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Background Papers for a Colloquium

National Academy of Engineering

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FOREWORD

A Colloquium on Industrial Innovation and Public Policy Options was held December 5-6, 1979. Sponsored by the National Academy of Engineering, the Colloquium reviewed a number of major government and private studies of government policy and industrial innovation in an attempt to assist public policy-makers identify and understand the recommendations on which there was agreement as well as lack of agreement. The report summarizing the Colloquium has been issued separately. This publication consists of individually signed analytical background papers for a series of panel discussions around which the Colloquium was structured.

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INDUSTRIAL INNOVATION AND PUBLIC POLICY OPTIONS

I. BACKGROUND

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ANALYSIS

The purpose of this paper is to provide the following:

- A brief introduction to the studies which were examined and compared by the NAE Colliquium on Industrial Innovation and Public Policy Options;
- A review of the background data and other considerations presented by the reports as the general evidence that gave rise to the studies;
- A comparative analysis of the supporting rationale and policy orientations that, either explicity or implicity, guided the report recommendations; and
- A suggestion of policy issues discussed by the Background Panel.

Studies Examined

The studies examined by the NAE Colloquium did not include all the reports that have been conducted on the subject of industrial innovation. The studies covered were selected because, in each case, they represent the output of a collection of experts who have formally examined current data and produced a consensus report with recommendations from a rather diverse set of experiences. Appendix A provides a list of the reports with publication information and the title abbreviations used in this text. A brief discussion of each of these reports is provided below.

Domestic Policy Review (DPR), and The President's Industrial Innovation Initatives

In May 1978, President Carter announced that he had established an interagency committee to conduct a comprehensive review of the issues and problems related to industrial innovation. The study was to develop, for the President, a set of policy options to address the issues and problems bearing on industrial innovation under the procedures of the Domestic Policy Review System.

The President's announcement stated that, "Federal economic, tax, regulatory, procurement, and foreign policies--as well as direct Federal support programs--have a profound impact upon the innovation process. Given the central role of innovation in economic development and the expressed concerns for the innovation process, Federal policy affecting industrial R&D and innovation must be carefully reconsidered."

The Secretary of Commerce was assigned to chair the interagency committee. The other members included the Secretaries of Defense, Treasury, HEW, and Energy; the Attorney General; the Administrators of EPA and NASA; the Directors of NSF and OMB; the Chairmen of the Domestic Council and Council of Economic Advisors; the Assistant to the President for National Security Affairs; the Special Representative for Trade Negotiations; and the Science and Technology Advisor to the President. The DPR was managed by Dr. Jordan Baruch, Assistant Secretary of Commerce for Science and Technology.

Based on extensive interactions with advisors, both in and outside of government, the Office of Science and Technology Policy identified the major areas of national policy that were considered to have important impact on industrial innovation. On this basis, industry advisory committees and interagency task forces were organized along the following lines:

- Economic and Trade Policy;
- Environmental, Health, and Safety Regulation;
- Regulation of Industry Structure and Competition;
- Patent Policy;
- Information Policy;
- Direct Federal Support of Research and Development; and
- Federal Procurement Policy.

Although reports of the interagency task forces were not made public, those of the Advisory Committee for each policy area were published. Because the Advisory Committee reports include conclusions and recommendations from a broad segment of industrial and other private sector authorities, they are included among the reports analyzed for this colloquium.

Based on the policy options developed through the DPR process, the President sent a message to Congress on October 31, 1979 containing his initiatives to help ensure the nation's "continued role as the world leader in industrial innovations." These initiatives are also included in the analyses and presentations of the panels.

Committee for Economic Development (CED)

The Committee for Economic Development (CED) is a nonprofit organization of 200 corporate executives and university presidents. In early 1978, CED established a subcommittee of 25 corporate executives, mostly chief executive officers, and 5 university presidents, to examine the state of technological progress in the U.S. economy and related public policy issues. The CED will shortly publish a national policy statement containing its proposals. The CED statement addresses areas of policy much the same as the DPR: tax policy, regulatory policy, patent policy, international technology transfer, and federal direct support of Research and Development (R&D).

National Research Council/National Academy of Engineering

In 1978 and 1979, the National Research Council published a series of monographs based on studies conducted by the Committee on Technology and International Economic and Trade Issues of its Assembly of Engineering and the Office of the Foreign Secretary, National Academy of Engineering. The titles of the reports are:

- Technology, Trade, and the U.S. Economy;
- The Impact of Tax and Financial Regulatory Policy on Industrial Innovation;
- Antitrust, Uncertainty, and Technological Innovation; and
- The Impact of Regulation on Industrial Innovation.

The Committee is comprised of recognized authorities from both industry and academia and has included active participation by federal agency representatives. General background information attributed to NRC/NAE in subsequent sections of this paper can be found in the NRC/NAE report, Technology, Trade, and the U.S. Economy.

Commerce Technical Advisory Board (CTAB)

In 1978, the Commerce Technical Advisory Board (CTAB) created a Committee of 13 representatives of industry and academia under the chairmanship of William Norris, Chairman and Chief Executive Officer of Control Data Corporation. The Committee produced 12 specific recommendations aimed at helping small enterprises regain their economic vitality and at fostering the application of advanced technology by small farmers and food processors.

The Role of Technological Progress

All the major studies have agreed that technological innovation is a major contributor to the economic well-being of the nation.

- The President, in his announcement of the Domestic Policy Review (DPR), stated that "Innovation provides a basis for the Nation's economic growth. It is closely related to productivity and to the competitiveness of U.S. products in domestic and world markets."
- The Industry Advisory Committee of the DPR notes that the economic literature points unanimously to the conclusion that there is a significant, positive relationship between the amount of innovative activity in an economy and the ecomomic growth and productivity.
- The Labor Advisory Committee for the DPR stated: "Industrial innovation is essential to economic growth, rising productivity. and higher living standards."
- The Committee for Economic Development (CED) cites the work of Edward Denison and others as showing that one-third to one-half of the growth of real per capita income is attributable to technology change.
- The NRC/NAE summarizes neoclassical economic thinking by stating:

> ". . . the effect (of technological innovation) is to enable the production of goods to be accomplished with less total input of resources, that is, to enable the goods to be produced more efficiently. More efficient production of goods, in a competitive economy, results in a lower price of these goods. The lower price, in turn, leads to expanded demand and expanded output of the goods and thus to economic growth."

The NRC/NAE points out that, although increased efficiency is ordinarily the only economic impact of technology that is incorporated in economic analyses, product innovation also is extremely important and interrelated. In addition to their potential application in increasing production efficiency, new and improved products impact the level of economic welfare in other ways, such as through increased demand and investment levels and increased international competitiveness of industry.

Sources of Technological Progress and the Design of Stimulative National Policies

Most of the studies acknowledge the leading role of organized research and development in providing "new knowledge" inputs to innovation.

The NRC/NAE reviews the literature addressing the issue of whether innovation is driven more by the availability of new technology or by the pull of market demand. Strategies followed by the recommendations resulting from most of the studies appear to accept the conclusion of Jacob Schmookler that the demand for new technology is a prime determinant of the rate of its introduction, but that innovation

depends on a successful coupling of market demand to the existing level of knowledge.

The DPR Industry and Labor Advisory Committees point up an issue in designing policy initiatives to stimulate industrial innovation. The Labor Committee states that "economic growth and full employment are prerequisites to industrial innovation," but agrees with the industry group in asserting that industrial innovation is essential to economic growth and increasing productivity. Thus, faced as we are with a need to stimulate economic growth while controlling inflation, the question is whether it is feasible to contribute to such growth through the encouragement of industrial innovation or whether it is necessary to stimulate the economy first through other means. Most of the studies appear to have concluded that it is possible to adjust economic and fiscal policies to favor an improved rate of innovation and, thereby, to contribute to revitalization of the economy.

The view that controlling inflation is crucial seems to run throughout. The DPR Industry Advisory Committee, CED, NRC/NAE, and CTAB conclude, at least implicitly, that increased capital formation is a critical connecting link between industrial innovation and economic growth with controlled inflation. The Labor Advisory group, however favors the approach of increasing consumer buying power through "expansionary economic policies--fiscal, monetary, employment, and training policies--aimed at achieving full employment." Except for certain steps aimed at increasing the availability of captial for innovation by new or small businesses, the President's statement is silent on the issue.

A key issue which cuts across the development of recommendations in most policy areas affecting industrial innovation is to what extent government should tailor its policies to favor specific technologies, industrial sectors, and types of firms as opposed to simply creating the best possible environment for innovation through the avoidance of unnecessary disincentives and barriers to innovation.

On the one hand, it may be argued that the preferable approach is to provide support to selected technologies or parts of the economy that promise to lead to the achievement of national social and economic goals most effectively and efficiently. The Labor and Public Interest panels oppose tax incentives directed generally to industry, and the Public Interest group was firm in its assertion that support for innovation be directed only at those areas where the outcome could be clearly identified by the government as in the public interest.

On the other hand, the CED and the NAS/NAE reports appear to reflect adherence to the concept that the private sector should be relied on for general industrial and economic development. Their recommendations are limited to more general incentives and initiatives which are "non-discriminating," relying on the inherent efficiencies of the market system for the allocation of resources.

To provide some indication of the state of knowledge on which to guide government policies in support of industrial innovation, the NAE reviews the literature regarding the effects of firm size and government funding of R&D upon technological innovation. With regard to firm size, the NAE report concludes, "It is in fact very difficult

to generalize on whether large or small firms are the most innovative." Likewise, the report reaches no conclusions on the relative success of government-funded R&D in fostering economic growth.

Status of U.S. Industrial Innovation

In evaluating the need for policy changes, the studies have reviewed current data and trends in the inputs to innovation (such as R&D and capital spending) and in the outputs from innovation (such as productivity growth and changes in international market shares).

The White House memorandum establishing the DPR made the following observations which, it stated, underscored the need for increased federal concern for the industrial innovation process:

- Indications that industry underinvests in innovation in terms of the ultimate benefits to the firm and to society.
- Increased private-sector R&D emphasis in recent years on low-risk, short-term projects directed at incremental product changes, and decreased emphasis on the longer-term research that could lead to new products and processes.
- Declining international competitiveness of some segments of U.S. industry as reflected in: a growth rate for productivity in manufacturing industries that is lagging behind that of some nations; the increasing penetration of domestic markets by producers of intermediate technology and basic industrial goods; and a level of production technology in certain important industries (for example, coal mining and steel production) that lag behind that in other countries.
- Difficulties that small, high-technology firms encounter in obtaining venture capital.
- The changed direction of industrial innovation in recent time resulting from the diversion of corporate effort from developing new products to meeting other social goals.

The following background data are excerpted from the CED report:

> The ability of the U.S. economy to increase productivity has been less than that of America's major industrial competitors (Figure I-1). . . . competitors have improved their output more rapidly by making greater strides in productivity improvement, especially in the manufacturing sector (Table I-1).
>
> This relative weakening of the competitive position of U.S. manufacturing is reflected in a declining U.S. share of total manufactured goods in world trade. For example, in 1971, the United States accounted for about 21 percent of the total manufactured goods exported by

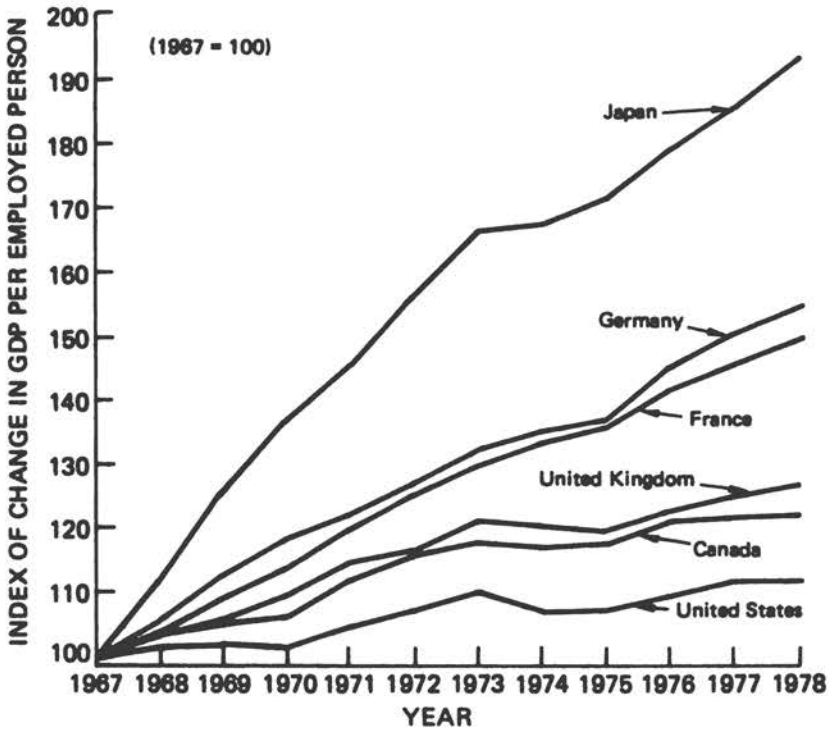

FIGURE I-1 Change in GDP per Employed Person, Selected Countries, 1967 to 1978.

TABLE I-1 Capital Investment and Output per Hour, Selected Countries*

	Capital Investment as Percentage of Output†				Percentage Annual Growth in Output per Hour‡	
	Total Economy		Manufacturing		Manufacturing	
	1960-1969	1970-1977	1960-1969	1970-1977	1960-1970	1970-1978
United States	14.9	14.5	8.8	9.6	2.9	2.7
Canada	20.0	19.3	14.4	15.1	4.3	3.6
Japan	28.8	26.7	29.9	26.5[a]	10.8	5.0
France	19.5	18.8	NA	NA	5.8	5.1
Germany	20.1	18.7	16.3	15.2[b]	5.5	5.3
United Kingdom	16.5	17.6	13.4	13.6	3.5	2.1

*Capital investment excludes residential construction.

†For comparative purposes output is measured at current factor cost.

‡All employed persons for U.S. and Canada; all employees for other countries.

[a]1970-1974.

[b]1970-1976.

NA = Not available.

SOURCE: U.S. Department of Labor, Bureau of Labor Statistics.

the world's fourteen major industrial countries. That share declined to a little over 20 percent in 1975 and dropped dramatically to about 16 percent at the beginning of 1978.

Over the past twelve years, U.S. expenditures for research and development have declined as a share of GNP. The data (Table I-2) show the extent of the decline in the proportion of R&D expenditures in the United States and the trends in several other industrial countries.

Priorities for Action

The reports are not, in general, structured in such a way as to provide an explicit statement of priorities. In those that do include an overall discussion of policies affecting innovation, however, there is a general consensus in the direction of emphasis on improved economic policy, in particular, fiscal policy. As stated earlier, the DPR Industry Advisory Committee as well as the Labor group appeared to place very high priority on policies that would improve stability and promote rational growth of the economy. This would also appear to be true of the NRC/NAE reports and is clearly the intent of the CED.

The problems of regulatory uncertainty and tax disincentives in the investment environment are cited most often by the private-sector groups as the critical barriers to innovation; high priorities are indicated for improvement in both these areas.

While there are many recommendations for policies that would stimulate the level of private investment in R&D, the reports do not appear to place as high a priority on R&D as on plant and equipment. This is, perhaps, due to the relatively high absolute level of R&D expenditures by the United States in comparison with its international competitors and the fact that the real level of investment has been growing since 1975. It is, perhaps, also attributable to the importance of capacity expansion, diffusion of existing advanced technology, and productivity enhancement to the control of inflation.

The problem of lagging capital formation appears to be paramount in the eyes of most of the private sector reports involving economic policy. The CED rationale for placing its highest priority on steps to stimulate capital spending includes the following observations:

- Current circumstances indicate that overreliance on stimulation of final demand could exacerbate inflation since the time lag between demand expansion and introduction of new capacity appears to have lengthened. Real GNP is 15 percent above the previous peak, while fixed investment is only 5 percent higher, and capacity expansion has decreased from 5 percent growth in 1960, to 4 percent in the early 1970s, to 3 percent presently.

- Industry spending on physical capital and R&D appears to respond to the same economic forces, i.e., availability of internal funds (cash flow) and potential profitability.

