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Patents and Inventive Effort

The evidence is insufficient to prove or disprove the claim that patent protection promotes inventive effort.

Fritz Machlup

A session of the December 1960 meeting of the AAAS was devoted to "The patent system and the advancement of knowledge." This issue, discussed for centuries, has never been resolved. Quotations from the U.S. Constitution, which empowered the Congress to establish patent and copyright laws "to promote the progress of science and the useful arts," cannot settle the question whether such laws actually serve this purpose. That patent protection may induce investment in further development and commercial application of new inventions is more readily conceded than that it is effective in inducing inventive activity where the corporate form of industry prevails. Doubts concerning this function of patents have been expressed with increasing frequency since the government contribution to research and development came to exceed half the total outlay. In 1959 private industry paid for less than 38 percent of total research and development in the United States. How important, then, can patent protection be in inducing inventive activity? Let us examine the arguments and sift the evidence that have been presented to answer this question.

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Large Corporations and Employed Inventors

Patent protection is supposed to serve as an incentive to invest in inventive work or to invest in development and plant construction or to disclose inventions that have been made. No matter which of these purposes are stressed, it is widely held nowadays that patents are not really important as incentives for large corporations, but only for independent inventors or for small firms competing with large ones. This view, strangely enough, is most emphatically stated by representatives of large corporations. Statements of this sort can be found in almost all Congressional hearings on patent legislation of the last 25 years.

If this contention is true, and we have no reason to doubt it, we are faced with the odd situation that patents as incentives for socially desirable activities are unnecessary for those who own the bulk of all patents. In the United States about 60 percent of all patents are assigned to corporations before issuance, which ordinarily indicates that the patented inventions were made by inventors employed by these corporations. Of all patents owned by corporations conducting research and development in 1953, 51 percent were owned by firms with more than 5000 employees, 30 percent by firms with between 1000 and 5000 employees, and only 19 percent by firms with less than 1000 employees. Thus it appears that those who hold most of the patents, the large corporations, testify that the patent system is not necessary for them, but only for those who hold the smallest number of patents.

In reply to the question whether patents are essential to the continuance of large expenditures for research and development, an officer of a large company stated that he might cut down these expenditures to perhaps one-half of the amount spent at that time if patent protection were removed. It happened, however, that approximately one-half of the research and development budget of that company was then devoted to the tasks of securing patents and enforcing the exclusive rights which they were supposed to confer. Hence, if the company were suddenly relieved of the necessity of spending money on obtaining patent rights and litigating about them, the remaining half of its budget would still buy the same amount of genuine research and development work. Most officers of large patent-holding corporations—except those in the chemical industry—do not think that their research expenditures depend on patent protection. For example, Robert E. Wilson, petroleum researcher and oil company executive, speculating about the possibly adverse consequences of a "weakening of the patent system," contended that this would *least* affect the research policies of *large* companies (*1*).

This judgment can be supported by deduction from the theory of oligopolistic competition: no firm in competition with a few others can afford to let its rivals steal a march upon it as far as the technological base of its competitive position is concerned. The research and development work is essential for the maintenance of its position. It cannot allow itself to fall seriously behind in the technological race, regardless of whether inventions promise it a 17-year patent protection, which in fact as a result of obsolescence means usually

Table 1. Number of domestic patent applications compared with population and number of technological workers, 1870–1950.

Year	Domestic patent applications (av. over 5 yr)*	Resident population (millions)†	Technological workers (millions)*	Patent applications per 100,000 population	Patent applications per 100 technological workers*
1870	18,600	39.91	1.51	46.60	1.24
1880	22,200	50.26	2.01	44.17	1.10
1890	35,800	63.06	3.13	56.77	1.15
1900	36,600	76.09	3.75	48.10	0.97
1910	59,400	92.41	5.39	64.29	1.10
1920	71,900	106.47	6.29	67.53	1.14
1930	73,700	123.08	7.10	59.88	1.04
1940	52,200	131.95	6.59	39.57	0.80
1950	60,100	151.23	8.59	39.74	0.70

*Source: J. Schmookler (*4*). The 1950 figures were supplied in an unpublished paper. †Source: *Historical Statistics of the United States.*

no more than a few years, or whether inventions promise it only a head start of two or three years or even only a means of catching up with the rivals. Hence it is not likely that the patent system makes much difference regarding the research and development expenditures of large firms.

