from small firms was pursued both through a two-pronged strategy aimed at discouraging the prescription of generic drugs whenever possible and promoting the prescription of new drugs independently of any therapeutic advantage over old ones.¹⁸⁵ These efforts succeeded in promoting norms of behavior by prescribing physicians and the public that made it possible for new firms to command a price premium over old ones.¹⁸⁶ This market

was only marginally above that of the manufacturing sector in general); Schwartzman, *supra* note 148, at 23-47 (arguing that accounting rates of profit for the industry are not suitable to determine the presence of market power, and estimating rates of return on 1960 R&D to be well below industry averages).

182. See Schwartzman, *supra* note 148, at 23-47 (discussing developing concerns with price fixing).

183. Steele, *Monopoly and Competition*, *supra* note 175, at 134-135.

"...[S]mall firms can purchase the active ingredient for a given drug in bulk...and sell it at prices greatly below those which the large firms see fit to charge; there is also considerable evidence that very small firms can actually manufacture their own fine chemicals as bulk powder and sell them to small firms in bulk at prices equal to or lower than those charged by the major firms." *Id.*

184. See Steele, *Monopoly and Competition*, *supra* note 175, at 137 (referencing the prominent monopoly element in the patent market and the requirements of cross-licensing).

185. See Steele, *Monopoly and Competition*, *supra* note 175, at 139 (noting the firms licensure of patents and economies of scale of small firms competing with large firms on a price basis).

186. See Steele, *Monopoly and Competition*, *supra* note 175, at 139 (measuring the influence of the normal means of disseminating market information to prevent physicians' awareness of lower priced sellers in the market which prevents the recognition of lower priced alternatives to higher

environment promoted R&D competition among large firms whose market shares and profitability depended on their ability to commercialize a steady stream of novel branded drugs.¹⁸⁷ The market also incentivized the reduction of market access opportunities for those firms that specialized in production, but not for the firms that specialized on R&D and marketing.¹⁸⁸ These firms relied on price competition to garner a share of the market segments where buyers were price sensitive, and therefore less likely to pay premium prices for new drugs whose therapeutic advantages were modest at best.¹⁸⁹ While this was not a significant immediate threat for purveyors of branded drugs, their pricing and product strategies created opportunities for price comparisons whose ramifications for legislative and regulatory action militated would be a threat to the interest of the members of the innovative cartel.¹⁹⁰

There was a significant strategic interest in preventing these small firms from participating in the commercialization of new, and presumptively better, drugs that commanded premium prices in the prescription market.¹⁹¹ As indicated earlier, small firms were excluded from the licensing deals that were otherwise endemic to the industry.¹⁹² The only other possible sources of innovative drugs were foreign pharmaceutical firms seeking a presence in the U.S. market through licensing deals and the government sponsored research carried out at universities and

priced drugs).

187. See Steele, *Monopoly and Competition*, *supra* note 175, at 141-42 (explaining price competition on the drug market comparing generic and branded name products).

188. See Steele, *Monopoly and Competition*, *supra* note 175, at 142 (stating the "selling effort on the structure of the market has been to eliminate price competition except in the hospital and government bidding markets, and to substitute product differentiation and brand preference").

189. See Steele, *Monopoly and Competition*, *supra* note 175, at 147-48 (referencing "the substitution of product differentiation for price competition").

190. See Steele, *Monopoly and Competition*, *supra* note 175, at 145-46 (comparing the generic name compound drugs on the market to the brand name).

191. See Steele, *Monopoly and Competition*, *supra* note 175, at 148 (discussing the three main dimensions of competition as price competition, product competition and product differentiation.)

192. See Steele, *Monopoly and Competition*, *supra* note 175, at 139.

other non-profit institutions.¹⁹³ In light of the FSA's and HEW's commitment to non-exclusive licensing and to dedicating the results of funded research to the public domain, the scale of their involvement in the invention of new drugs was a potential concern.