TABLE I-2 R&D Expenditures as a Percentage of GNP, Selected Countries, 1961-1977

	United States		France		Germany		Japan		United Kingdom	
Year	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)
1961	2.74	1.34	1.38	0.98	NA	NA	1.39	1.37	2.39	1.48
1967	2.91	1.87	2.13	1.59	1.97	1.81	1.53	1.52	2.33	1.68
1972	2.43	1.66	1.81	1.55	2.33	2.18	1.85	1.84	2.06	1.53
1975	2.30	1.62	1.82	1.39	2.39	2.23	1.94	1.93	2.05	1.52
1976	2.27	1.57	1.74	1.47	2.28	2.15	NA	NA	NA	NA
1977	2.25	1.59	NA	NA	NA	NA	NA	NA	NA	NA

NA = Not available.
(1) = Total R&D expenditures.
(2) = Total R&D expenditures (excluding national defense).
SOURCE: U.S. Department of Labor, Bureau of Labor Statistics, based on data from the National Science Foundation, April 1979.

- Capital formation is itself an essential element of the innovation process in most instances and almost always results in the diffusion of advanced technology. It constitutes a long run, structural attack on inflation by improving productivity and bringing capacity growth more in line with demand growth.

- Spending on plant and equipment would create increased demand for new technologies and expanded private R&D investment, as well as increased employment and economic growth.

Below are brief descriptions of certain new studies of general interest recently begun by the National Research Council and the Institute of Medicine (IOM).

Mandatory Retirement Age for Airline Pilots

The Federal Aviation Administration requires that all airline pilots be grounded at age 60. Recently, Congress has questioned the validity of this requirement and directed the National Institutes of Health to determine if it is medically warranted. Operating on a contract with the National Institute on Aging, an IOM committee will attempt to determine if any age limit is medically called for, whether the medical examinations periodically required adequately determine a pilot's physical condition, and the effects of aging on a pilot's abilities. A report is expected early in 1981.

Nitrites in Food and Alternative Curing Agents

Recently, the U.S. Food and Drug Administration (FDA) decided to delay its proposed ban on nitrites used to preserve meats, stating that more definitive evidence was needed on the nitrite-cancer link. At the request of the FDA and the U.S. Department of Agriculture, a Research Council committee will review what is known about the health risks and benefits of nitrites in food and advise the federal agencies on how to investigate the problem, issuing a report in 1981. A second report will follow, assessing federal research efforts on alternative curing agents and recommending research directions.

Diet, Nutrition, and Cancer

Research in the last few decades has led to a multitude of confusing assertions concerning cancer-causing agents in the American diet. The National Cancer Institute has asked the Research Council to examine what role, if any, dietary patterns and various nutrients, food additives, and food contaminants have in causing or preventing cancer. An interim report evaluating present knowledge is expected in two years, with the final report on research objectives planned for a year later.

U.S.-Canada Scientific Committee on Acid Rain

When sulfur and nitrogen oxides from factories and automobiles mix with the moisture in the atmosphere, they form acids that can be transported thousands of miles to places that have no factories and little auto pollution. The so-called acid rain that results falls without respect for international boundaries, affecting plants, fish, and even buildings. Consequently, the National Research Council and the Royal Academy of Canada have established a joint study committee to review the adequacy of research and to assess monitoring programs that measure concentrations of acid rain and its biological consequences.

International Security and Arms Control

Concerned with the increasing likelihood of nuclear war and the recent organization of the Soviet Research Council on Peace and Disarmament, the Research Council's Commission on International Relations has established a Committee on International Security and Arms Control. The committee will undertake a variety of projects to reduce the threat of nuclear war, to limit the use of materials and personnel for weapons production, and to seek ways to limit further development of sophisticated weapons worldwide. Among the committee's specific goals are the establishment of an internship program to place career-level natural scientists and engineers with the various government agencies concerned with nuclear materials and the initiation of discussions with other international bodies that share the same concerns for human safety and survival.

SUMMARY OF PANEL DISCUSSION

The panel Chairman, Dr. Bueche, reviewed the background for the Colloquium and posed the following points for discussion by the panel members:

- Do you agree that increased industrial innovation could help improve the rate of productivity growth and the performance of the manufacturing sector in competition for world export markets?
- If so, what areas of national policy offer the highest potential payoff for improvement?
- Should we move in the direction, as the Japanese have, of more centralized guidance of technological innovation and industrial and economic development, i.e., should the government take the lead in determining which technologies and which industrial sectors and types of firms should be favored, and then set policies consistent with those decisions?

Agreement on Dr. Bueche's general observations was indicated, and improvement in broad incentives for investment was given high priority by panelists Eads, Hahn, Hannay, and McKelvain. Direct federal support for technology development was not given a high priority by any of the Panelists.

Averch, Eads, Hahn, and Holmfeld stated that the existing data base is inadequate to know exactly what policy changes will work and how.

Roberts and Averch said that there are disagreements about the values that guide the establishment of government policies affecting technological change. Hannay and McKelvain advocated that the role of government is to provide a generally encouraging environment, reducing disincentives and uncertainty rather than intervening in commercial markets through establishment of targeted incentives and stimulants.

From the audience, Guy Black, of The George Washington University, recommended a case study in the area of energy to assess the impact of price, government R&D, and consumer interest on the rate of technological innovation. Vince Rogavane, an independent consultant, suggested that more concentration on removing disincentives for the individual be worked into the social structure.

II. ECONOMICS AND TAX

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ANALYSIS

The U.S. economy has recently been plagued by sluggish economic growth and unacceptably high rates of inflation. Declining productivity growth has been identified as a significant cause of such poor economic performance. Because the level and quality of industrial innovation is an important determinant of productivity growth, public policies toward innovation have received substantial attention.

Several government and private groups have sponsored studies to identify public policies that appear to discourage innovation, as well as policies that may stimulate innovation. This paper summarizes, compares, and contrasts the major findings of four such studies. The studies summarized are (1) the draft report of the Industry Advisory Subcommittee on Economic and Trade Policy convened by the Secretary of Commerce as part of the Domestic Policy Review (DPR Industry Report); (2) a report, Recommendation for Creating Jobs Through the Success of Small, Innovative Business, prepared for the Commerce Technical Advisory Board (CTAB Report); (3) a monograph, The Impact of Tax and Financial Regulatory Policies on Industrial Innovation, prepared under the auspices of the Committee on Technology and International Economic and Trade Issues, Assembly of Engineering, National Research Council and the Office of the Foreign Secretary, National Academy of Engineering (NRC/NAE report); and (4) a report, Stimulating Technological Progress, prepared by the Committee for Economic Development (CED Report). The policy recommendations of these reports are presented both in tabular form and in the text. Two other statements about innovation policy are mentioned, though not discussed in detail, in the text and tables. These are (1) the report of the Labor Advisory Subcommittee of the Advisory Subcommittee on Industrial Innovation (DPR Labor Report) and (2) the President's statement of October 31, 1979, on federal policies toward innovation. These statements are included because they either reject altogether or defer consideration of policy recommendations made in the other reports.

Overview of Reports and Recommendations

Before discussing specific recommendations, it is useful to describe each report briefly and summarize the major recommendations. With the exception of the NAE monograph, the reports summarized discuss a wide range of policy issues.[1] This review, however, deals with the specific themes of tax policy and government regulation of financial markets.

DPR Industry Report

This document presents recommendations made by the Industry Advisory Subcommittee on Economic and Trade Policy of the Advisory Committee on Industrial Innovation established as a part of the Domestic Policy Review conducted during 1978 and 1979. Twelve tax policy recommendations are presented addressing the issues of general tax incentives for saving and investment; calculating the revenue impact of tax proposals; tax treatment of research and development; taxation of multinational firms; taxation of small, innovative firms; and tax treatment of patents. In addition, four recommendations are made pertaining to government regulation of financial markets. Of these recommendations, the Industry Subcommittee believes that improved general tax incentives for savings by individuals and investment by established corporations are of the greatest potential significance for innovation.

CTAB Report

This report is based on the premise that small businesses create a disproportionate share of new jobs. Accordingly, the CTAB report emphasizes government policies toward small business. Five tax policy recommendations are offered dealing with taxation of capital gains, corporate taxation of small firms, taxation of stock option plans, and tax treatment of costs incurred by small firms in complying with government regulations. Three recommendations are made concerning changes in government spending policies; one recommendation is made pertaining to regulation of capital markets. Among these recommendations, the highest priority is given to tax and financial regulatory policies that increase the availability of capital and management expertise in small businesses.

CED Report

This report, prepared under private auspices, argues that accelerating the pace of U.S. technological innovation requires improvments in four areas of public policy. These areas are tax policy, government regulation, government patent policies, and government support of R&D. Of these, changes in tax policy are viewed

as the most important, in particular, changes that would improve existing incentives for capital spending by industry.

NRC/NAE Monograph

This study was sponsored by the Committee on Technology and International Economic and Trade Issues of the Assembly of Engineering, National Research Council and the Office of the Foreign Secretary, National Academy of Engineering. Unlike the other reports summarized, it focuses exclusively on the relationship between innovation and tax financial regulatory policies. Numerous changes in tax and financial regulatory policies that would favor increased innovation are identified. These changes are quite similar to those discussed in the DPR Industry, CTAB, and CED reports. A basic theme of the NRC/NAE report is that stimulating industrial innovation cannot be separated from the objective of stimulating capital formation. Consequently, the NRC/NAE report assigns the highest priority to general macroeconomic policies that make the investment environment more stable and to policies that improve existing general tax incentives for investment by corporations.

Comparing the DPR Industry, CTAB, CED, and NRC/NAE Reports

Comparison of these four studies reveals a broad consensus about the appropriate focus of tax and financial regulatory policies toward innovation, i.e., such policies should encourage general capital spending, research and development, and the formation of small innovation-oriented firms. The reports disagree, however, about the relative importance of these items, as well as in the ranking of some specific policy measures. These differences reflect divergent views about the importance of R&D in the innovation process, the contribution to innovation made by small firms, and the relative merits of general as opposed to "innovation-specific" tax incentives.

It should be noted that the recommendations of these studies diverge significantly from those in both the report of the Labor Advisory Subcommittee of the Advisory Subcommittee on Industrial Innovation and President Carter's statement on federal innovation policy of October 31, 1979. The DPR Labor report explicitly rejects the use of tax incentives to industry, favoring instead reliance on broad monetary and fiscal policies to stimulate innovation. The President's statement defers consideration of any tax incentives until fiscal year 1981.

Tax and Financial Policies and Innovation

The following sections discuss in detail the major similarities and differences among the DPR Industry, CTAB, CED, and NRC/NAE reports. The themes of tax policy and government regulation of financial markets

are emphasized. Specifically, we compare and evaluate the conclusions of these four analyses pertaining to (1) corporate income tax policy, (2) personal income tax policy, and (3) government regulation of securities markets and pension funds.

Corporate Income Tax Policy

The corporate income tax affects business investment decisions through its impact on after-tax returns and liquidity. Since innovation is a form of investment, corporate tax policy can influence the amount and/or type of industrial innovation. Aspects of corporate tax policy mentioned in the four studies are (1) tax incentives for capital spending, (2) tax treatment of research and development (R&D) expenditures, (3) tax treatment of U.S. multinationals, and (4) tax treatment of small firms. Changes in corporate tax policy discussed in the policy studies are summarized in Table II-1.

Tax Incentives for Capital Spending: Tax incentives for capital spending affect innovation in several ways. Jacob Schmookler (1966) has shown that increases (or decreases) in capital goods innovations were typically preceded by increases (or decreases) in capital spending; consequently, government policies that either encourage or discourage capital spending are likely to encourage or discourage innovations in capital goods industries. Moreover, studies by Mueller (1976) and Grabowski (1968) have found that R&D expenditures are affected by corporate liquidity, which is partly determined by tax incentives available to a firm. Finally, since much innovation is embodied in new capital equipment, measures that stimulate new investment speed the rate at which the benefits of innovation spread throughout the economy.

During the 1960s and early 1970s, tax incentives for capital spending were provided through reductions in the corporate tax rate, accelerated depreciation, and investment tax credits. Empirical studies of investment tax incentives have generally found that such measures stimulate corporate investment spending; however, estimates differ as to the size of the stimulus. Some studies have concluded that tax incentives provide only modest stimulus to corporate investment spending, while others have found the investment stimulus provided by such measures to be quite substantial.[2]

The value of these tax incentives has been reduced by inflation. This is particularly so in the case of depreciation allowances, which are based on historical rather than replacement costs. Computing depreciation on the basis of historical rather than replacement costs understates true capital costs during periods of inflation. Recent calculations by Gramlich (1976) suggest that current procedures have substantially reduced the real value of depreciation deductions.[3]

Changes in corporate tax policy enacted in the Revenue Act of 1978 provide some stimulus to capital spending. Most notable among these are (1) a reduction in the statutory corporate income tax rate from 48 to 46 percent, (2) permanent enactment of the existing 10 percent

TABLE II-1 Recommended Changes in the Corporate Income Tax

Policy Measures	DPR Industry Report	DPR Labor Report[a]	President's Statement of 10/31/79[b]	CED Report	CTAB Report	NRC/NAE Monograph
General corporate tax policy						
Reduce the corporate tax rate				R		M
Provide tax incentives to capital spending	R			R		R
(1) Index depreciation allowances for replacement cost				M		R
(2) Shorten depreciable asset lives	R			R		M
(3) Increase tax credit for new investment						
Provide tax incentives for R&D	R			R		R
(1) Expand current expensing provisions to plant and equipment used in R&D	R			R		M
(2) Give plant and equipment used in R&D additional tax credits	R			R		M
(3) Reduce the depreciable life of patents to a maximum of 10 years	R			R		M
(4) Give corporations a tax credit for contributions to university research	R			R		
(5) Give tax credits to research-related expenditures that currently do not qualify for tax credits	R					M
Taxation of U.S. Multinationals						
(1) Repeal Regulation 861 if warranted by research findings						R
(2) Limit the applicability of Regulation 861				R		
(3) Repeal Regulation 861	R					
Corporate taxation of small firms						
Structure corporate tax policy to encourage formation and profitability of small, innovative firms	R			R	R	R
Increase the deductibility of losses incurred by small firms	R			R	R	R
(1) Expand coverage of Subchapter S for all small firms				R		
(2) Expand coverage of Subchapter S for R&D intensive small firms	R					
(3) Increase carry-forward period for losses incurred by small firms from 5 to 10 yr					R	

R = explicitly recommended as a policy initiative.
M = discussed as a policy alternative, but not recommended.
[a]This report rejects tax incentives as a means of stimulating innovation.
[b]This statement defers consideration of tax incentives for innovation until Fiscal Year 1981.

investment tax credit, (3) a broadening of the tax credit to permit corporations to use the credit to offset 90 percent of their other taxes instead of 50 percent, and (4) allowing corporations a full write-off for expenditures on pollution control equipment. These changes, however, do not adequately deal with distortions introduced into the income tax base by inflation.[4]

In view of these considerations, it is not surprising that the DPR report, NRC/NAE monograph, and CED report all recommend that serious consideration be given to improving existing tax incentives for capital spending. Indeed, all three reports conclude that such tax incentives are the most promising way of stimulating innovation. The CTAB report does not specifically endorse broad tax incentives for capital spending. This is largely attributable to that report's emphasis on the role of the small unestablished business in innovation. The CTAB report does, however, endorse measures that would reduce the effective corporate tax on small firms and that would ensure that new firms, in their early years, are able to make full use of investment tax incentives provided to established corporations.

There are several alternative ways of stimulating capital spending through changes in corporate tax policy. These include (1) reducing corporate income tax rates, (2) permitting depreciation allowances to be indexed for rising replacement costs, (3) permitting faster write-offs for depreciation, and (4) increasing the current tax credit for new investment.

The NRC/NAE monograph, DPR Industry report, and the CED report assign a relatively low priority to further reductions in the corporate income tax rate. This position is consistent with the view that general rate reductions are the least effective means, per dollar of foregone tax revenue, of stimulating capital spending. This is so because the tax savings provided by rate reductions do not depend on the investment activities of the firm.

Both the DPR Industry and the CED reports explicitly favor more rapid capital recovery through depreciation. The CED report recommends that this be done by shortening the useful lives over which investments may be depreciated. The basis for this recommendation is that such a change would be easily understood and implemented by firms.