Small Firms and Independent Inventors

Whether or not it is true that the patent system makes a serious difference regarding the competitive position of the small firm can hardly be decided on the basis of our present knowledge. There are strong arguments on both sides of the question. For example, the patent position of the big firms makes it almost impossible for new firms to enter the industry; patent litigation carried on by big firms makes it difficult for small firms to defend their own patents successfully. On the other hand, there are cases of small firms having succeeded, on the basis of strong patents on inventions of radically new processes or products, in gaining a position in markets previously dominated by a few giants. Be this as it may, this is a question of industrial organization, not a question of the effects of the patent system upon the production of new technological knowledge.

There still remains the problem of the individual inventor. The majority of writers have contended that the days of the free-lance inventor are gone, that invention has become the business of organized large-scale research and development in specialized departments of large corporations. John Jewkes is almost alone in denying this verdict, and he has adduced massive evidence to show that the individual inventors are still having a sizable share in the production of *important* inventions, even if their share in the production of commercially useful routine inventions has seriously declined. Jewkes believes that the individual inventor needs protection: "So long as the survival of the individual inventor is not utterly despaired of . . . and so long as nothing better can be suggested for the purpose, there is a very strong case for the retention of the patent system." (*2*).

Table 2. Number of scientists and engineers compared with number of patents issued, 1900–1954.

	(1)	(2)	(3)	(4)	(5)
Year	Scientists and engineers*	Index of growth of scientists and engineers	Patents granted for inventions†	Index of growth of patents granted for inventions	Index of relative growth of patenting in relation to scientists and engineers [col. (4) ÷ col. (2) × 100]
1900	42,000	100	24,660	100	100
1910	86,000	220	35,168	142	65
1920	135,000	320	37,164	150	47
1930	227,000	540	45,243	183	34
1940	310,000	740	42,333	171	23
1950	573,000	1,360	43,072	175	13
1954	691,000	1,640	33,872	137	8

*Source: National Science Foundation, *Scientific Research Personnel Resources* (1955), p. 9. †Source: *Historical Statistics of the United States, 1789–1945* (1949); *Statistical Abstract of the United States* (1955).

End of Growth in Patented Inventions?

In amazing contrast to the phenomenal growth in research and development expenditures and personnel since 1920, the number of inventions for which patents are sought has not increased since that time. The number of applications filed for patents on inventions was greater in 1920 than in any year during the 1950's, or indeed in any year since 1930. The number of patents actually issued happened to be relatively small in 1920, because applications had dropped during the years of World War I, and it is partly for this reason that the number of patents issued in the late 1950's exceeded that of 1920. The annual average of patents issued in the 10 years, 1950 to 1959, was 42,599, or only 2½ percent above the annual average of patents issued from 1920 to 1929, which was 41,492.

Examining the historical statistics of the patent system in the United States (*3*), we find that the peak in patent applications occurred in 1929, when 89,752 applications were filed. The largest number of applications filed in any year during the 1950's was 78,594, in 1959. The peak year for numbers of patents issued was 1932—note the customary 3-year lag behind applications—with 53,458 patents. During the 1950's the low was 30,432 patents in 1955, and the high was 52,408 in 1959.

The absence of growth, since 1920, in the absolute number of patents applied for or granted implies a decline in patenting relative to such magnitudes as population, the number of technological workers, of scientists and engineers, of professional research and development personnel, or the amounts of research and development expenditures. Some of these data are not available for all years; different tables, therefore, are used to show the relevant relationships. Table 1 compares the number of domestic patent applications with total population and with the number of technological workers in census years from 1870 to 1950. The number of technological workers, compiled by Jacob Schmookler, includes all occupations listed in the population census, whose members are skilled in a technical art or whose training includes some field of technology (*4*). Following Schmookler, we do not use the number of patent applications filed in just the census years—which would reflect the working capacity of the patent office rather than that of the inventors—but take 5-year

Table 3. Patent applications filed compared with the number of research and development (R&D) scientists and engineers and the amount of research and development expenditures.

