

5481

THE GEORGE WASHINGTON UNIVERSITY

FINAL REPORT

NASA RESEARCH PROJECT  
NsG 425

B. The Productivity of Federally Financed  
Research and Development

Period: December 1, 1965 to May 14, 1966 (Sixth semi-annual  
period)  
May 15, 1963 to May 14, 1966 (Term of grant)

Principal Investigator: Donald S. Watson, Professor of Economics

Associate Investigator: Mary A. Holman, Associate Research  
Professor of Economics

Status of Research

Beginning on September 1, 1965, NsG 425 has run  
concurrently with NsG 425, Supplement No. 1. No research  
effort and no funds have been allocated to the "Productivity  
of Federally Financed R & D" part of NsG 425 since  
September 1, 1965. At the request of NASA, all research  
effort has been directed to NsG 425, Supplement No. 1 -  
a policy study that will evaluate the patent policies of  
the National Aeronautics and Space Administration.

Before September 1, 1965, three studies were completed  
under NsG 425. Research of a fourth study was suspended  
and will be completed by Donald S. Watson and Mary A. Holman,  
on their own time. after August 31, 1966 (the date of

GPO PRICE \$ \_\_\_\_\_

CFSTI PRICE(S) \$ \_\_\_\_\_

Hard copy (HC) 1.00

Microfiche (MF) 1.50

FACILITY FORM 602	<b>N66 35974</b>	
	(ACCESSION NUMBER)	(THRU)
	<u>12</u>	<u>1</u>
	(PAGES)	(CODE)
<u>CR-77776</u>	<u>34</u>	
(NASA CR OR TMX OR AD NUMBER)	(CATEGORY)	

completion of NSG 425, Supplement No. 1).

### Research Findings

First Completed Study: "Patents from Government-Financed Research and Development," Patent, Trademark and Copyright Journal (Vol. 8, No. 2, Summer 1964), pp. 199-222.

This is a report on the numbers of patents arising in the postwar period from government-financed research and development. The many previous studies and investigations of federal patent policies never yielded more than incomplete and often inconsistent data. The total number of patents, owned by or licensed to the federal government, has grown rapidly. The total, however, is quite small when compared with the total of all patents issued or assigned in the postwar period to residents of the United States and to U. S. corporations. The numbers of patents from government-financed R & D have grown and fluctuated in step with applied research, but with a lag whose average length is estimated to be at least five and one-half years.

Data are presented on the numbers of titles and licenses by major federal agencies. The title-policy agencies hold many licenses, and the license-policy agencies administer large portfolios of titles. The government acquires titles and licenses from its own employees and

from R & D contractors. Employees account for about one-third of all the patents. They are heavily concentrated in a few technologies and in a few industries.

Reprints of this article have been sent to NASA.

Second Completed Study: "Concentration of Patents From Government-Financed Research in Industry." This study will be published in a forthcoming issue of the Harvard Review of Economics and Statistics.

In its contracts for research and development, the United States government has generally followed the policy of allowing business firms to acquire title to the patented inventions emerging from the R & D. This policy has caused much controversy, one of the issues being increased concentration of economic power from the acquisition of patents. We gathered complete data on patent acquisitions, for the 17-year period ending in 1962, of 177 major R & D contractors (business firms) for the U. S. government. The patents are those resulting from both government-financed and company-financed R & D. We measure concentration of patents and of R & D with conventional ratios and with the slope coefficient ( $\alpha$ ) of a simple Paretian distribution. We find that the concentration of patents from government-financed R & D actually declined

from 1946-1955 to 1956-1962, and that this concentration is less than the concentration of R & D.