Neither the NRC/NAE monograph nor the CED report specifically endorses increasing the existing tax credit for new investment. The DPR Industry report mentions enhancing the investment tax credit, but assigns this lower priority than improving capital recovery through depreciation. This is significant because the investment tax credit is viewed by many tax scholars as an extremely effective way of encouraging new investment.[5] The position of the reports is, however, consistent with their general emphasis on offsetting the erosion of existing investment tax incentives by inflation. This is so because the value of the tax credit increases automatically with the cost of new investment purchases; thus, unlike depreciation allowances, the real value of the investment credit has not been eroded by inflation.[6]

If additional tax incentives for capital spending are to be provided, one must consider how such measures are to be financed. Tax

policies that stimulate innovation entail, at least initially, some revenue loss to the U.S. Treasury. The final impact of tax incentives for innovation on the economy, generally, and on firms, specifically, depends on (1) the size of the revenue loss and (2) the manner in which the revenue loss is financed. As emphasized in the CED and DPR Industry reports, there is considerable disagreement about how to estimate the "true" revenue losses from tax cuts. Furthermore, there are many alternative ways by which revenue losses, however estimated, can be offset. These issues must be confronted when specific tax incentives are considered for legislative approval.

Tax Incentives for Research and Development: Research and development (R&D) is an integral part of the innovation process; therefore, policies that lower the net cost of R&D are likely to encourage innovation. Currently, Section 174 of the U.S. Internal Revenue Code permits firms to fully deduct some R&D expenditures in the year they are incurred, even though R&D may produce an intangible asset with a useful life of more than one year.

Expenditures that qualify for immediate expensing include all costs incurred in connection with the taxpayer's trade or business that represent R&D in the experimental or laboratory sense. There are, however, some relevant costs of R&D that may not be expensed. While the costs of obtaining one's own patent or developing one's own model or process can be expensed, the costs of acquiring someone else's patent, model, or process may not. Instead, these items are treated like other capital expenditures, to be amortized over their useful lives. In addition, structures and equipment used in R&D activities may not be immediately expensed. The costs of such R&D depreciable assets are recovered through general depreciation allowances for investments.

Because Section 174 is equivalent to granting instantaneous depreciation to some portion of R&D, it is viewed as a tax incentive for investments in R&D. A potential way of encouraging innovation would be to expand this tax incentive. One way of achieving this objective would be to broaden the coverage of Section 174 to include expenses for plant and equipment used in R&D, as well as expenses incurred to purchase patents on processes. Another approach would be to enact new, specific tax credits for R&D.

The DPR Industry report, the NRC/NAE monograph, and the CED report all recommend that consideration be given to increasing tax incentives for R&D; however, the reports differ somewhat in the strength of their support for such measures.

The NRC/NAE monograph is the least enthusiastic of the three analyses about tax incentives for R&D as a means of stimulating industrial innovation. The reason given for this view is that innovation is a complex process in which R&D is but one part. Not only must a technically viable concept for a new or improved product be developed, it must also be rendered commercially viable. The NRC/NAE monograph acknowledges that the tax incentives for R&D may have a substantial impact in industries where R&D costs are a significant portion of the total costs of innovation; however, in many industries,

R&D expenditures are a modest share of the costs of innovation--perhaps 10 to 20 percent. In such cases, tax incentives for R&D would have a modest impact on innovation. In addition, the monograph also notes that if lagging innovation is due to pessimistic expectations about profits, the prospect of receiving tax savings through tax incentives for R&D may not offer much encouragement for innovations.

Consistent with these views, providing additional tax incentives for R&D is assigned a lower priority in the NRC/NAE monograph than other measures, such as changes in personal income taxation and in government regulation of financial markets (see discussion below). Moreover, no specific tax incentive is endorsed in the NRC/NAE analysis.

The CED report qualifies its support of R&D tax incentives by noting that such selective incentives are most likely to encourage innovation if they are introduced along with, rather than separately from, general tax incentives for capital spending. The CED report, however, regards R&D tax incentives as sufficiently promising to devote considerable discussion to such measures. Specifically, the CED report recommends that (1) Section 174 be broadened to permit immediate expensing of plant and equipment used in R&D, (2) plant and equipment used in R&D be given a double tax credit, (3) the useful life governing depreciation of patents be shortened to a maximum of 10 years, and (4) corporations be given a tax credit for contributions to university research.

Of the twelve tax policy recommendations presented in the DPR, four pertain to R&D tax incentives. The specific measures proposed are basically quite similar to those discussed in the CED report, though there are some differences. Like the CED report, the DPR Industry report recommends extending Section 174 to plant and equipment, providing a larger tax credit for plant and equipment used in R&D, permitting patents to be depreciated more rapidly, and providing tax credits for contributions to university research. Unlike the CED report, the DPR Industry report does not stipulate the amount by which tax credits should increase the R&D-related investments. Furthermore, the DPR Industry report recommends that tax credits be provided for those R&D-related expenditures that are not currently eligible for the investment tax credit. This is a measure not mentioned in the CED report.

Several issues must be resolved if any, or all, of these tax incentives are to be implemented. A major issue is whether the specific measures mentioned should be viewed as competing alternatives or as elements of an overall package of specific tax incentives. Both the CED and DPR Industry reports suggest that as many of such measures as are feasible should be implemented; however, constraints imposed by the political process may preclude the adoption of more than one or two of these tax incentives. The order in which the measures are discussed in both the CED and DPR Industry reports may reflect the relative importance of the recommendations. If so, both the CED and DPR Industry reports agree in assigning first priority to extending the coverage of Section 174 to plant and equipment used in R&D.

If additional tax credits are extended to R&D, further attention must also be given to the form of the tax credit. Specific issues

include the size of the tax credit, defining eligibility for the tax credit, and whether or not tax credits should be limited to R&D expenditures that exceed some "base-line" effort by the firm. The latter two issues are particularly relevant to the objective of not subsidizing activities that either (1) are innovative, but which would have been funded in the absence of tax incentives or (2) are more or less conventional investment activities that have simply been redefined on paper as "innovative" in order to quality for tax incentives.[7]

Taxation of U.S. Multinationals: A new Treasury regulation (1.861-8) requires multinationals to allocate some of their domestic R&D expenditures against foreign source income. This reduces foreign source income for U.S. tax purposes. However, unless foreign governments allow tax deductions for R&D expenditures incurred in the U.S., this procedure would not reduce taxable income for foreign tax purposes. Since the foreign tax credit is based on the Treasury's definition of foreign source income, this guideline reduces the credit that multinationals may take against U.S. taxes without reducing their actual foreign tax liability. Because of this it is argued that multinationals have a tax incentive to move their R&D activities overseas.

Regulation 861 is discussed in the NRC/NAE monograph and in both the DPR Industry and CED reports. The NRC/NAE monograph recommends that further research be conducted to assess the amount of tax revenue raised by this provision and to determine whether Regulation 861 has seriously discouraged innovation. If such research determines that small additional revenues are obtained at the expense of significant reductions in innovation by U.S. multinationals, the NRC/NAE monograph recommends the repeal of Regulation 861. In contrast to the NRC/NAE report, both the DPR Industry and CED reports advocate either repeal or revision of Regulation 861. Repeal of this provision is recommended in the DPR Industry report, whereas the CED report recommends the regulation be limited to the portion of a U.S. multinational's R&D expenses directly related and traceable to foreign earnings. However, revision of Regulation 861 is ranked behind general tax incentives for capital spending, and specific tax incentives for R&D, in all three analyses.

Corporate Tax Treatment of Small Firms: Certain small enterprises seem to play an important role in the innovation process.[8] Some observers claim that small firms have contributed a disproportionate share of inventions in industries such as instrumentation and electronics. Others have been more cautious in assigning sole credit for inventions to small firms, pointing to the involvement of larger firms either at the beginning or the end of the invention process. However, under both views, small technology-based firms are considered to play a vital role at some point in the development of innovations.

All four reports consider policies for encouraging the formation and profitability of small, innovative firms. Indeed, the CTAB report is primarily concerned with public policy toward small firms. All four reports agree on two broad issues. First, the analyses emphasize the

role of the individual income tax and government regulations of financial markets as opposed to the corporation tax. Second, in discussing corporate tax policy, none of the analyses advocates new corporate tax incentives for small businesses. Instead, the analyses focus either on expanding existing tax preferences for small firms or on ensuring that small, unestablished firms are able to take full advantage of tax incentives available to all firms.

With one exception, recommendations concerning corporate tax policy deal with deductibility of losses incurred by small firms. Ensuring adequate tax deductibility of losses is one way of encouraging investor participation in new, innovative firms that are likely to be unprofitable in their early years. Subchapter S treatment of corporations with 15 or fewer shareholders as partnerships for tax purposes, as well as various provisions allowing individual investors to deduct losses from investments in small business from ordinary income, are current efforts to provide adequate loss offsets. Both the DPR Industry and CED reports recommend the expansion of the first provision. The DPR Industry report recommends that the qualifications for Subchapter S treatment be liberalized for small firms that spend more than a certain percentage of revenues in R&D. The CED report recommends that the Subchapter limit on shareholders be increased from 15 to 100 investors. In contrast to the DPR Industry proposal, no mention is made in the CED report of limiting this change to "R&D intensive" small firms.

Some features of the corporate income tax may unintentionally discriminate against small firms, in particular new firms. Loss offsets, depreciation deductions, and investment tax credits are not of immediate value to new, initially unprofitable firms because they face no corporate tax liability. The NRC/NAE monograph notes that this will discriminate against such firms if carry-forward provisions for unused operating losses are inadequate. The CED and CTAB reports maintain that current provisions, which allow losses to be carried forward for five years, are inadequate and should be extended. The CTAB report specifically recommends increasing the carry-forward period from five to ten years. The CTAB report also recommends further reductions in the taxation of firms with net earnings of less than $200,000 per year in order to place such firms on a more equal footing with large established corporations.

Two main issues arise in using specific corporate tax incentives to encourage innovation by small firms. The first is whether to extend such tax preferences to small business in general or to limit them to small innovative firms. While research has shown that some small firms have made significant and disproportionate contributions to innovation, these findings do not apply to small businesses generally. Limiting the scope of tax preferences requires, however, that one distinguish between "innovative" and other firms. Such distinctions are difficult to make in practice. For example, the DPR Industry report, which favors limiting the scope of small business tax incentives, merely recommends extending such tax incentives to "small businesses, properly defined, which spend more than a given percentage of revenues on research and development."

In providing tax incentives that stimulate the formation of new firms, caution must be exercised lest such measures encourage ill-conceived ventures. The risk of this occurring would seem to be lower if stimulus were provided through extended carry-forward provisions, which would be of value primarily to firms that ultimately became profitable.

Personal Income Tax Policy

The personal income tax affects both how much households save and how they allocate their savings among different investments. Since household savings are an important source of investment capital, the personal income tax, albeit indirectly, affects both the amount and the composition of private investment.

As is seen in Table II-2, the feature of the individual income tax given the most attention in the four studies is taxation of capital gains. There are two major reasons for this. First, the returns to corporate stock ownership and other equity investments are directly affected by capital gains taxation. Certain innovative activities, particularly those undertaken by small firms, depend on equity as a major source of finance. In addition, the willingness of investors to assume risk is sensitive to capital gains taxation, and investments in innovation are relatively riskier than other investments.

Long-term capital gains have traditionally received preferential tax treatment. Until recently, the tax advantage conferred on capital gains had been eroding due to changes in both tax law and inflation. Prior to 1969, the maximum effective tax on capital gains was 25 percent; however, the Tax Reform Acts of 1969 and 1976 increased the maximum rate to 49.1 percent. In addition, inflation has distorted the computation of capital gains, increasing the effective tax on real capital gains. The trend toward increased taxation of capital gains was reversed by changes enacted in the Revenue Act of 1978. The changes lower the maximum capital gains tax from 49.1 percent to 28 percent and lower capital gains taxes for investors in all income brackets.

The changes enacted in the Revenue Act of 1978 are either implicitly or explicitly endorsed in the NRC/NAE monograph and in the DPR Industry, CED, and CTAB reports. Moreover, the DPR Industry, CED, and CTAB reports propose additional liberalization of capital gains taxes.

One proposal made in the DPR Industry and CTAB reports would extend the coverage of existing tax preferences by liberalizing provisions for employee stock option plans. Specifically, the DPR Industry report recommends increasing the qualified options time from five to ten years and postponing taxation of nonqualified options until the shares have been sold, rather than taxing such options when they are exercised. The CTAB report recommends a similar change; however, the DPR Industry report proposes that this change be applied only to small businesses that are R&D intensive. The CTAB report recommends that the change apply to small business, generally.

TABLE II-2 Recommended Changes in the Personal Income Tax

Policy Measures	DPR Industry Report	DPR Labor Report[a]	President's Statement of 10/31/79[b]	CED Report	CTAB Report	NRC/NAE Monograph
Personal income tax policies						
Liberalize taxation of capital gains	R			R	R	
(1) Liberalize provisions for employee stock option plans in small firms					R	
(2) Liberalize provisions for employee stock option plans in small, R&D intensive firms	R					
(3) Enact further reductions in capital gains taxes	R			R	R	M
(4) Lower maximum tax rate on capital gains when those gains are realized on sales of stock held for more than 3 yr in small firms					R	
(5) Reduce maximum tax rate on capital gains from 28 to 20 percent				R		
(6) Improve deductibility of capital losses				R		M
(7) Permit tax-free rollover of investments in small firms					R	
(8) Permit tax-free rollover of investments in small, R&D intensive firms	R					M

R = explicitly recommended as a policy initiative.
M = discussed as a policy alternative, but not recommended.
[a]This report rejects tax incentives as a means of stimulating innovation.
[b]This statement defers consideration of tax incentives for innovation until Fiscal Year 1981.

Other proposals entail increasing general tax preferences for capital gains. These can be grouped into three broad categories: (1) reductions in capital gains tax rates, (2) liberalized deductibility of capital losses, and (3) changes to minimize the lock-in effect.

Those favoring preferential treatment of capital gains maintain that risk-taking would be discouraged if capital gains were taxed as other income.[9] Theoretical analyses of the relationship between capital gains taxation and risk-taking have highlighted the relationship between risk-taking, taxation, and adequate deductibility of capital losses. Taxation of capital gains permits the government to share in the returns of an investment if it is successful. Full deductibility of capital losses requires the government to share in the losses from an unsuccessful investment. In evaluating a risky investment one should consider both the after-tax return earned if it is successful and the after-tax loss suffered if it is not. Decreases in capital gains taxes increase potential after-tax returns, whereas liberalizing deductibility of capital losses reduced potential after-tax losses; thus, both actions favor investment in risky investments.

The DPR Industry, CED, and CTAB reports all recommend further reductions in capital gains tax rates. The CTAB study recommends lowering the maximum tax rate on capital gains to the pre-1969 rate of 25 percent when those gains are realized on sales of stock held for more than three years in businesses with 500 or fewer employees. The report also recommends reducing the maximum rate to 10 percent for firms with 100 or fewer employees. The CED report indirectly favors reducing the maximum rate on capital gains from 28 to 20 percent. The DPR Industry report in its first recommendation supports the general principle of reducing the burden of the capital gains tax; however, it does not propose any specific rates. Finally, reducing capital gains tax rates is mentioned in the NRC/NAE monograph as one of several possible policies for encouraging investors to purchase the equity offerings of small technological firms; however, it is not specifically endorsed.

Both the NRC/NAE monograph and the CED report also suggest the deductibility of capital losses be improved, though neither study recommends specific measures along these lines. Currently, investors with net capital losses may deduct such losses against up to only $3000 of ordinary income each year and must exclude 50 percent of long-term capital losses when doing so. The inadequacy of these loss offset provisions is demonstrated by recent U.S. Treasury calculations that show the presence of significant undeducted capital losses in each income class.[10] There are several ways in which loss offsets could be made more complete. The most substantial change would permit full deductibility of capital losses against ordinary income. Less drastic changes would involve increasing the dollar income limit and/or increasing the fraction of long-term capital losses deductible within the limit.

Finally, three of the four studies discuss changes that would permit investors to defer paying capital gains taxes on sales of stock in small firms, provided that such sales are "rolled over" to purchase

securities of other small firms. These measures are all intended to reduce the lock-in effect of the capital gains tax. Capital gains are only taxed when realized into income and in many cases may be passed on to heirs virtually tax-free. Consequently, investors have an incentive to postpone sales of assets. Bailey (1969) and Feldstein and Yitzhaki (1978) present evidence that the lock-in incentive may be quite strong; hence, investors may be discouraged from efficiently allocating capital in response to new investment opportunities.

The three studies differ somewhat in the coverage of the rollover positions that are discussed. Both the NRC/NAE monograph and the DPR Industry report support the tax-free rollover of equity investments in small technological firms. The CTAB report supports tax-free rollover for equity investments in all small firms.