Patent applications filed: Period	Patent applications filed: Av. per year*	Year	Research and development: Scientists and engineers† (thousands)	Research and development: Expenditures‡ (in millions of $)	Patent applications per 100 R&D scientists and engineers	Patent applications per $1 million R&D expenditures
(1)	(2)	(3)	(4)	(5)	(6)=(2)÷(4)	(7)=(2)÷(5)
1941–43	47,794	1941	87	900	54.94	53.10
1942–44	48,411	1942	90	1,070	53.79	45.24
1943–45	55,843	1943	97	1,210	51.57	46.15
1944–46	67,697	1944	111	1,380	60.99	49.06
1945–47	74,815	1945	119	1,520	62.87	49.22
1946–48	75,113	1946	122	1,780	61.57	42.20
1947–49	70,625	1947	125	2,260	56.50	31.25
1948–50	67,865	1948	133	2,610	51.03	26.00
1949–51	65,098	1949	144	2,610	45.21	24.94
1950–52	64,085	1950	151	2,870	42.44	22.33
1951–53	65,759	1951	158	3,360	41.62	19.57
1952–54	71,341	1952	180	3,750	39.63	19.02
1953–55	75,552	1953	192	4,000	39.35	18.89
1954–56	76,426	1954		4,140		18.46
1955–57	75,430	1955		5,400		13.97
1956–58	75,553	1956		6,500		11.62
1957–59	76,792	1957		8,200		9.36

*Source: *Historical Statistics of the United States.* †Source: National Science Foundation, *Scientific Research Personnel Resources* (1955), Table B-9. ‡Source: *Statistical Abstract of the United States* (1960).

averages centered on each census year, for example, the average of 1938–1942 for 1940.

We see from these data that between 1870 and 1920 patenting grew along with population and with the size of that group within the population which is likely to make inventions. The growth of patenting apparently stopped after the 1920's, and patent applications relative to population and to the number of technological workers declined rapidly.

Table 2 reproduces a table prepared by Seymour Melman to show the contrast between the growth of the number of scientists and engineers and that of patents issued, for the period 1900 to 1954. Table 3 is confined to a more recent period, beginning in 1941, for which research and development data, however unreliable, are available; it compares the number of research and development scientists and engineers and the amounts of research and development expenditures with the average annual number of patent applications filed during consecutive 3-year periods.

Why the Relative Decline?

These comparisons show a conspicuous decline in patenting relative to the presumably relevant variables. This decline has aroused a big debate: does the decline in patenting indicate a similar decline in the relative number of inventions? or only in the relative number of patentable inventions? or perhaps merely a decline in the "propensity to patent"? Of course, these are not disjunctive alternatives; all three things may have happened, and there are good reasons for believing that this is actually the case.

Easiest to explain is the decline in the number of patent applications per million dollars spent on research and development. We have only to remember the enormous portion of research and development funds that goes into aircraft development (missiles, rockets, space ships, and so forth) and that it is most unlikely that patentable inventions will grow out of the extensive and expensive experimentation in this area. No matter whether the solutions of the many technical problems which we try to get in a hurry are regarded as inventions, combinations of inventions, improvements, or anything else, they are not likely to meet the requirements of patentability. The same explanation would hold for the decline in patent applications per 1000 research and development scientists and engineers. Like the research and development expenditures, the professional research and development staff has been similarly concentrated in the aircraft industry, in attempts to find out as quickly as possible what combination of fuels, metals, devices, and all the rest, would make certain types of missiles, and so forth, operational. The implications of the comparisons in question have not always been fairly presented. While it is fair to conclude that patents play a relatively small role in the present research and development activity, in the sense that they are neither a necessary incentive for, nor a likely result of, the research and development effort, it would not be fair to conclude from the data that patents no longer play a role in any part of the nation's inventive effort.

Patents and Research Expenditures

The chemical industry suggests itself as an example of an industry in which patents may play a role. While it usually ranks behind three or four other industries as far as total research and development expenditures are concerned, it rises to rank No. 1 if the industry's own contributions of funds for research and development are compared. At the same time the chemical industry holds rank No. 1 in the number of patents pending. This "rank correlation" between patent applications and self-financed research and development expenditures does of course not prove anything, but at least it conforms to the traditional theory of the patent incentive. Incidentally, if for all industries the government funds are disregarded and only the industry's own funds for research and development are taken into account, the rank correlation between these research and development expenditures and the number of patent applications pending is very high. The data for this statistical test were taken from the National Science Foundation's 1953–54 survey, *Science and Engineering in American Industry*.