The gain in monopoly power from the acquisition of patents from government-financed R & D is negligible, because only a small fraction of the inventions have any commercial value at all. Where there is commercial value, it is slight. A large university, however, has earned millions of dollars of revenue from a computer invention initially developed with government funds. The accumulation of patents from research done for the government has increased total patent portfolios in industry by only an average of about 10 per cent. All in all, then, patents from government-financed R & D have an imperceptible influence on existing monopoly power. The greater concentration of R & D expenditures than of patents is evidence, though it can hardly be conclusive, of diseconomies of scale in the inventive process. We conclude that our findings do not support a major change in policy on the disposition of patent rights in contracts for research and development.

Reprints of this article will be sent to NASA.

Third Completed Study: "The Federal Government's Propensity to Patent." This study will be published in a forthcoming issue of the Patent, Trademark, and Copyright Journal.

One of the puzzles accompanying the rapid growth of research and development in the postwar period has been the much slower increase in the numbers of patents issued on inventions. In current dollars, total research and development (R & D) expenditures grew about tenfold from 1945 to 1963. The numbers of scientists and engineers engaged in R & D work increased about fourfold. Technical publications in the postwar period have poured forth in an avalanche, of unknown, though of agreedly enormous dimensions. But, as Fritz Machlup has shown, the numbers of patent applications per million dollars of R & D expenditures and per hundred R & D scientists and engineers has steadily declined.

About the same is true for that part of all R & D financed by the federal government and conducted in its laboratories and in those of its contractors. Federally financed R & D went from about \$1 billion in the fiscal year 1946 to about \$10 billion in the fiscal year 1962. But between the calendar years 1946 and 1962, the number of patents emerging from that R & D only doubled.

Even though it declined slightly in the postwar period, the federal government's propensity to patent (a drop in the proportion of raw inventions that become the subjects of patent applications) of about 27 per cent cannot be made to explain the discrepancy between the growth of

federally financed research and development and the much slower increase in the number of patented inventions emerging from that R & D. Thus what seemed to be a promising hypothesis crumbled when we assembled the data on inventions and patent applications. The gap between the input of R & D and the output of patented inventions is probably to be explained, we think, by something as conceptually simple as diminishing returns.

The propensity to patent varies, and not just slightly, among the federal agencies. They apply different sets of criteria in selecting inventions for patent application. They follow no standard practice in publishing the inventions they reject. It seems entirely possible to us, therefore, that among the 85,000 rejected inventions of 1945-1963 there would be a few thousand whose potential contributions remain unexploited. Even if there is a loss or slippage here, we doubt however if it is at all large.

In view of the sizes of postwar federally financed R & D programs and of the volumes of private patent applications, our estimate of 154,000 inventions is that of a comparatively small number. But such data are a far better measure of inventive activity than statistics on patent applications and issues.

The disposition of patent rights between the federal government and its R & D contractors continues to be a

subject of controversy. Where the government confines itself to taking licenses to patents, that is, where contractors retain ownership, about 40 per cent of all the inventions are filed on by contractors. Upon receiving the other 60 per cent of the inventions, the government files on about a quarter of them. In contrast, where the government takes title to all contractors' inventions, relatively fewer are written into patent applications. As quantitative generalities, these facts were not hitherto known. We think they should be given weight in any future changes in policy on the patent rights in contracts for research and development.

Reprints of this article will be sent to NASA.

Suspended Study: "Concentration of Patents Owned by Domestic Corporations"

Patents and patent accumulation can be barriers to new competition. Many of our data on the numbers of patents assigned to U. S. corporations are a byproduct of data gathered for the study on the concentration of patents from federally-financed research in industry. Our information on the numbers of patents assigned to U. S. corporations spans four decades. It includes all U. S. corporations assigned 200 or more patents during three

17-year periods -- 1921 to 1938, 1939 to 1955, and 1946 to 1962.

We measure concentration by the Pareto slope coefficient and also by conventional concentration ratios. The data show that there has been a glacial drift, rather than an increase, in patent concentration during the past 40 years. The numbers of patents assigned to the largest patent holders have increased, but not the patent concentration ratios. We find that the patents of the largest patent holders are less concentrated than the assets of these companies. Patents are also much less concentrated than funds to total research and development performance in industry.