Several issues arise in using tax preferences for capital gains to encourage innovation. A major issue is whether general reductions in capital gains taxes are the most effective stimulus to innovation. The CED report appears to favor reducing capital gains tax rates and increasing capital loss offsets for all taxpayers. This view is consistent with the first recommendation of the DPR report. Subsequent DPR Industry recommendations, however, seem to favor restricting further capital gains tax concessions to small, technological firms. Finally, the CTAB report favors restricting the coverage of capital gains tax concessions to equity investments in small firms (less than 500 employees at the time of purchase) and recommends denying eligibility for such concessions to capital gains realized from real estate.

Another issue is whether rate reductions and increases in loss offsets should be viewed as competing options. This is particularly important if recommendations pertain to general tax concessions. Although reducing capital gains tax encourages investment in risky activities, it also encourages investments that are neither particularly risky nor innovative, but which legally qualify as capital gains. This is less likely to occur if capital gain tax relief is provided by liberalizing deductibility of capital losses because more tax relief, per dollar of revenue loss, is extended to those making risky investments.

Government Regulation of Securities Markets and Pension Funds

Government Regulation of Financial Markets: Policymakers have begun to consider whether various government regulations can be modified so as to achieve their stated objectives at lower cost. One issue is whether government regulation of financial markets can be altered to provide the same level of investor protection while reducing regulatory barriers to the financing of innovation. Possible changes in financial regulatory policies are listed in Table II-3.

Government Regulation of Pension Funds: Until recently the Employment Retirement Income Security Act of 1974 (ERISA) established criteria for "prudent" behavior, as well as penalties for "imprudent"

TABLE II-3 Recommended Changes in Government Regulation of Financial Markets and in Other Government Policies

Policy Measures	DPR Industry Report	DPR Labor Report	President's Statement of 10/31/79	CED Report	CTAB Report	NRC/NAE Monograph
Government regulation of financial markets						
Ensure that ERISA regulations do not unduly discourage pension fund managers from investing in small firms	R			R	R	R
Permit pension fund managers to invest up to 5 percent of pension fund assets in small firms					R	
Ensure that Regulation A ceiling limit is adequate	R					R
Ensure that SEC Regulations 144 and 146 do not restrict the liquidity of securities sold in nonpublic offerings	R					R
Other government policies						
Increase federal support of basic research	R			R		
Allocate research grants to universities more efficiently			R	R		
Improve industry-university research cooperation through the NSF						
Allocate federal funds to identify commercial applications of new technologies					R	
Improve federal support for small firms			R		R	
Redirect federally supported agricultural research					R	
Review government procurement policies to facilitate competition by small and venture companies	R	R	R			

R = explicitly recommended as a policy initiative.
M = discussed as a policy alternative, but not recommended.

behavior that have discouraged pension fund managers from making "risky" investments, including investments in innovation. The NRC/NAE monograph, the DPR Industry report, and the CTAB report all recommend that ERISA's criteria of prudent behavior be defined in terms of portfolio risk, rather than the risk of specific investments. In addition, the CTAB report recommends permitting pension fund managers to invest up to five percent of pension fund assets in small firms.

These recommendations were, however, formulated prior to recent alterations in ERISA. These changes establish standards of accountability based on portfolio diversification. Under this approach, investments in risky ventures, if part of a balanced portfolio, are viewed as prudent behavior. The issue, therefore, is whether these changes provide sufficient encouragement to pension fund managers to commit some of their assets to innovative ventures.

Government Regulations of Securities Markets: Concern is also expressed in the NRC/NAE monograph and the DPR Industry report about the extra burden of Security and Exchange Commission (SEC) regulations on small firms, generally and on small technological firms, specifically. Both reports mention three SEC regulations of particular importance to small firms: Regulation A, Rule 144, and Rule 146.

All three regulations are ultimately intended to lower the costs to small firms of complying with SEC registration requirements. Regulation A exempts public offerings below a certain ceiling amount from full SEC registration requirements. Similarly, Rules 144 and 146 deal with "nonpublic" offerings ("restricted securities") that are exempt from registration requirements.

With respect to Regulation A, the major concern expressed in both reports is whether the ceiling limit is high enough to provide effective relief to small securities issues. The ceiling limit imposed by the SEC on Regulation A offerings has been changed several times since 1933. Most recently, the limit was raised from $500,000 to $1.5 million, and it has been proposed that this new limit be increased to $2 or $2.5 million. One issue is whether the Regulation A ceiling should be regularly adjusted to reflect inflation; another is whether the ceiling limit should be increased in real terms.

Rules 144 and 146 were initially designed to ease the burden of SEC regulations by making it easier to issue unregistered securities. However, the costs of complying with Rules 144 and 146 deter some small firms from seeking private placement exemptions. In particular, restrictions on the resale of unregistered securities reduce their liquidity. The cost savings from reductions in SEC registration requirements are, therefore, partially offset by higher interest premiums needed to compensate purchasers for the reduced liquidity of unregistered securities. Recent changes in SEC rules have increased the liquidity of unregistered securities. An issue consistent with the discussion in both the NRC/NAE and DPR Industry report is whether limitations governing resale of unregistered securities should be further relaxed.

Other Government Policies Toward Innovation

This discussion has emphasized tax and financial regulatory policies because these either receive the most attention or are assigned the highest priority in the studies reviewed. However, the CED, DPR Industry, and CTAB reports, as well as the Presidential statement, also discuss certain government spending policies. For the sake of completeness, these policies are listed below:

1. Increase federal support of basic research (DPR Industry and CED).
2. Improve the effectiveness and efficiency in the awarding and managing of research grants to universities (CED and President).
3. Allocate five percent of each federal agency's R&D funds for technology transfer to identify commercial applications of new technologies (CTAB).
4. Allocate ten percent of each federal agency's R&D funds (excluding those for basic research) to small businesses (CTAB).
5. Redirect federally supported agricultural research to the development of technology for improving the efficiency of small family farms and food processors and for making food production and preservation less capital and fossil-fuel intensive (CTAB).
6. Review government procurement policies to make it less difficult for small and venture companies to compete for projects and contracts (DPR Industry, DPR Labor and President).

FOOTNOTES

[1]For example, the CED report devotes considerable attention to the relationship between government regulation and innovation. The DPR report also devoted attention to government regulation and to foriegn trade issues.

[2]A number of empirical studies of the impact of investment tax incentives on corporate investment behavior can be found in Fromm (1971). Among these studies, that of Hall and Jorgenson is the most optimistic in its assessment of the impact of investment tax incentives, whereas that of Coen and that of Klein and Taubman find a considerably more modest impact of tax policy than Hall and Jorgenson.

[3]Specifically, Gramlich's estimates suggest a decline, due to inflation, in the present value of depreciation deductions of roughly 23 to 41 percent.

[4]For example, Gramlich (1976) estimates that the corporate tax rate would have to be cut from 48 to 40 percent to offset the impact of inflation on historic cost depreciation.

[5]See Break (1974), pp. 217-219.

[6]Furthermore, since relatively short-lived assets are favored by tax credits, further increasing of the tax credit would favor short-lived rather than long-lived investment projects.

[7]This concern is raised by Mansfield, National Science Foundation (1977).

[8]See Jewkes, et al. (1969).
[9]For an empirical analysis, see Feldstein (1976).
[10]See Wetzler (1976).

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SUMMARY OF PANEL DISCUSSION

On December 5, 1979, a panel was convened under the auspices of the National Academy of Engineering to discuss economic and tax policies for encouraging innovation. Members of the panel were each involved in preparing one of the reports summarized above. The panel was chaired by Professor Mohammed I. Nadiri of New York University.

In opening the discussion, Professor Nadiri proposed several questions to be addressed by the panel:

1. How effective are tax incentives in promoting innovation?
2. How may the effectivenes of tax incentives be measured?
3. What factors must be present for tax incentives to be effective?
4. How should tax incentives be structured?
5. What is the time lag between introduction of tax incentives for innovation and actual investments in innovation?

Professor Nadiri also requested each panel member to identify priorities among the various recommendations made in each report, as well as the philosophy behind those recommendations.

Dr. Abrahamson of Control Data Corporation began the discussion with remarks about the CTAB report. He noted that the report deals with unemployment as well as lagging innovation and is based on the premise that small businesses create more jobs and are better innovators than their larger counterparts. The ability of small businesses to create jobs and to innovate has been hampered in recent years by several factors. Given these factors, 12 specific remedies are identified in the CTAB report. These remedies are grouped in five broad areas: (1) improving the availability of capital and management expertise in small businesses, (2) reducing the burden on small businesses of compliance with government regulations, (3) stimulating diffusion and application of new technolgies, (4) increasing the amount of R&D performed by small business, and (5) improving the export performance of small business. Of these, the first area receives the greatest attention in the CTAB report with 5 of the 12 CTAB recommendations pertaining to capital availability and management expertise.

Dr. Holland also discussed the CED report, describing in some detail how the CED developed its recommendations. The initial CED premise is that stimulating U.S. technological progress deserves high ranking among U.S. economic priorities. Given this premise,

improvements are needed in four major areas of public policy: patents, government regulations, direct federal support of R&D, and taxation. However, in the CED's judgment, changes are most critically needed in federal policies.

In particular, current tax policies discourage the commercial introduction and the diffusion of innovations through the production process. The most worthwhile and achievable remedy for this problem is accelerated depreciation. Consequently, this remedy should be given immediate priority. Other tax remedies should also be implemented, but only after capital cost recovery is improved. These remedies include reducing capital gains taxes and reducing personal and corporate marginal income tax rates.

Specific tax incentives aimed at the early research phases of innovation processes would also be desirable. Of these, the most worthwhile would improve the flexibility with which firms may depreciate capital used in research and development. Other desirable changes would be reducing the depreciable life of patents, limiting the allocation of R&D expenses to foreign source income, expanding the coverage of Subchapter S, lengthening loss carry-forwards and carry-backs for tax return purposes, and granting tax credits for corporation contributions to university research. Dr. Holland emphasized, however, that such selected tax changes would not be as significant a stimulus to innovation as more general tax changes. Indeed, such selective changes would be most effective if accompanied by general tax incentives for capital spending. Finally, among alternative government spending programs, the CED felt that increased federal funding for basic research, especially at universities, would be most effective.

Dr. Landau discussed the major elements of the NRC/NAE monograph, which rests on three main premises. The first is that both large and small firms play an important role in innovation. The second is that innovation has been discouraged because rewards to risk-taking have been reduced by inflation, government regulation, and taxation. The third is that encouraging R&D is not necessarily synonymous with encouraging innovation.

Given these premises, the NRC/NAE report reaches several conclusions about tax policy. For small firms, capital gains taxation was seen to be most relevant. While the NRC/NAE report was being written, substantial reductions in capital gains taxes were enacted; thus, the NRC/NAE report does not make specific recommendations about further changes in capital gains taxation. The NRC/NAE report agrees completely with the CED report that more rapid depreciation in some form would provide the greatest encouragement for the development and adoption of innovations by large firms. Finally, the NRC/NAE report considered the need for additional tax incentives to R&D undertaken by both large and small firms. Such measures, however, were assigned a lower priority than general tax incentives for savings and investment.

The NRC/NAE report also identified numerous other policies that would be desirable, but the underlying view in the report was that tax policies should not be aimed at stimulating particular activities. Rather, such policies should be designed to encourage capital formation by providing greater incentives for risk-taking.

Dr. Landau also noted that he sensed a lack of urgency in studies of innovation and even in the Presidential review memorandum on innovation. In his view, this reflected a lack of understanding of how rapidly the U.S. is losing its competitiveness and its ability to develop industries of the future.

Mr. Stanhope concluded the panel discussion by commenting on the DPR Industry report. He noted that the recommendations of this study are in basic agreement with the recommendations presented by the other panelists. The DPR Industry subcommittee felt there were numerous tax policies that would be useful, but because of political problems involved there was no explicit attempt to rank policies by priority.

Mr. Stanhope also noted that one important non-tax matter considered in the DPR Industry report was government regulation of pension funds under ERISA. Recent changes in these regulations should provide more encouragement to pension-fund managers to invest some capital in potentially innovative but risky ventures. In Mr. Stanhope's view, more specific regulatory changes are needed.

III. INTERNATIONAL TRANSACTIONS

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ANALYSIS

Technology is increasingly becoming an important factor in U.S. international trade. American firms face growing foreign competition in domestic and overseas markets, most recently in markets for high-technology goods. Over the past decade, the U.S. has experienced large trade deficits and a decline in its share of world exports, although it has a large, positive trade balance in high-technology manufactured goods. This balance had been rising, but has fallen in recent years.

Market opportunities here and abroad are major stimulants to industrial innovation. It is believed that more innovation is needed to enhance the international competitive position of the U.S. Foreign markets for American products and foreign competition in the U.S. markets are increasingly important in determining market opportunities for American R&D-intensive products.[1] Policy questions in the area of international trade and technology include (1) where and to what degree does U.S. policy in international transactions influence market opportunities for America R&D-intensive goods and (2) what effect do these policies have on the American economy and, in particular, on domestic innovation?

There are three major classes of international transactions: exports and imports, foreign direct investment, and licensing. In considering the importance of technology in these transactions, two distinctions should be made. First, trade in products should be distinguished from trade in technology. Products embody the technology needed to produce them. Technology is the knowledge needed to apply scientific and engineering principles to the design and manufacture of products and to the day-to-day production operations. Second, products are often classified under the categories of "high-technology" and "low-technology," depending on "how much technology" is incorporated into their production. This classification is artificial to the extent that the operational definition refers to the amount of R&D resources related to these products.

The U.S. trades in both products and technology. Trade in technology often refers to international licensing, but can include foreign direct investment when technology is transferred abroad to subsidiaries. The distinction between products and technology becomes blurred when, for example, an American firm sells a high-technology product and includes, as part of the sale, training to use (e.g., computers) and/or produce the product. Similarly, licensing may refer to the sale of a patent only, but can cover the range from a single patent sale to the sale of a patent plus the technical training and know-how to use the technology.

Objective of This Paper

The purpose of this paper is to review and contrast the international trade and technology aspects of recommendations made to the U.S. government to encourage technological innovation. These recommedations were taken from reports that studied national policies affecting industrial innovation. These reports are:

1. A report of the Advisory Subcommittee on Economic and Trade Policy of the Advisory Committee on Industrial Innovation established as part of the Domestic Policy Review, February 15, 1979. (DPR Industry report)
2. The effects of Domestic Policies of the Federal Government upon Innovation by Small Businesses, a report of small business members who served on the Industrial Innovation Advisory Committee established as part of the Domestic Policy Review on Industrial Innovation, May 1, 1979. (DPR Small Business report)
3. A draft report of the Public Interest Advisory Subcommittee of the Advisory Committee on Industrial Innovation established as part of the Domestic Policy review on Industrial Innovation, December 28, 1978. (DPR Public Interest report)
4. A draft report of the Labor Advisory Subcommittee of the Advisory Committee on Industrial Innovation established as part of the Domestic Policy Review, December 22, 1978. (DPR Labor report)
5. Stimulating Technological Progress: A Draft Statement on National Policy, Committee for Economic Development, September 19, 1979. (CED report)
6. Technology, Trade, and the U.S. Economy, report of a workshop held at Woods Hole, Massachusetts, August 22-31, 1976, Committee on Technology and International Economic and Trade Issues, Assembly of Engineering, National Research Council and Office of the Foreign Secretary, National Academy of Engineering, Washington, D.C., 1978. (NRC/NAE report)
7. Recommendations for Creating Jobs through the Success of Small, Innovative Businesses, a report of the Commerce Technical Advisory Board to Jordan J. Baruch, Assistant Secretary for Science and Technology, Department of Commerce, December 1978. (CTAB report)
8. The President's Message to the Congress of the United States on Industrial Innovation Initiatives, October 31, 1979. (President)

Only one report concentrates on international transactions. The others cover a range of options that could encourage industrial innovation but include recommendations about international trade and technology. Many of these recommendations focus on the expansion of overseas market opportunities for American products, rather than stimulation of industrial innovation per se.

This paper examines those recommendations related to international transactions. It does not treat recommendations intended to encourage industrial innovation in general. The recommendations are classified by type of policy tool considered: that is, trade policies (exports and imports); tax policies, export credit, and insurance; and government regulations. The paper points out areas where recommendations agree or disagree, where new policy initiatives are being taken, and where questions must be addressed before the government should undertake any policy changes. The recommendations made in the studies are compared in a summary matrix in Table III-1.