A high correlation between self-financed research and development expenditures and applications for patents strongly suggests that industry tends to spend its own money on inventive efforts where these efforts are most likely to lead to inventions. It does not establish that these expenditures would not be made without the promise of patent protection. Undoubtedly, if there is a chance to obtain patents on inventions, industry will not pass up this chance. But it cannot be demonstrated from any statistical relationships that only the patents rather than the inventions were wanted, or that inventions without patents would not have been considered worth the money spent on research. As was said earlier in this article, to have a headstart on new processes or products, even if competitors are not barred from imitation, or to catch up with competitors who are leading in the race for new technology, may be sufficiently desirable in a world of oligopolistic competition to bring forth all the inventive efforts that are now attributed to the patent incentive.

The absence of any empirical evidence for either the claim or its denial that the patent system is an effective promoter of inventive research—and thus of the production of socially new technological knowledge—is most frustrating. The doubting Thomases are usually timid and reserved lest they invite the wrath of the faithful. [A recent denial of the claim, by Seymour Melman, is quite exceptional in its directness (*5*).] Advocates of patent protection have for centuries propounded the faith in this institution, and their statements admit of not an iota of doubt. They may well have the truth—but faith alone, not evidence, supports it.

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Science in the News

Kennedy's Education Program: Notes on the Political Background

The Administration's education program is beginning to emerge from the House and Senate committees, and it appears that the bills which reach the floor of each house will be in substantially the form Kennedy has requested: grants, in the neighborhood of $1 billion a year, to the states for public schools; loans on about the same scale for universities, both public and private; and an expansion of the federal loan program for students. Kennedy also requested a scholarship program, which may not appear in the committee versions, although, if outright scholarships are not included, an alternative limiting the amount of money students entering low-paying professions will have to repay to the government is likely to be included in the loan program.

The different parts of the program vary widely in their prospects. Expansion of the established loan programs for colleges and college students can be taken for granted. The outlook for a scholarship program or the alternative of generous forgiveness provisions in the loan program is less clear. The proposals have never been fully discussed before in Congress, and few members outside the committees concerned with education have committed themselves to any particular approach. Aid to public schools, including teachers' salaries as well as construction, is another matter: it has been widely debated for years, and remains by far the most controversial item.

The handling of the education program, particularly the issue of teachers' salaries, is likely to prove the most severe test to date of the Administration's relations with Congress. Kennedy has yet to be beaten on an important issue, but he also has yet to commit himself on an issue on which the outlook, based on votes last year and on the known positions of new members, looked so dismal.

On this basis, the nonpartisan Congressional Quarterly estimated at the beginning of the session that any school bill, even one excluding teachers' salaries, faced an apparent deficit of 27 votes in the House of Representatives. By this standard, the outlook for a school bill including money for teachers' salaries would be virtually hopeless, although since the teachers' salary issue has never reached a vote in the House it is hard to estimate the apparent vote deficit. But Congressional Quarterly attempted only to measure what can be fairly precisely measured: the known inclinations of the members of the House. The difference between certain defeat and at least a fair chance for victory is the power of the Presidency, which Kennedy has never yet fully used.

The Kennedy forces pushed through the minimum wage bill last week by a margin of 35 votes in the House, although in the form Kennedy proposed the bill faced, by Congressional Quarterly's estimate, an apparent deficit of 54 votes. The margin of victory, though generally regarded as surprisingly large, was far from comfortable: the margin was wide only when compared with the five-vote margin by which the Kennedy forces won the Rules Committee dispute. The vote was 231 to 196, and a shift of 18 members out of the 427 who voted would have defeated the bill.

Political Tactics

The factors that made a fairly narrow Administration victory possible on minimum wages would not be enough to push across a school bill with money for teachers' salaries, but they will provide a basis for the effort the Administration needs to make to have a chance. Both bills are handled by the same House committee, Education and Labor. Last year the chairman of the committee was Graham Barden, of North Carolina, one of the most conservative of the Southerners. Barden retired last year, and Adam Clayton Powell, of Harlem, succeeded by the usual seniority rule. The chairman has great powers to delay, if not to kill, legislation he disapproves. Powell has a good claim to being the most unpopular man in the House, but