Whereas academic R&D activities of interest to the pharmaceutical industry had received substantial support from industry sponsors, the growing involvement of the federal government in the national R&D enterprise manifested itself clearly in the explosive growth of budgetary appropriations for various research programs administered by HEW.¹⁹⁴ The resources allocated to the NIH for intramural and extramural research grew from 3.1 million dollars in 1946 to 385.3 million dollars in 1961.¹⁹⁵ The share of extramural research increased in this time period from around one fourth to about three fourths, so that about thirty per cent of the national expenditure on medical research was accounted for by the NIH grant program.¹⁹⁶ By comparison, the research expenditures of the pharmaceutical industry were estimated at 55 million dollars in 1946 and 215 million dollars in 1960.¹⁹⁷

193. See ADMINISTERED PRICES DRUGS, S. Res. 52, at 48 (1st Sess. 1961). Foreign firms were in fact an important source of new drugs for the large U.S. pharmaceutical firms, whose marketing capacity held the promise of greater sales, and thus greater royalties for the licensor. *Id.* We note here that the prices practiced in the U.S. by the licensees of drugs of foreign origin exceeded by a wide margin the drug's prices in the country of origin. *Id.* For example, Smith Kline & French sold chlorpromazine under the brand name Thorazine at a price six times larger than the price of the licensor company, Rhone-Poulenc, in France. *Id.* at 113.

194. See Berman, *supra* note 62, at 843-44. The Department of Defense was the largest government funder of university science in the 1950's, but by 1960 the HEW had outpaced it, and by 1974 fifty-five percent of federal research funding came from HEW. *Id.* Furthermore, congressional appropriations increased from \$48 million in 1953 to \$737 million in 1963. *Id.*

195. Dale R. Lindsay and Ernest M. Allen, *Medical Research: Past Support, Future Directions*, 134 SCIENCE 2017, 2019 (1961) (enclosing Table 5 reporting funding for NIH-supported medical research from 1946-1961).

196. *Id.*

197. For 1946 data, see Kenneth M. Endicott and Ernest M. Allen, *The Growth of Medical Research and the Role of Public Health Service Research Grants*, 118 SCIENCE 337, 337 (1953). For 1960 data, see William S. Comanor, *Research and Competitive Product Differentiation in the Pharmaceutical Industry in the United States*, 31 ECONOMICA 372, 382 n. 2 (1964).

The rapidly growing support of academic research from the federal government had important consequences on the relation between academic scientists and industry, as the former became less and less dependent on financial support from the latter. The growing scale of the government R&D funding programs raised the specter of publicly-funded drug development.¹⁹⁸ This prospect, and the attendant possibility of more intense price competition from the non-exclusive licensees of government-owned (or grantee-owned) inventions, was resolutely opposed by the pharmaceutical industry.¹⁹⁹ While acknowledging the massive government investment in drug research, the Pharmaceutical Manufacturers Association (PMA) maintained that dedicating patents to the public accomplished next to nothing.²⁰⁰ The PMA claimed that the role of industry, not government, was to invest the millions of dollars needed in clinical tests and marketing to bring about the commercialization of new drugs, and without adequate incentives in the form of property rights, this task would not happen.²⁰¹ Of course, the largest pharmaceutical firms had accumulated over the course of the 1950s substantial capabilities for broad screening of molecular compounds that were indeed not available at universities, public laboratories, or contract testing centers.²⁰²

198. A step in this direction could be identified in the broad screening program for cancer launched in 1956 by the PHS. To this aim, the Cancer Chemotherapy National Service Center was established as a testing center of the National Cancer Institute. See *Milestone (1955): Creation of CCNSC, The National Cancer Institute's Website*, Sept. 27, 2009, http://www.dtp.nci.nih.gov/timeline/noflash/milestones/M3_CCNSC.html, archived at <http://www.webcitation.org/5k6uWXRbr>.

199. See GOVERNMENT PATENT POLICY, PART I, *supra* note 78, at 204 (statement of Austin Smith, M.D., President of the Pharmaceutical Manufacturers Association). Dr. Smith notes that "industry, not government, must be relied on to make" investments. See GOVERNMENT PATENT POLICY, PART I, *supra* note 78, at 204.

200. See GOVERNMENT PATENT POLICY, PART I, *supra* note 78, at 204 (statement of Austin Smith, M.D., President of the Pharmaceutical Manufacturers Association).

201. See GOVERNMENT PATENT POLICY, PART I, *supra* note 78, at 204. "It is industry, not Government that must be relied upon to make this investment." *Id.*

202. See Eisenberg, *supra* note 2, at 1682 (discussing that prior to 1962, large pharmaceutical firms routinely screened compounds.)