Recommendations

Trade Policies

There are two views with opposing recommendations on trade policies. One side recommends more control of trade, and the other, less control. Recommended trade policies are considered in three groups: exports, imports, and trade with developing nations.

Exports: Recommendations for more control relate to regulation of the export of high-technology products (especially capital), industrial plants, and technology, including know-how. This recommendation is based on the argument that exports of technology and high-technology products have contributed to the decline in American international competitiveness. The government, it is argued, has the obligation to control exports of high-technology products and to regulate the technology transfer that often accompanies such exports and also occurs through foreign direct investment and licensing. Not only do exports of high-technology products and technology erode the base of U.S. innovation, but they also have a large negative impact on the numbers and skills of people employed.[2]

The other view recommends little or no control of trade. Any control of exports, especially of technology, would be difficult to enforce because American technology often competes with available foreign substitutes and would entail complex legal issues. Control of exports would also be harmful to employment and growth and is not likely to resolve any problems relating to innovation and investment. (DPR Industry, CED) Moreover, there is the possibility that other countries will retaliate with similar controls.

In trying to reconcile these two positions, several factors should be considered. First, control of exports of high-technology goods and technology may be justified on national security grounds. Advocates of control for national security purposes, especially control of

TABLE III-1 Major Issue: U.S. Competitiveness in International Trade and Technology[a]

	Recommendations					
Policy Tools	DPR (Industry Advisory Group)	DPR (Industry Advisory Group–Small Business)	DPR (Labor Advisory Group)	Committee for Economic Development	National Academy of Engineering	Small Business Commerce Technical Advisory Board
TRADE POLICIES Exports/Imports	Protection of domestic industries does not represent solution to problem of faltering innovation and investment. Relief from unfair trade practices, e.g., dumping and subsidized imports, rather than protection from vigorous but fair competition is proper policy. The U.S. should successfully conclude current international trade negotiations and reduce tariff and nontrade barriers to trade. Review on a more timely and aggressive basis export items that government prohibits.	Government needs to improve techniques of defining, developing, disseminating information about trade opportunities. Overseas government commercial facilities should be uniformly staffed with qualified commercial officers, rather than current haphazard system. Government should organize low-cost overseas business seminar and factory visit tours and make-a-deal sessions. Schedule for charges for government services should be revised to encourage use by small business; formulas could be based on trade volume.	U.S. should regulate export of most advanced equipment, plant, capital, and technology, including know-how. Government should regulate imports into the U.S. to help secure jobs and ensure America's future as a strong and innotive industrial base.	Exports of technology or goods should not be restricted because of difficulties in enforcing, legal problems, availability from foreign firms, reduction in employment and growth. Control justified for national security reasons for weapons systems; changes needed are: (a) clear objectives of controlling agency, (b) specifications of controlled technology, (c) implications of control needed-benefits/costs, (d) improved review procedures and limitation on control (duration). U.S. should press for international conventions to protect ownership rights (patents/copyrights).	U.S. should not impose controls on imports or investment, but should expand and modify the trade adjustment assistance program by broadening eligibility and provide better retraining or early retirement. Export control lists for national security should be shortened or simplified criteria for granting export licenses should be established.	
Trade with LDC's		U.S. should organize small business missions in cooperation with LDC governments to create manufacturing joint ventures to meet LDC infrastructure needs.			A major study should be undertaken of implications to U.S. of LDC demands for technology transfer. Mechanisms should be created to transfer nonproprietary technologies to LDCs, and programs should be coordinated with other OECD nations. U.S. should financially assist regional institutions to develop and apply technology appropriate for LDCs.	
TAX POLICIES	U.S. should liberalize or repeal Treasury Reg. Sec. 1.861, which inhibits U.S. R&D activity and competitiveness.	U.S. should allow double deduction for costs of developing export sales, for adaptation costs for overseas markets, for maintaining foreign patents and trademarks. U.S. should permit accelerated 5-year depreciation and 20% investment tax credit based on cost of U.S. capital equipment used to produce export items. To reduce obstacles to technology transfer, U.S. should allow tax-free exchange of investments in kind (machinery for equity) in foreign ventures; tax dividends, only if converted to dollars, do not tax profits if reinvested; minority equity positions subject to capital gains only when liquidated.	U.S. should end preferential tax treatment for multinationals' foreign operations, specifically, foreign income tax deferrals, foreign tax credits, DISC tax deferrals, Tariff Code Items 806 and 807.		U.S. should strive for tax neutrality, i.e., create neither incentives nor discentives for U.S. investment abroad, but what constitutes tax neutrality warrants further study.	U.S. should encourage Small Business Export Trade Corporations through double deduction allowances for annual expenses associated with exporting (up to $100K), with a ten carry-forward of 10 years. All small businesses should be allowed a double deduction of special expenses of moving export markets (up to $100K/year).
Export Credit and Insurance		Government should provide a qualified export manufacturer with credit up to $10,000 FOB. Each firm be allowed a bad debt reserve equal to 50% of outstanding export receivables not covered by a letter of credit (up to $50K); low-cost insurance be provided for specified risks.	Loan guarantees are opposed.			
Regulations Economic and Social	U.S. should minimize the application of U.S. laws to extraterritorial business ventures. Anti-trust and other regulations (unspecified) impede international trade.	Antitrust regulations are an obstacle to technology transfer by small business. Small businesses should be allowed to acquire exclusive grant-back rights from foreign licensees or joint ventures, to retain exclusivity and marketing rights in the U.S., to source parts exclusively. Government should set up a Small Business Export Council similar to the President's Export Council to promote exports and marketing of U.S. goods.	Social regulations should not be weakened (worker health and safety, environmental protection) to lure business to engage in industrial innovation. (Did not refer to foreign trade *per se*.)			We recommend that the creation of Small Business Export Trade Corporations be encouraged.

[a]No specific policy recommendations on international trade and technology were provided in "A Draft Report of the Public Interest Advisory Subcommittee of the Advisory Committee on Industrial Innovation," or in "The President's Message to Congress of the United States on Industrial Innovation Initiative, October 31, 1979."

technology, argue that time is crucial. Having a lead time, albeit a short one, is vital for stategic military strength.[3] The argument for control has been extended to commercial transactions and the economic strength of the U.S.; however, the problems encountered in implementing control for national security purposes suggest the difficulties in identifying a list of critical technologies and products mutually agreeable between industry and government and in tracking changes in technologies (e.g., when foreign firms develop their own competing technologies or when a technology is no longer new.)[4] A major complaint about national security controls is the delay in obtaining clearance for exports and the subsequent loss of sales to foreign competitors. Delays in sales entail loss of export markets and inhibition of technological development, resulting in losses in jobs and growth in the U.S., at least in the short term. (DPR Industry, CED) If controls were instituted for commercial transactions, similar problems are likely to be encountered. The controversy centers around the issue of cost of losing markets versus the gains from technology lead times, and this question has not been resolved to anyone's satisfaction.

Second, high-technology products comprise a large fraction of U.S. manufacturing exports and, thus, represent an important source of foreign exchange earnings. Studies have shown a positive and statistically significant relationship between indices of technology (e.g., the fraction of R&D spending to sales or R&D scientists and engineers to total employment) and export performance (total and net exports) for a number of countries.[5] These results, however, do not imply that increases in R&D efforts will necessarily improve trade performance. Moreover, available data suggest that exports and foreign market potential are important in determining a firm's domestic R&D spending decisions. If firms could not utilize new technologies abroad through exports, sales by subsidiaries, or foreign licensing, they might not undertake as much domestic R&D, with the result that the U.S. technological position might be weakened in the long term.[6] Hence, the research results show that technology and trade are related, but do not explain the cause and effect between the two or the strength of causality.

One difficulty in trying to determine causality is that of ascertaining the importance of technology relative to other influences on trade performance, such as the effects of skilled labor, industry concentration, and economies of scale--factors often associated with technology intensive industries. For a firm the ability to sell abroad depends on the combined impact of a number of considerations: the costs of labor, capital, and other inputs; factor productivity; exchange rate changes; terms of delivery, insurance, and credit; product characteristics; and seller reputation and service facilities.[7] Studies that have examined some of these factors point out the interrelationships between variables. Keesing found that export growth was highest in American manufacturing industries that employed a high proportion of skilled workers, but these industries also have relatively high ratios of R&D to value added.[8] Analyses of the product life-cycle hypothesis support the skill-intensity result.

The hypothesis indicates that trade success in high technology products reflects the first stage in the adjustment process following the introduction of a successful innovation. In the initial phase of commercialization, production may require considerable imputs of skilled labor. Over time, as the product becomes standardized and the demand for the product expands as price falls, the need for skilled labor in production is reduced. The innovating firm may continue R&D efforts for incremental product and process improvement, but is likely to seek production locations where less-skilled labor is cheaper than in the U.S.[9] Hence, it is hard to know the extent to which R&D and technology contribute to exports compared to other factors, such as labor skills or stage of product life cycle or the interaction between exports and technology.

Third, the effects of foreign, direct investment and licensing need to be studied before regulations can be considered. Recent research has found that foreign production is a way to gain or retain overseas markets. Foreign, direct investment by American firms tends to enhance exports from the U.S. and reduce exports from foreign competitors--implying a positive effect on employment in the U.S.[10] It is a channel through which technology is transferred, and it tends to speed up the diffusion of new products. Research indicates, however, that it generally makes a small contribution to the technological capabilities of the receiving countries, partly because a major portion of American investment occurs in industrial countries where competitive domestic firms already exist and partly because substantial adaptation and learning costs are often necessary in the transfer.[11] In the reverse case, investment by foreign firms has brought new technology into the U.S. where foreign firms find the large market to be an excellent base from which to exploit their technologies.[12]

Many firms license their technologies in order to gain access to foreign technologies, as well as overseas markets. But for high-technology firms, licensing tends not to be an important mechanism through which an industrial nation acquires technological capability because sophistication and learning economies are required before the foreign firms can take full advantage of the technology. Moreover, potential licensors often do not want to share process technology.[13] For older technologies, the experience of countries such as Brazil, Mexico, and Korea suggests that others can gain economically by licensing technologies. These older technologies are often available from a number of industrial nations.[14]

Both types of international transactions influence exports, as well as the diffusion of technology and the technological capabilities of the recipient country. The effects of these transactions on employment, economic growth, and foreign exchange earnings are harder to assess, and research findings are limited. Many industries (e.g., textiles, chemicals, electronics, electrical machinery) in the U.S. and abroad have benefited from international technology transfer. The benefits have been gained through the direct application of knowledge of products and of imported knowledge to R&D programs.[15] These transactions contribute to the technological capabilities of the U.S. and other countries, though the balance of the contributions is difficult to determine.

Imports: Paralleling the two positions on exports, there are two opposing, analogous positions on imports into the U.S. One group recommends restrictions on imports of products because of the adverse effect on employment. (DPR Labor) The second group recommends little control of trade and investment. (DPR Industry, CED, and NRC/NAE)

Import restrictions may lead to several adverse effects on the U.S. First, tariffs and quotas are essentially a tax paid by American consumers to subsidize protected, often inefficient, industries. Second, import protection, particularly of lagging industries, tends to reduce domestic competition and the incentives to innovate in the long term, even though employment may be maintained in the short run. Third, import restrictions may lead to a decline in U.S. exports. Import restrictions are negotiated between the U.S. and its trading partners. The GATT (General Agreement on Tariffs and Trade) specifies the types of restrictions allowed. Any action by the U.S. diverging from the agreement is likely to bring retaliatory barriers to American products from its trading partners.

Controls on imports could, therefore, have a number of negative impacts on the U.S. economy. A supplemental option has been offered to trace hardships resulting from trade and investment. It was recommended that the government expand or modify the trade adjustment assistance program initiated under the Trade Act of 1974. Eligibility requirements should be broadened to include workers who are indirectly affected by imports (as in the case where the demand for an intermediate input or product hinges on the demand for the final or consumer good which competes with imports) or workers who have lost their jobs as a result of the transfer of operations overseas. In addition, retraining programs could be improved to provide new skills and job opportunities for displaced workers and early retirement could be encouraged for workers with no alternative employment opportunities. (NRC/NAE)

Trade with Developing Countries: Two groups made recommendations about trade with developing countries (LDCs), but they had completely different concerns. Small businesses recommended federal assistance in organizing small firms to cooperate with LDC governments in creating joint ventures to meet industrial infrastructure needs and providing U.S. training for LDC personnel in the U.S. They also argued for a tax-free exchange of investments (machinery for equity) in developing countries to promote technology transfer.[16] (DPR Small Business)

Developing countries represent a growing market for American products. In the past decade, the proportion of U.S. exports going to LDCs has grown from one-third to two-fifths of the total. In addition, the proportion of R&D intensive products traded with LDCs has been rising in both gross and net export terms.[17] What is important to know in considering this recommendation is the extent to which small businesses export high-technology products and the extent to which federal assistance would enhance the technological capabilities of these businesses. It is known that small businesses represent a small fraction of total U.S. exports (CTAB), and it can be inferred that they also represent a small fraction of high-technology exports (although this remains to be determined).

The second set of recommendations focuses on the demands made by the LDCs (77), whose objective is to increase their share of world income through industrialization. This group of countries believes that an important factor in achieving industrialization is the transfer of technology from industrial nations. They have demanded an acceleration of technology transfer and a change in the terms on which they receive technology.

Three recommendations were made. (NRC/NAE) First, an analysis is needed of the policy implications for the U.S. of demands related to technology transfer. The analysis should include an assessment of the impact on the U.S. of the industrialization of LDCs, especially through technology transfer, and an evaluation of the proposed code of conduct for international technology transfer. The Organization for Economic Cooperation and Development (OECD) has considered some aspects of the question in a study that examined the effects of newly industrialized countries' manufacturing capabilities on industrial nations.[18] This study may provide a useful basis for analyzing the effects on the U.S., particularly on the competitiveness of American industries. The OECD has also established a committee to study the proposed code of conduct and to develop an alternative code.

Second, mechanisms should be created to transfer nonproprietary (public) technologies to LDCs, and the programs should be coordinated with other OECD nations. Third, the U.S. should support and financially assist regional institutions located in developing nations to develop and apply technologies appropriate to conditions in LDCs.

With respect to technology transfer, President Carter proposed the establishment of the Institute for Scientific and Technological Cooperation (ISTC) to help strengthen the scientific and technological problem-solving capacities of developing countries. Congress approved this proposal, scheduling the operations of the Institute to begin October 1, 1979. As of this writing, Congress had not yet approved appropriations for the Institute. Actual operations must begin before the effect of the Institute can be examined in general and, specifically, for small businesses. Moreover, as discussed under exports, there remains the question of determining the effect of technology transfer on the competitiveness of American industry.

Tax Incentives

Recommendations proposed for tax policies that influence trade include conflicting ones, but they are directed at different groups. Small businesses would like to see tax incentives in the form of double deductions for costs of exporting activity--including new market development, product adaptation costs, and foreign patents--and favorable treatment of income and capital depreciation. (DPR Small Business)

Large businesses recommended liberalization or repeal of Treasury Regulation 1.861-8. This regulation requires firms to allocate a portion of R&D expenditures incurred in the U.S. among foreign sources of income because the income may be attributed to domestic R&D.

Supporters of this recommendation argue that the regulation inhibits R&D activity in the U.S. and reduces the competitiveness of American firms. In their view, the regulation forces firms to apportion expenses to foreign source income even if the income is incidental to innovation, causes double taxation because foreign governments do not allow a deduction for this allocation when computing taxes due them, encourages the location of R&D facilities abroad to escape the effects of the regulation and, thus, diminishes the amount of R&D conducted in the U.S. and the tax revenue generated from its conduct. (DPR Industry)

The opposing recommendations would end all tax incentives, including foreign income tax deferrals, tax credits, DISC tax deferrals, and tariff codes 806 and 807. (DPR Labor) The argument underlying these recommendations is that export of high-technology goods and technology harms American tax payers, workers, communities, and the nation's industrial base. These recommendations, however, focus on the activities of large multinational corporations.

There are two related questions that must be addressed in considering changes in tax policies. First, how much and to what degree do these tax policies affect the technological capabilities of American firms? In the specific case of Regulation 1.861-8, a determination is needed of the possible negative or neutral effects of this regulation on domestic R&D activities and the competitiveness of American firms. The Department of Treasury is currently conducting an analysis of the effects of this regulation on the domestic R&D activites of American firms. In general, few evaluations have been made of the effects of tax policies on R&D and innovative activity, and none has linked tax policies, R&D, and international competitiveness.[19] A few studies have been made of tax incentives for R&D among many industrialized nations. Although they do not show a clear link between the level of tax incentives and the level of innovative activities, they suggest that tax provisions play a relatively minor role in encouraging R&D.[20] The second and more difficult question is: Are the costs of the policies (e.g., reduced tax revenues) worth the benefits gained in increased employment and growth if, in fact, these tax policies provide incentives to exploit technologies and expand exports?

Exports Credit and Insurance: Small businesses have set out guidelines for financing exports and insurance for bad debts, cost increases, and supply commitments. They argue that government credit assistance will help them market goods abroad. (DPR Small Business) Labor unions, on the other hand, believe that businesses do not need any form of government help, including export credit and insurance. (DPR Labor)

The Export-Import Bank (Eximbank) provides export credit and insurance through a mixture of direct loans, interest rate subsidies, loan guarantees, and other insurance (e.g., against political risks). The Eximbank has recently made some changes in the programs offered in order to help American products compete on world markets. In the last half of 1978, the Eximbank added some new programs: a foreign distributor program that can cover sales of a distributor to a

credit-worthy end-user; construction guarantees to protect against inconvertibility and confiscation of an American contractor's assets abroad in both developed and developing countries; and small business programs that cover 95 percent of the commercial risks and 100 percent of the political risks, with no deductible requirements for firms with assets of less than $2 million, exports of less than $350,000 per year over the last two years, and firms that have not previously used Eximbank or FCIA (Foreign Credit Insurance Association) services. Changes in existing programs include a simplified fee schedule, a bank guarantee program more attractive to commercial banks, and a cooperative financing facility that no longer limits the mark-up on funds borrowed, the dollar ceiling on transactions, and total support to one buyer. American officials are also working with governments in the Organization for Economic Development and Cooperation to harmonize governments' financing practices and to head off any type of export credit race.[21] Thus, the Eximbank has made some changes that concur with small businesses' recommendations.

It is unclear whether the government export credit programs will successfully increase American exports,[22] especially R&D intensive goods over the long term. Part of the problem is determining the relative effectiveness of various parts of the programs, i.e., direct loans, interest-rate subsidies, loan guarantees, and insurance. Moreover, other countries offer similar types of credit programs, with no clear evidence of success.[23] More information is needed about similarities and differences in the U.S. and other countries' programs in enhancing the competitiveness of high-technology products. The extent to which the programs enhance American technological capabilities and foreign capabilities also needs to be considered.

Governmental Regulations

It has been suggested that government regulations may reduce productivity because they may divert resources to comply with regulations, adversely affect the efficient allocation of resources, and "delay or prevent remunerative projects using new technology."[24] Government regulations may be classified into two groups: social (health, safety, environmental) and economic (anti-trust).

The policy issue related to social government regulations is the possible decline in productivity and increase of production costs (specifically, regulations of production processes) and, thereby, the loss in comparative advantage to American exports. Alternatively, foreign firms have argued that U.S. product regulations and failure to recognize European tests of products serve as effective nontariff barriers to their exports.[25] The reports provide no specific recommended changes in social regulations as they relate to international transactions. Labor unions support the current regulations in this area and argue against any weakening of them. They do not, however, direct the discussion toward international trade and technology. (DPR Labor) Industry points out that U.S. regulations result in unnecessary and useless impediments in international

transactions and loss of markets. The industry report does not specify the regulations that inhibit overseas activities, except for antitrust. (DPR Industry)

With regard to economic regulations, industry recommends that the application of domestic antitrust regulations be minimized for international business transactions of large and small businesses alike. In particular, they want clarification of the applicability of antitrust laws to joint ventures with overseas firms. Industry argues that these and other regulations complicate international transactions and result in loss of business when attempts have been made to apply them to the behavior of individuals or corporations in a venture with an American firm, but outside the jurisdiction of the U.S.[26] (DPR Industry) Small businesses feel that they should be allowed exclusive grant-back rights to patentable improvements made by foreign licensees and partners, exclusive marketing rights in the U.S, and exclusive sourcing rights of materials and components, in order to compete on the same basis as large firms in world markets. Moreover, small businesses have proposed that the government could provide assistance in marketing their goods abroad through the formation of the Small Business Export Council and the Small Business Export Trade Corporation. (DPR Small Business, CTAB)

There are two policy changes that have been initiated. First, President Carter has directed the Department of Justice to clarify antitrust regulations on cooperative research activities among industrial firms. This direction, however, was not focused on international transactions but on stimulating industrial innovation in the U.S. (President)

Second, it has been argued that American firms face cartels of foreign producers for at least cartellike behavior.[27] Hence, changes in U.S. antitrust laws are needed to allow the formation of American export trading companies that can compete effectively in world markets and enhance American exports. There is legislation pending (Bill S.864, 96th Congress), sponsored by Sen. John C. Danforth, to amend the Webb-Pomerence Act of 1918. The Webb Act allows the creation of producer associations solely to engage in export trade. The proposed changes in legislation would amend the Webb Act to expand the antitrust exemptions and allow additional restraints on domestic trade (as long as they are incidental) and include services as well as goods. The associations would be administered by the Commerce Department and would be insulated from oversight from the Justice Department. Complaint procedures would be limited to federal agencies, with private parties having only the right to petition the Commerce Department to investigate an association's actions.[28]

It is unclear whether American firms are facing cartels or cartellike behavior in foreign markets and, if they are, what the losses or gains may be. One major objective of any cartel is to set prices of goods. It may well be that any foreign cartel situation may prove advantageous to American companies because they are able to predict prices (i.e., they are covered under the cartel umbrella), and they may compete effectively through pricing strategies (i.e., cut prices to gain market share and sales volume).

Along the same line of argument, American firms in an export cartel may very well set prices for international markets. The implication of such price setting behavior for the domestic market is clear--domestic prices are set. In other words, it would be difficult to differentiate pricing and marketing strategies developed for export markets from their influence on the domestic market.

Another important question is the extent to which such trade associations really promote exports from the U.S., especially high-technology products. A Federal Trade Commission report (1967) of associations founded under the original Webb Act indicates that the trade associations did not promote exports in any significant way. Rather, the successful associations were characterized by an oligopolistic producers' market, producing homogenous products. Their success lay not in expanding volume but in setting prices.[29] Hence, the Webb Act did not encourage the sale of technology intensive, differentiated products, where American past strength in export markets has been and is likely to remain.

Before any recommendation on changes in antitrust legislation for foreign markets is acted upon, the extent to which foreign cartels inhibit markets for American goods and the extent to which trade associations are likely to undermine domestic antitrust objectives and enforceability of such laws must be determined.

Conclusion

This review shows no agreement in recommendations made by large business, small business, and labor unions to the government on policies that should be pursued to enhance the relative technological capabilities of American firms and to promote international markets for high-technology goods and technology. The divergence in position not only indicates fundamentally different interests, but also suggests our lack of understanding of the effects of technology on international transactions and the American economy. Areas where further research is needed to improve understanding have been noted. In summary, they include the determination of (1) the direction and strength of causality in the relationship between R&D spending and export performance; (2) the effects of foreign direct investment and licensing on the competitiveness of high-technology American industries and on the U.S. economy; (3) the influence of tax policies and export credit and insurance policies in expanding markets for high-technology exports and enhancing the technological capabilities of American firms; and (4) the effects of government regulations on domestic innovation (and comparative advantage of American goods), as well as on domestic and international competition. A major difficulty in addressing these research questions is the problem of determining the interrelationships among R&D, innovation, international transactions, and government policies. Moreover, any examination of the effects of technology must take into account the transactions of foreign firms as well as American firms and ascertain the net impact on the balance of payments, the capabilities of American firms, and the U.S. economy.

This review discussed only those domestic policies that could be related to international transactions. Other papers prepared for the Colloquium examined specific categories of government policies (e.g., tax policies, regulations) that could affect domestic innovation. However, there is an international aspect of these types of policies that is not covered, i.e., international comparisons of government policies. Available research indicates that among Western European countries government policies to promote innovation have had few positive, and sometimes counterproductive, effects and have tended to favor large firms.[30] Two studies looked at foreign government incentives in the electronics industries and found that they tended to weaken rather than strengthen the long-run competitive positions of the industries.[31] In addition, while government R&D incentives for selected industries may increase the competitiveness of these industries, through cost and product improvements, these policies may lead to a deterioration in the trade positions of other industries. In other words, account should be taken of interindustry effects.[32]

The review indicates no majority policy changes that would, beyond doubt, enhance the competitive position of the U.S. in international markets. In addition, the President's message to Congress (October 31, 1979) includes no changes or initiatives in this area.

FOOTNOTES

[1]See Edwin Mansfield, Anthony Romeo, and Samuel Wagner, "Foreign Trade and U.S. Research and Development," Review of Economics and Statistics, forthcoming; Edwin Mansfield, "International Technology Transfer and Overseas Research and Development," Statement to U.S. Senate Commerce Committee, May 16, 1978.

[2]See NRC/NAE Report, Chapter 4, for an elaboration of labor concerns.

[3]See J. Fred Bucy, "Technology Transfer: We're Still Selling Them the Rope," Government Executive (September 1978), pp. 37-41.

[4]See American Enterprise Institute, Proposals for Reform of Export Controls for Advanced Technology (Washington, D.C.: AEI, August 1979), for an analysis of current proposals before Congress.

The Export Administration Act of 1979 (Public Law 96-72, 96th Congress), extending for four years the nation's basic export control law, was signed by President Carter on September 29, 1979, and became effective October 1, 1979. This act provides several provisions that correspond with recommendations made: review of export control list within specified time frames, review of foreign availability of goods and technologies on specified schedules, review of possible effects of control, and time limits for actions on licensing applications. (DPR Industry, CED, and NRC/NAE)

See "Streamlining the Export Control Process," Business America (November 5, 1979), pp. 8-12, for a discussion of the provisions.

[5]See Michael Boretsky, "Concerns About the Present American Trade Position in International Trade," National Academy of Engineering, Technology and International Trade, Proceedings of the Symposium at the

Sixth Autumn Meeting, 1970; William H. Branson and Helen B. Junz, "Trends in U.S. Trade and Comparative Advantage," Brookings Papers on Economic Activity 2, Edited by Arthur Okun and George L. Perry (Washington, D.C.: Brookings Institution, 1971); W. Gruber, D. Mehta, and R. Vernon, "The R&D Factor in International Trade and International Investment of U.S. Industries," Journal of Political Economy (February 1967), pp. 20-37; G. C. Hufbauer, "The Impact of National Characteristics and Technology on the Commodity Composition of Trade in Manufactured Goods," Ray Vernon, ed., The Technology Factor in International Trade (New York: National Bureau of Economic Research, 1970) pp. 145-231; D. B. Keesing, "The Impact of Research and Development on United States Trade," Journal of Political Economy (February 1967); Regina K. Kelly, "The Impact of Technological Innovation on International Trade Patterns," Staff Economic Report, Office of Economic Research, U.S. Department of Commerce (December 1977); Keith Pavitt, "Technical Effort and Economic Performance: Some International Comparisons," mimeo, 1978; M. V. Posner, "International Trade and Technological Change," Oxford Economic Papers (October 1961), pp. 323-341.

[6]Edwin Mansfield et al., "Overseas Research and Development by U.S.-Based Firms," Review of Economics and Statistics (forthcoming); "Foreign Trade and U.S. Research and development," Economic Journal (forthcoming); Edwin Mansfield, "Returns from Industrial Innovation, International Technology Transfer, and Overseas Research and Development," Relationship Between R&D and Returns from Technology, National Science Foundation Colloquium, May 21, 1977.

[7]Rachel McCulloch, Research and Development as a Determinent of U.S. International Competitiveness (Washington, D.C.: National Planning Association, 1978).

[8]D. B. Keesing, "Labor Skills and Comparative Advantage," American Economic Review, May 1966.

[9]R. A Vernon, "International Investment and International Trade in the Product Cycle," Quarterly Journal of Economics, May 1966, pp. 190-207; L. T. Wells, ed., The Product Life Cycle and International Trade (Harvard University, Graduate School of Business Administration, 1972).

[10]See Robert E. Lipsey and Merle Y. Weiss, Exports and Foreign Investment in Manufacturing Industries (New York: National Bureau of Economic Research, 1976); Edwin Mansfield, "The Relationship between International Technology Transfer and R&D Expenditures by U.S. Firms," presented at the American Economic Association Meetings, December 1978.

[11]William F. Finan, The International Transfer of Semiconductor Technology Through U.S.-Based Firms (New York: National Bureau of Economic Research, 1975); Arthur Lake, Foreign Competition and the U.K. Pharmaceutical Industry (New York: National Bureau of Economic Research, 1976); D. J. Teece, "Technology Transfer by Multinational Firms: The Resource Costs of International Technology Transfer," Economic Journal (June 1977).

[12]W. Halder Fisher, Technology Transfer as a Motivation for United States Investment by Foreign Firms (Columbus: Battelle Memorial Institute, 1977); National Academy of Engineering, Technology Transfer

from Foreign Direct Investment in the United States (Washington, D.C.: NAE, 1976).

[13]Piero Telesio, Foreign Licensing Policy in Multinational Enterprises, doctoral dissertation, Harvard University, Graduate School of Business Administration, 1977; Arthur Lake, Transnational Activity and Market Entry in the Semiconductor Industry (New York: National Bureau of Economic Research, 1976); Arthur Lake, Foreign Competition and the U.K. Pharmaceutical Industry (New York: National Bureau of Economic Research, 1976); David Teece, "Technology Transfer by Multinational Firms: The Resource Cost of International Technology Transfer," Economic Journal (June 1977).

[14]See NRC/NAE report, Chapter 6.

[15]See Anita Benvignati, International Technology Lags: The Case of Textile Machinery, University of Pennsylvania, 1978, unpublished dissertation; C. Freemen, "Research and Development in Electronic Capital Goods," National Institute Economic Review, Vol. 34 (November 1965), pp. 40-91; "Chemical Process Plants: Innovation and the World Market," National Institute Economic Review, Vol. 45 (1968); "The Plastics Industry: A Comparative Study of Research Innovation," National Institute Economic Review (November 1963); Papers and Proceedings of a Colloquium on the Effects of International Technology Transfers in the U.S. Economy, National Science Foundation, July 1974 (Washington, D.C.: GPO, 3800-00181); G. C. Hufbauer, Synthetic Materials and the Theory of International Trade (London, 1965); G. C. Hufbauer and F. M. Adler, Overseas Manufacturing Investment and the Balance of Payments, Tax Policy Research Study, No. 1, U.S. Department of Treasury (Washington, D.C., U.S. Government Printing Office, 1968).

[16]The discussion on tax incentives is provided below. The recommendations cover both developed and developing nations, with a greater incentive for investments in developing countries.

[17]See National Science Foundation, Science Indicators, 1978 (Washington, D.C.: National Science Foundation, 1979).

[18]Organization for Economic Cooperation and Development, The Impact of the Newly Industrializing Countries on Production and Trade in Manufactures, Report by the Secretary-General (Paris: OECD, 1979).

[19]The NRC/NAE report recommended that the U.S. should strive for tax "neutrality," providing neither incentives nor disincentives for foreign investment by America firms. It was recognized, however, that a major difficulty in considering this recommendation is determining what constitutes tax neutrality, and further study was recommended. See p. 80-81.

[20]Robert S. Kaplan, Tax Policies for R&D and Technological Innovation, Chapter 1, "Tax Policies of U.S. and Foreign Nations in Support of R&D and Innovation," Carnegie-Mellon University (Washington, D.C.: NTIS, 1976).

[21]Business America (December 4, 1978), pp. 3-6.

[22]See Robert J. Samuelson, "The Export Credit Subsidy Game--If You Can't Lick 'em, Join 'em," National Journal (April 14, 1979), pp. 587-602.

[23]See Export Stimulation Programs in the Major Industrial Countries: The United States and Eight Major Competitors, prepared for

the Committee on International Relations, U.S. House of Representatives by the Foreign Affairs and National Defense and Economics Divisions, Congressional Research Service, Library of Congress, October 6, 1978 (Washington, D.C.: U.S. Government Printing Office, 1978).

[24]See Edward F. Denison, "Explanations of Declining Productivity Growth," Survey of Current Business, Part II (August 1979), pp. 1-24.