The development of the industry structure was not altered significantly by the 1962 Amendments to the Food, Drugs, and Cosmetics Act.²⁰³ This legislative reform contributed further to the deterioration of the competitive prospects for small and medium sized firms, while strengthening the incentives for large firms to secure exclusive rights to their products.²⁰⁴ There are two crucial provisions of the Act that support this argument. First, the Food and Drug Administration (FDA) was granted authority to oversee the premarket clinical testing of new drugs in humans, aimed at establishing not only safety but also effectiveness for the drug's intended purpose.²⁰⁵ Second, safety and effectiveness testing became a requirement for all new drugs, including identical generics and similar "me-too" drugs.²⁰⁶ These drugs were until then subject only to a certification by the FDA that they were not novel, but rather bioequivalent copies or variants of existing drugs.²⁰⁷

Arguably, these changes contributed to the drastic reduction in the number of New Chemical Entities (NCEs) approved by the FDA since the early 1960s. Clearly the changes increased the cost of bringing a new drug to market, whether they were innovative or not.²⁰⁸ But the consequences of this fact were more painful for the small firms in the industry.²⁰⁹ Indeed, the overall reduction in the flow of NCEs has been attributed to the drop in the development of new drugs by small firms.²¹⁰ Until then, these firms followed an imitative strategy based on the development of generics or of similar drugs, and their

203. See Lacy Glenn Thomas, *Regulation and Firm Size: FDA Impacts on Innovation*, 21 RAND J. OF ECON. 497, 500 (1990). "For the U.S. pharmaceutical industry from the sample period 1960-1980... the annual ranking...by research size is astonishingly stable over time." *Id.*

204. See *id.* at 502 (noting that small firm R&D costs rose significantly for each new drug and thus few imitative drugs could be launched).

205. See *id.*

206. See *id.*

207. See *id.* at 501. "Before 1962, firms performed only perfunctory market testing and received certification that their product was effectively identical to an established, successful drug." Thomas, *supra* note 203, at 501.

208. Thomas, *supra* note 203, at 502.

209. See Thomas, *supra* note 203, at 502.

210. See Thomas, *supra* note 203, at 501 (arguing that it is unsurprising that many firms completely ceased innovation after 1962 resulting in a sharp drop in the total number of NCEs approved at that time).

commercialization in price-sensitive segments of the market.²¹¹ The advent of more expensive testing requirements since 1962 forced small firms to further reduce their participation to the industry's innovation, and focus instead on the production and sale of drugs developed by others.²¹² Large firms were obviously also impacted by the more stringent testing requirements.²¹³ These drove up the costs of drug development and reduced further the effective time of patent protection.²¹⁴ However, the same regulatory hurdles ended up also restricting entry into specific markets, and thus had the effect of increasing the prospective sales of a new drug.²¹⁵ The net effect of the more stringent regulatory environment was then favorable to large firms whose investment in R&D continued in fact to rise at the same time that their R&D portfolio became more concentrated.²¹⁶

V. Conclusion

Beginning in 1962, the PHS requested that NIH grantees sign a patent agreement with their research collaborators whose primary purpose was to assert governmental ownership rights to the inventions resulting from the collaborative work, and—crucially—royalty-free licensing rights to any later inventions made by a grantee's collaborator in the grantee's field of research.²¹⁷ It is not surprising to learn that such agreement was met with considerable hostility by pharmaceutical firms, who stopped collaborating with NIH grantees as they claimed to have been doing in earlier times.²¹⁸ Contemporary accounts of these university-industry interactions emphasize the pharmaceutical firms' willingness to carry out broad screening tests of molecular

211. See Thomas, *supra* note 203, at 501.

212. See NATIONAL RESEARCH COUNCIL, THE COMPETITIVE STATUS OF THE U.S. PHARMACEUTICAL INDUSTRY: THE INFLUENCES OF TECHNOLOGY IN DETERMINING INTERNATIONAL INDUSTRIAL COMPETITIVE ADVANTAGE 40-1 (National Academy Press, 1983) [hereinafter NATIONAL RESEARCH COUNCIL] (discussing the high cost and risk faced by small firms seeking to make strides in drug innovation). See also Thomas, *supra* note 203, at 501.

213. NATIONAL RESEARCH COUNCIL, *supra* note 212, at 41.

214. See Thomas, *supra* note 203, at 502.

215. See NATIONAL RESEARCH COUNCIL, *supra* note 212, at 41.

216. Thomas, *supra* note 212.

217. Sampat, *supra* note 8, at 778.

218. Sampat, *supra* note 8, at 778.

compounds identified and synthesized by NIH grantees, at no charge and without any formal agreement on the disposition of property rights on the inventions (should any be conceived).²¹⁹ Absent more detailed discussions of this matter, these assertions raise questions on the precise scope of the interactions between NIH grantees and pharmaceutical firms: How many compounds identified by NIH grantees were screened? What share of these compounds was patented and developed further into commercial drugs? These declarations also raise questions about the incentives that pharmaceutical firms had to screen these compounds on behalf of the NIH grantees.