[25]For the opposing positions, see "Do Producers Need a 'Measure' of Protection," Chemical Week (May 2, 1979) and "Will Toxic Substances Laws Be Trade Barriers?" Chemical Week (March 7, 1979).

[26]See Douglas Ginsburg, "Comparative Analysis of Recent Studies of Antitrust Policies Affecting Industrial Innovation," prepared for the Antitrust Panel, NAE Steering Committee on Industrial Innovation and Public Policy Options, mimeo., November 5, 1979. The paper provides a complete discussion of issues and questions about antitrust and innovation.

[27]U.S. Export Policy, A report submitted by the Subcommittee on International Finance to the Committee on Banking, Housing, and Urban Affairs, U.S. Senate, February 1979 (Washington, D.C.: Government Printing Office, 1979).

[28]Emile Sherer Finley, "The Realities of United States Foreign Trade and the Fictions of Our Cartel Advocates," National Journal (May 5, 1979), pp. 758-763.

[29]Ibid.

[30]See H. Holloman, et al., National Support for Science and Technology: An Examination of Foreign Experience, Center for Policy Alternatives, Massachusetts Institute of Technology, Cambridge, (Washington, D.C.: NTIS, 1976); Keith Pavitt and W Walker, "Government Policies Towards Industrial Innovation: A Review," Research Policy (January 1976), pp. 11-97.

[31]See J. Zysman, "Between the Market and the State: Dilemmas of French Policy for the Electronics Industry," Research Policy (October 1975), pp. 312-336; P. Drath, M. Bibbons, and R. Johnston, "The Super Computer Project: A Case Study of the Interaction of Science, Government, and Industry in the U.K.," Research Policy (January 1977), pp. 2-34.

[32]See McCulloch, op. cit., for a description of potential sectoral effects.

IV. FEDERAL R&D SUPPORT

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ANALYSIS

This paper presents a comparative analysis of the principal recommendations on federal R&D support contained in the following documents and reports on national policies affecting industrial innovation:

		Abbreviation
1.	President's Message on Industrial Innovation and White House Fact Sheet (October 31, 1979)	President
2.	Selected reports of Subcommittees of the Advisory Committee on Industrial Innovation established as part of the President's Domestic Policy Review on Industrial Innovation:	
	a. Report on Direct Federal Support of Research and Development (December 21, 1979)	DPR R&D
	b. Report on Federal Procurement Policy (December 22, 1979)	DPR Procurement
	c. Report of Public Interest Advisory Subcommittee (December 28, 1978)	DPR Public Interest
	d. Report of Small Business Members (May 1, 1979)	DPR Small Business
3.	Draft report of the Committee for Economic Development "Stimulating Technological Progress" (September 1979)	CED
4.	Report of the Commerce Technical Advisory Board "Recommendations for Creating Jobs through the Success of Small Innovative Businesses" (December 1978)	CTAB

Table IV-1 shows the principal recommendations on federal R&D support in these documents, grouped in six categories. The categories overlap, but serve to show the types of federal R&D support the reports considered significant for industrial innovation. As indicated by the symbols "X" and "O," there is a variety of recommendations in each of the categories. Convergences are indicated by instances where the same or similar recommendations are supported in two or more reports; some further convergences in policy direction are evident even where the

TABLE IV-1 Recommendations on Federal R&D Support for Industrial Innovation

Issues and Recommendations	President	DPR Advisory Committees: DPR R&D	DPR Procurement	DPR Public Interest	DPR Small Business	CED	CTAB
Federal support of R&D on commercial technology							
Establish "Generic Technology Centers"	X	X		O			
Support research not supplied by industry				X			
Foster "appropriate technology"				X			
Decrease applied research in universities and government labs					O		
Avoid direct federal support						O	
Federal support of R&D in small business							
Enhance small business participation in federal R&D	X	X		X	X		X
Increase the small business share of federal R&D	X				X		X
Establish new institutional mechanisms		X					
Sponsor federal-state extension service type programs		X		X			
Expand NSF small business programs	X		X		X		
Assist development of "compliance technology"	X			X			
Establish "Corporations for Innovation Development"	X			X			
Redirect some agricultural research							X
No preferential support for small business R&D (implied)						O	
Federal support for industry R&D at universities							
Support by tax credits or incentives		X	X			X	
Support by matching grants		X					
Expand NSF support of joint industry–university proposals	X						
Decrease support of applied research at universities					O		
Federal support of technology transfer							
Allocate 5 percent of each R&D project							X
Sponsor federal-state extension-type programs		X		X			
Establish new "Centers for Utilization of Federal Technology" in NTIS	X						
Utilize proposed "Generic Technology Centers"	X	X					
Support of R&D through federal procurement							
Encourage procurement of innovative items	X		X	X		X	
Liberalize IR&D policies			X		X		
General and miscellaneous							
Increase total level of federal R&D support			X		X		
Be restrictive in federal support of applied research and development					O	O	
Increase federal support of basic research	X				X	X	
Improve handling of federal research at universities		X	X		X	X	
Review appropriateness of R&D at federal labs			X		O		
Redirect defense R&D to civilian needs				X			

"X" and "O" indicate recommendations in each report.
"O" indicates a major policy divergence.

specific proposals vary. Major policy divergences are highlighted by the use of "0" rather than "X".

The Reports

Before we analyze the recommendations in each category, it will be useful to characterize briefly each of the documents and reports and summarize its principal recommendations relating to federal R&D support.

The President presents the offical conclusions and recommendations of the Carter Administration that have emerged from the Domestic Policy Review (DPR) on industrial innovation. The recommendations relating to federal support of R&D include (1) enhancing the transfer of federally developed technology by creating a "Center for Utilizing Federal Technology" in the Department of Commerce National Technical Information Service (NTIS); (2) establishing "Generic Technology Centers" jointly financed by industry and government to develop and transfer technologies that underlie the needs of industrial sectors; (3) bolstering federal efforts in the development of "compliance technology" to provide innovative ways of meeting regulatory objectives at least cost; (4) fostering innovation in small-high technology firms by (a) expanding the current National Science Foundation (NSF) small business innovation research program, (b) supporting state or regional "Corporations for Innovative Development" to assist new ventures in obtaining start-up capital, (c) improving the opportunities for small business to compete for federal R&D contracts, and (d) changing certain federal regulations to encourage the availability of general venture capital; and (5) changing federal procurement policies and practices to increase the federal market for industrial innovations. The President's message and the White House Fact Sheet do not assign priorities to the recommendations nor attempt to assess their expected impact on innovation. But it is clear that the proposed initiatives on federal support of R&D are a major component of the administration's program for encouraging industrial innovation.

The DPR R&D report is the only one of the reports reviewed that focuses entirely on the topic of federal support of R&D to stimulate innovation. It identifies and makes recommendations in three areas in which direct federal support is expected to induce an accelerated rate of innovation: (1) improvement of the coupling of university research with industry by federal tax credits or matching grants, (2) preferential support for R&D in technology-based small business ventures, and (3) direct federal support, together with industry, of R&D (and transfer) of generic technology through a network of "Cooperative Technology Centers." The report does not assign priorities to its recommendations or seek to relate them to other measures to enhance innovation, but the report is clearly supportive of the use of federal funding of R&D for this purpose.

The DPR Procurement report addresses a wide range of aspects of federal procurement policy that relate to innovation. In the field of federal R&D support its recommendations include (1) liberalization of policies on independent research and development (IR&D), (2) use of

federal procurements to stimulate the development of innovative items, (3) a national policy to reverse the decline of federal R&D expenditures as a percent of the federal budget, (4) tax deductible grants for industry-funded research at universities, (5) NSF support of R&D by small innovative firms, (6) a review of the appropriateness of technical programs at federal laboratories, and (7) reform of federal procurement of R&D at universities.

The DPR Public Interest report looks at innovation from some of the broad social perspectives of public interest groups. Its recommendations relating to federal R&D support include (1) federal support of R&D on "appropriate technology," (2) establishment of federal-state extension services to foster development of technology suitable for small business, (3) use of technology forcing yardsticks by GSA in federal procurement, (4) federal assistance for regulation "compliance technology" where needed, (5) support for state-level development corporations to provide commercialization capital, and (6) an assessment to determine where and how government spending on R&D for defense can be converted to civilian needs. The report accepts the need for federal support of basic and applied research, which is not being supplied by private industry in priority areas.

The DPR Small Business report primarily addresses the effects of domestic policies of the federal government on innovation by small business. With respect to federal support of R&D it contains recommendations that (1) the decline in R&D expenditures as a percent of GNP be arrested and redirected to a goal of three percent, (2) at least ten percent of federal R&D funds be allocated to small business, (3) decreased emphasis be placed on applied research in federal laboratories and nonprofit institutions, (4) federal funds be prohibited from being used to finance R&D projects that are competitive with or duplicatory of private sector technological developments, and (5) IR&D costs of small business be allowed at double or more the rate allowed for large business.

CED addresses the problem of innovation in a broad economic context. On federal support of R&D it supports (1) increased governmental support of basic research, especially at universities; (2) tax deductions for industry support of nonproprietary research at universities; and (3) use of government procurement in civilian markets to stimulate innovation when it can be done efficiently. CED opposes proposals for direct federal support of R&D directed at technological innovation as an end in itself and believes that direct federal support of R&D, other than basic research, should be undertaken only under limited special circumstances (i.e., to meet direct federal needs and responsibilities) or in exceptional cases where the private sector is unable to meet the need either by itself or with indirect, less intrusive government incentives. The CED report recognizes enlarged direct federal support of R&D on this selective basis as an important means of meeting the government's responsibilities and also as a positive contribution to a favorable climate for private sector innovation, but believes that the CED's other policy recommendations on taxes, regulations, and patents are more important for spurring the introduction and diffusion of new technologies.

CTAB addresses the factors considered important for the success of small innovative business. Its principal recommendations relating to federal support of R&D are that each agency be required to allocate at least ten percent of its R&D funds to small business and five percent to organized technology transfer programs. It also recommends encouragement of small business sponsorship of research at universities by allowing a double deduction from income taxes and a redirection of federally supported agricultural research to the development of technology for improving the efficiency of small family farms and food processors.

General Discussion

The principal divergence in the recommendations of the reports reviewed is a basic difference in view on the role of the federal government. All of the reports except CED advocate or accept the need for one or more forms of direct federal support of R&D to foster industrial innovation. As noted above, the CED report opposes federal support of R&D for innovation as an end in itself and advocates restrictive policies on the scope of federal support of applied research and development. While couched in undogmatic terms and admitting that special circumstances may warrant exceptions, the CED report raises a fundamental policy question on the role of the federal government in fostering industrial innovation. As noted above, it also raises the question of the relative priority of direct federal support of R&D and indirect mechanisms to foster innovation such as changes in tax, regulatory, and patent policies.

Prior to the President's message of October 31, 1979, the official position of the Carter (and the Ford) administration on the role of the federal government in the support of R&D corresponded closely to the CED position, i.e., that the federal government has legitimate roles in the support of basic research generally and of applied research and development to meet federal mission responsibilities, but that the private sector should be relied on for support of applied research and development for general industrial and economic development. The President, as we have seen, departs from this policy in advocating a number of types of direct federal support of R&D to foster innovation in the private sector. While the degree and types of federal support endorsed are limited, and primary reliance would still be on the private sector, the initiatives recommended by the President to include positive federal actions in each of the principal areas of possible federal support identified in the other reports. The acceptance by the Carter administration of support of R&D for private sector innovation as a legitimate federal role may represent a significant policy change.

Issues and Recommendations

We now consider the various recommendations in each issue area, indicate the divergences to be resolved, and suggest the next steps required to implement the recommendations.

Federal Support of R&D on New Technology

Both the President and the DPR R&D report propose the establishment of new centers for development of generic technologies to be jointly financed by the federal government and industry. The proposal outlined by the President is that the first four centers (three sponsored by Commerce, one by NSF) be established in FY 1981 at a cost of $6-8 million. This proposal is consistent with, but less detailed than, the recommendations in the DPR R&D report which gives a number of guidelines for the structure and functioning of the centers. Neither the President nor the DPR R&D report is clear on how the generic technologies to be addressed are to be selected and the necessary institutional arrangements made. The position outlined is not inconsistent with the more general views expressed in the DPR Public Interest report; presumably the "appropriate technology" endorsed by DPR Public Interest might perhaps be subsumed in one or more of the "generic technologies."

The CED report, in line with its general position discussed above, explicitly opposes "broad technology centers jointly financed by government and industry to undertake non-proprietary applied industrial research" except in exceptional critical cases. Another divergence between the President and the DPR R&D recommendation is implict in the DPR Small Business report which states that federal support of applied research in universities and federal laboratories should be cut back in favor of support and other encouragement of R&D performed by small business. An agenda to proceed in this area could be as follows:

1. Debate and resolve the policy divergence on the federal role noted above between the President's and the DPR R&D view on the one hand and those in CEB and DPR Small Business reports on the other.
2. If the DPR R&D view is supported, consider and develop proposals on the processes to be followed in (1) selecting the generic technologies to be addressed and (2) establishing the industrial sponsorship for and location of each center. A key question will be the mechanisms for industry and other nonfederal participation in these processes.
3. Consider whether additional legislative authority is required. If so, alternative proposed legislation should be drafted for consideration by the interested public and private sectors and the Congress.

Federal Support of R&D in Small Business

All of the reports except CED and DPR Procurement favor enhancement of small business participation in federal R&D and some forms of preferential support for R&D in small business itself. CED and DPR Procurement are silent on these subjects. DPR Procurement appears to be neutral on these issues, but in the case of CED, silence must be interpreted as opposition in view of the general CED position on federal support of R&D.

There is a wide variety in the recommendations for federal support of R&D in small business. The recommendations are not mutually exclusive, so if it is accepted that federal R&D support is appropriate, specific measures can be selected on the basis of expected efficacy, cost, or other factors.

- The President, the DPR Small Business report and CTAB favor increasing the proportion of federal R&D dollars going to small business--the President through policies mitigating current obstacles, the DPR Small Business report and CTAB through required set-asides with a target of at least ten percent of federal R&D dollars.
- DPR R&D believes there should be new mechanisms of support for small business R&D and suggests three possibilities for consideration: a National Advisory Committee for Aeronautics style "National Advisory Committee for Technology," a Federal Housing Administration style institution to make low-interest loans, or a federal sponsorship of state programs in the agriculture pattern (a suggestion also made in the DPR Public Interest report).
- The President's, DPR Procurement, and DPR Small Business documents propose expansion of the existing NSF Small Business Innovation Research Program, including possibly the establishment of similar programs in other agencies. It is reported that the President will propose an increase from $2.5 to $10 million in the NSF FY 1981 budget and set a future goal of $150 million per year.
- The President and the DPR Public Interest report both support the principle of federal support of the development of "compliance technology" to help small business deal with the regulatory environment.
- The President and the DPR Public Interest report recommend the establishment of state or regional "Corporations for Innovation Development" (CID's) to provide small new ventures with start-up capital to develop and market innovative items. The President states that the department of Commerce will support two regional CID's in FY 1981 with $4 million each in matching loans.
- CTAB makes a recommendation that federal support of agricultural research be redirected to give more support to the needs of small family-size farms and other small business enterprises in agriculture and food processing. The agenda in this area could be (1) debate and resolve the policy divergence on the federal role with respect to R&D in small business; (2) if the need for federal action is accepted, assess the merits and expected impact of the various measures proposed and select those to be implemented; and (3) consider the needs for legislation and prepare the necessary drafts.

Federal Support for Industry R&D at Universities

The DPR R&D and the DPR Procurement reports advocate the use of tax credits or other tax incentives to encourage increased industry sponsorship of research at universities as a means to enhance innovation in industry; support for this recommendation is implied but not explicit in CED. DPR R&D recognizes that passage of tax credit

legislation may be difficult to achieve and therefore recommends a scheme of matching grants as a transition mechanism. Federal matching funds would be automatically provided from an appropriation for this purpose to support industry selected programs in a way that would seek to minimize federal involvement. The President agrees with the importance of increasing university research for industry but proposes to do this through an expansion of the current NSF program of grants in partial support of joint university-industry proposals. The President states that $20 million of new funds will be budgeted for this program starting in the FY 1981 budget and that efforts will be made to establish similar programs in other agencies aimed at an aggregate of $150 million per year. A divergent note is struck, however, by the DPR Small Business recommendation that federal support of applied research at universities should be reduced and channeled to small business concerns instead. The action agenda could be (1) debate and resolve the policy issue on universities and small business raised by DPR Small Business; (2) if increased support of universities is accepted as an objective, consider the alternative mechanisms--tax credits or incentives, simple matching grants, or the support of joint proposals in the NSF pattern; and (3) consider the need for and draft any necessary legislation.