Based on available secondary sources, this paper has shown that—consistent with HEW policy—the vast majority of the inventions conceived by NIH grantees until 1962 were dedicated to the public domain through scientific publications or through the dedication to the public of government-owned patents.²²⁰ The number of patents granted to either the government or grantees' institutions for inventions conceived while working on grant research was remarkably low until 1962.²²¹ Moreover, HEW consented to granting exclusive licenses on NIH-sponsored inventions in no more than a handful of cases.²²² We conclude from this evidence that the incentives for pharmaceutical firms to interact with NIH grantees could not possibly result from the prospect of exclusive licensing agreements on the resulting patents unless poor oversight allowed such agreements to take place outside the regulatory framework of HEW's patent policy. Alternatively, we have proposed that pharmaceutical firms found the information produced while interacting with NIH grantees useful in planning their own research and development activities. According to this conjecture, they did not depend on securing exclusive control over NIH-sponsored inventions, but at the same time did not want to sign away ownership rights to the inventions that could have followed from the collaboration with the NIH grantee.

219. See GOVERNMENT PATENT POLICY, Part II, *supra* note 76, at 630.

220. See Sampat, *supra* note 8, at 777.

221. See Berman, *supra* note 62, at 845.

222. See Schacht, *supra* note 17, at 5-6.

Hence, they opposed the introduction of the 1962 patent agreement.²²³

Until further research is done in order to evaluate the conjecture that NIH grantees' institutions evaded HEW's patent policy, there is little evidence to indicate that exclusive licenses were necessary in order to promote collaborations with NIH grantees. It is interesting to note the pharmaceutical firms' opposition to the 1962 patent agreement was voiced by making continuing collaboration with NIH grantees appear to depend on NIH acceptance of exclusive licensing terms. Evidence of the economic significance of pharmaceutical patents during the post-war period is mixed.²²⁴ The proliferation of interference proceedings, licensing and cross-licensing arrangements, and me-too drugs, indicate that innovative pharmaceutical firms could not rely upon patents as a means for monopolizing specific therapeutic markets.²²⁵ These proceedings contributed, however, to efforts by large innovative firms to support a regime of non-price competition in the pharmaceutical market. The origin of this competitive regime is found in the regulatory reform that introduced prescription requirements in the market for ethical drugs. As a result of this reform, the structure of the industry was characterized by large firms that integrated R&D function and extensive marketing operations aimed at prescribing physicians and smaller firms with limited capability for innovative R&D and marketing. The former eschewed price competition, and relied upon branding, patenting, and aggressive marketing in order to compete with similar firms in the segments of the market where demand was not sensitive to prices. The latter competed in price-sensitive markets by offering generic drugs at low prices.

As evidenced by the hearings of the Kefauver Commission, the activities of small firms had the potential to cast a negative light on the activities of large pharmaceutical firms. Comparisons of prices placed by small and large firms on drugs deemed

223. See GOVERNMENT PATENT POLICY, PART I, *supra* note 78 at 630.

224. See *discussion, supra* notes 85-88.

225. See Thomas, *supra* note 203, at 500-02.

therapeutically equivalent could easily be held up as a manifestation of abuse of pricing power by the large firms. Moreover, public spending on biomedical research had grown rapidly and exceeded the R&D investment of the pharmaceutical industry by the mid-1950s. To the extent that public research could act as a substitute for private R&D, the large firms had to be concerned about its possible competitive consequences.

The response to these changes was twofold. First, the industry concerned itself with preserving a division of labor between publicly funded research (primarily concerned with basic research) and privately funded drug development. Second, it became increasingly concerned with restricting the ability of small firms to participate in specific markets on the basis of novel drugs without bearing the R&D and marketing costs that large firms incurred. From this perspective, the growing calls for exclusive licensing on NIH-sponsored inventions represented a desire to promote the survival and growth of a regime of non-price competition. The change in the regulatory regime in 1962 contributed further to this goal by raising the cost of bringing a new drug to market. It also lent additional legitimacy to the pharmaceutical firms' demands for exclusive licensing.