Federal Support of Technology Transfer

There appears to be a consensus on the desirability of facilitating the transfer to private sector use of new technology developed in federal R&D programs. CTAB proposes that five percent of the funding for each federal R&D project be earmarked to support technology transfer activities. The DPR R&D and Public Interest reports suggest the establishment of federal-state extension services in the agriculture pattern. DPR R&D and the President see improved technology transfer as one of the functions of the proposed "Generic Technology Centers." The President proposes the establishment of a new "Center for Utilization of Federal Technology" within the existing Department of Commerce National Technical Information Service (NTIS) and certain other measures to expand the availability of information on new domestic and foreign technology. The action agenda would appear to include selection of the measures to be implemented and provision of the legislative authority and budgetary support needed.

Support of R&D through Federal Procurement

Here again there is a broad consensus. All reports support and none opposes the idea that federal procurement policies and practices be modified where necessary to encourage the procurement of innovative items. It seems generally agreed that the federal government can and should encourage innovation in industry by providing a market for innovations that meet federal needs. The DPR Procurement and Small Business reports go on to make specific recommendations that federal

policies on contractors's independent research and development (IR&D) be liberalized. DPR Procurement proposes a wider definition of allowable IR&D costs and less federal review; DPR Small Business advocates preferential treatment of small business IR&D. A possible action agenda is: (1) identify and develop in detail the specific changes in federal procurement regulations that are needed; (2) consider the merits of the DPR Procurement and the DPR Small Business recommendations on IR&D and formulate the changes in regulations and practices required; and (3) take the necessary implementing actions--legislation, if needed, and promulgation of revised regulations.

General and Miscellaneous

Each of the recommendations under this subheading needs to be considered on its merits as it may contribute to industrial innovation.

1. DPR Procurement and DPR Small Business recommend an increase in total federal R&D support as a matter of policy. The basic questions raised by this recommendation are what areas of federal R&D should be inceased and whether such increases would materially affect innovation in industry.

2. On the other hand, CED and DPR Small Business recommend that federal support of applied R&D be restricted on a policy basis generally consistent with the present basic federal R&D policy of relying on the private sector in these areas (see President's message of March 27, 1979). The relevance of this recommendation to industrial innovation is not clear. To the extent there is an implication that federal R&D activities serve to impede industrial innovation, substantiation and consideration on a case-by-case basis are needed.

3. CED, DPR Small Business and the President advocate increased federal support of basic research. Since this appears to be settled federal policy in the Executive Branch and Congress, the issue does not seem to need special attention from the standpoint of innovation in industry.

4. There is a consensus among DPR R&D, DPR Procurement, DPR Small Business, and CED that the effectiveness of university research as it affects innovation could and should be increased by changes in the way it is administered. DPR R&D favors a return to the former Office of Naval Research (ONR) approach; other reports favor simplification of procedures, broader concepts of accountability, etc. These questions deserve consideration on their merits and in a context much broader than their impact on industrial innovation.

5. DPR Procurement and DPR Small Business are concerned with the appropriateness of research done in federal laboratories. DPR Procurement asks for a review and assessment; DPR Small Business recommends that some of their applied research activites be shifted to small business concerns. The underlying policy question is whether the talents of federal laboratories should be directed in part at R&D that contributes to private sector innovation or whether they should be

restrained from such activities to avoid preempting private sector opportunities. A selective policy might be able to identify areas where federal laboratories could contribute without inhibiting private initiatives.

6. DPR Public Interest raises the question of balance between defense and civilian oriented R&D and favors efforts to adjust the balance in favor of nondefense social needs. This does not seem to be an issue that should be dealt with in the context of industrial innovation.

Conclusions

There is major disagreement in the reports reviewed on the role of the federal government in direct support of R&D for new technology. CED in general opposes such a role. The other reports generally endorse it. DPR R&D indicates a limited move by the administration in the direction of direct support.

There is broad consensus on the need for federal actions to foster R&D in small business, industry research at universities, transfer of federal technology to the private sector, and innovative R&D through federal procurement.

In the areas of consensus, the next steps are to decide on the best mechanisms and the degree to which they are to be implemented. The policy disagreement on the federal role requires further debate followed by resolution or compromise.

SUMMARY OF PANEL DISCUSSION

Chairman Charpie opened the session by stating four key questions that need answering for developing a consistent policy for federal R&D support related to industrial innovation: (1) Should the federal government be responsible for enhancing R&D directed at industrial innovation? If so, should there be direct support or indirect encouragement? (2) What changes should be made in current federal patterns and systems of supporting R&D? (3) What impacts on innovation can reasonably be expected from changes in federal support for R&D? (4) How do we sort out the priorities in the wide variety of measures that have been suggested to enhance U.S. industrial innovation?

Beno Sternlicht, the first panel speaker, stressed the seriousness of the innovation problem ("a slow terminal illness"), the widespread frustration with the continual "recycling of findings and recommendations," and his disappointment with the initiatives recommended by the President, especially with the omission of proposals for tax incentives or changes to encourage innovation. Mr. Sternlicht offered four specific recommendations: (1) acceptance of the need for a partnership between industry and government; (2) establishment of a government-industry-university National Council on Industrial Innovation; (3) establishment of a national engineering foundation, similar to the NSF; and (4) creation, through appropriate incentives, coupling of resources, education, and motivation, of a climate conducive to risk taking, which in turn would enhance industrial innovation.

Sidney Hess focused his remarks on the university-industry interface, which he believes needs rebuilding. He noted that it is important for industry to have some input into university research by providing significant research problems to be worked on. To foster innovation, areas of research should be pinpointed by people who want to innovate from them--not the NSF but industry. The question is how to stimulate industry to fund research at universities. Dr. Hess believes "a little pump priming" from the government is needed and pointed to the recommendations in DPR R&D for tax credits or matching grants. Industrial companies could put up amounts they can afford; in combination they could thereby accomplish university research useful to each of them. A useful by-product would be better mutual understanding between universities and industry.

Professor Mills began by noting two basic assumptions on which most people seemed agreed: (1) market incentives do not provide an adequate amount of R&D, even for new commercial products and processes and (2)

decisions on R&D directed at commercial applications ought to be made by those who expect to produce and market the products. From these two assumptions he drew two conclusions: (1) the government should get involved in the R&D required, but (2) it should get involved in an indirect way (e.g., tax credits) that leaves the R&D decisions to the private sector. He explained that this reasoning was the basis for the CED's opposition to cooperative federal-industry undertakings like the proposed generic technology centers. He made it clear, however, that he and CED were not opposed to federal support of basic research, of R&D when the federal goverment is the user, or of R&D in selected cases like health, enviroment, and energy, where the special circumstances justify direct federal support.

Philip Smith concurred generally in Professor Mills' articulation of the issues relating to federal sponsorship and investment in R&D. He noted the clear consensus in the leadership of both the Ford and Carter administrations on the important role of the federal goverment in the support of long-term basic research and mentioned the special efforts during the last three years to get more longer-term research going in the Department of Defense and other major agencies. The questions of how far the federal government should go in applied research, in energy for example, or in stimulating innovation are harder to resolve. On innovation, the administration has tried to take a course that gives several responses to the many inputs received over the last two years. One important need is to restore communication and collaborative activity between industry and universities. Another is the development by the Department of Justice of guides on joint ventures. Federal support of generic technology is at the boundary line from the administration's perspective. The examples of Germany and Japan suggest that the U.S. needs more work in generic R&D, with government and industry working in partnership. The administration's conclusion is that, to a limited degree, this is a desirable thing to <u>experiment</u> with. It recognizes that the government should not try to get into product development, marketing, and delivery at the federal level. Hence, in the experimental approach to federal support for generic technology, the boundary is being drawn a little more tightly, bringing it closer to what would be truly fundamental work. In summary, on direct federal intervention, the administration is taking a limited and experimental approach and does not believe it is appropriate to go much further. Beyond this it seems clear that indirect approaches--like incentives, tax adjustments, loans, loan guarantees, and special arrangements for small business--are the way to go.

Albert Murray, substituting for Thomas Moss, questioned whether the President's statement on innovation represented a significant policy change, as suggested in the analysis prepared for the symposium. He cited the expansion many years ago of the NSF charter to include applied research and a later directive from President Nixon permitting the NSF to do business with <u>for-profit</u> organizations. He discussed the way the NSF small business research program has been operating and emphasized that the requirement that recipients of these NSF research funds obtain commitments of private venture capital serves to bring

private sector judgments into the selection of the research to be supported. Thus, the government objectives of supporting certain kinds of research and the industrial objectives of marketable products are brought together, but at the same time kept "delicately separated." In the case of generic technology centers it will require a neat balancing job to maintain this kind of distinct separation between the roles of government and industry, to protect the interests of each partner, while still allowing the forward transfer and feedback of research interests and results.

Ronald Konkel spoke, briefly, from the standpoint of an OMB examiner dealing with the difficult problems of shoehorning a lot of things into a fiscally constrained total budget. He pointed out that the success of the experiments with federal support of generic technology will depend a lot on the degree and quality of the response from industry. His expectation is that, if industry comes to bat and makes the case in specific areas that this is a useful thing to do, the generic technology program will be significantly expanded. He also noted that the federal government does indeed support much applied research, in the Defense Department and many other mission agencies. Beyond this, he suggested that, perhaps, the federal government has an appropriate role to play in "step function changes in technology." He noted that when the government does make a commitment, as in space or energy, it gets involved across the whole spectrum of R&D activities.

The general discussion following the statements by panel members was wide ranging.

- On university-industry relations, several speakers pointed to the importance of the exchange of people and personal contacts between industry and universities. The point was made that industry should recognize the full costs, indirect as well as direct, of university research and should deal with universities in a generalized, not micromanagement, approach.
- On the international side, Allen Smith, the Office for Economic Cooperation and Development, noted some difficult international implications of U.S. policies and actions on innovation. John Thompson, of the British Embassy, referred to some relevant British experiences and offered the assistance of the British research associations and National Research Development Corporation in setting up the generic technology centers and the CID's.
- Mr. Steinberg, of Lockheed, was struck with the timidity and small scale of the administration's approach to generic technology centers compared with the European approach and urged a more flamboyant approach and more risk taking.
- In commenting on some of the discussion, Mr. Mills surmised that it would be hard to agree on what industries are most deserving of federal support for R&D to promote their technologies, but that it would be easy to agree that the auto industry, which has been selected, is one of the least deserving.
- Several speakers expressed the hope that the National Academy of Engineering would undertake follow-up actions to the symposium.

In concluding the session, Dr. Charpie summarized it in headline form as follows:

There is little new in the latest round of innovation studies. On direct federal support of R&D, we heard from the studiers that climate is everything: improve the climate. Rebuild the university-industry interface. Government should not directly fund R&D aimed at marketable new products and processes, but should directly fund basic research, R&D in those areas where government is the buyer of the results, and R&D related to health, environment, and perhaps energy.

From the receivers, the listeners, the analyzers, the legislators, we hear that direct federal support of R&D, while it is tricky, is important and very necessary in many areas. But be careful. Be willing to be bold, to experiment with novel mechanisms. Government is not good at picking winners, but government can and should be prepared to directly support industrial-type R&D, without getting involved in making selections and picking winners. There are ways we know about which will work.

The generic technology concept is really new ground for the U.S. Let's try it, see if we can make it successful as a catalyst for industrial innovation.

Advice to the Academy: don't drop the innovation ball after this colloquium. And from our friends in the U.K., a generous offer to give us the benefit of advice from their research associations and the NRDC organization in putting together the new generic technology centers and the CIDs.

Your panel chairman's contribution is headlines of headlines. One, stop studying innovation. We know all we need to know. Two, don't try to organize innovation; it can't be done. Three, reward successful innovation. Make it readily possible for a successful entrepreneur to be a multimillionaire. And four, lionize or advertise or celebrate--you pick the verb--the successful entrepreneurs, for we do know that entrepreneurship breeds entrepreneurships.

V. REGULATION AND INDUSTRIAL INNOVATION

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ANALYSIS

This paper provides an analysis of the policy recommendations on government regulations presented in several recent studies of national policies influencing industrial innovation. It is confined to an analysis of regulations in the health, safety, and environmental areas and does not consider economic regulations specifically designed to control prices or market entry (i.e., public utility regulation, general price controls, etc.).

The reports surveyed in this paper are:

1. President Carter's Message to the Congress on Industrial Innovation Initiatives, October 31, 1979 (President)
2. Domestic Policy Review, Advisory Committee on Industrial Innovation, Advisory Subcommittee on Environmental, Health, and Safety Regulation, Draft Report, December 20, 1978 (DPR Environmental, Health and Safety)
3. Domestic Policy Review Advisory Committee on Industrial Innovation, Advisory Subcommittee on Regulation of Industry Structure and Competition, Draft Report, December 20, 1978 (DPR Regulation)
4. Domestic Policy Review, Advisory Committee on Industrial Innovation, Public Interest Advisory Subcommittee, Draft Report, December 28, 1978 (DPR Public Interest)
5. Domestic Policy Review, Advisory Committee on Industrial Innovation, Labor Advisory Subcommittee, Draft Report, December 22, 1978 (DPR Labor)
6. Domestic Policy Review, Advisory Committee on Industrial Innovation, Report of the Small Business Members, May 1, 1979 (DPR Small Business)
7. Commerce Technical Advisory Board, Recommendations for Creating Jobs Through the Success of Small, Innovative Businesses, December 1978 (CTAB)

8. Committee for Economic Development, Stimulating Technological Progress, Draft Statement, September 19, 1979 (CED)
9. Committee on Technology and International Economic and Trade Issues, Assembly of Engineering, National Research Council, and Office of the Foreign Secretary, National Academy of Engineering, The Impact of Regulation on Industrial Innovation, prepared by Henry Grabowski and John Vernon, Washington, D.C. 1979 (NRC/NAE).

Introduction

All the studies surveyed here accept the basic objectives of government regulation in the health, safety, and environmental areas. They also generally accept the need for at least some government policy intervention to achieve these objectives. There is disagreement, however about the proper boundaries of government regulation and also about the extent to which the benefits and costs of regulation should be balanced in undertaking particular regulatory actions. There is also widespread criticism of the process of regulation. Most of the policy recommendations considered here center around these basic questions.

We should emphasize, at the outset, that government regulation can affect innovation in diverse ways, varying by industry and type of regulation. The effects can be both positive and negative in nature. For example, regulation may have an adverse impact on innovation by directly increasing the cost or uncertainties of a particular new product or process. In addition, the costs and investments entailed in meeting general regulatory requirements may reduce the availability of R&D funds for innovative new products, the capital available for new plants to manufacture such products, or the competitiveness of the products in U.S. and world markets. On the positive side, government regulation can stimulate innovations to meet social objectives, such as the development of new pollution-control equipment. These can also have positive technological spill-over effects on innovation in other sectors.[1]

Government regulation, therefore, influences industrial firm decisions on innovation through a number of direct and indirect ways. The discussion and policy recommendations that follow focus on the common impacts of a broad range of governmental policies in the health, safety, and environmental areas. At the same time, some of the policy recommendations considered are industry or product specific and relate to situations for which the empirical evidence suggests that the effects of regulation on innovation are especially significant in nature.

The Appropriate Domain of Government Regulation

The vast increase in regulatory activity that has occurred in the U.S. over the past two decades was directed at remedying some

TABLE V-1 Matrix of Issues and Recommendations

	President	DPR Environmental Health and Safety	DPR Regulation	DPR Labor	DPR Public Interest	CTAB	DPR Small Business	CED	NRC/NAE
Appropriate domain of government regulation									
Substitution of voluntary consensus standards for regulatory controls in many situations		R		O	O		R		
Substitution of economic incentives (e.g., effluent fees) for direct regulatory controls in many situations								R	R
Changes in regulatory procedures									
Performance standards in place of design or specification standards	R	R	R				R		
Preparation of long-range forecasts by regulators of priorities and concerns	R	R	R						
Increased long-term research on the cause and effect of safety and health hazards	R	R		R					
Fast-tracking regulatory clearance of highly innovative products	R								
"Technology-forcing" regulatory standards		O	O	R					
Broader representation on the Regulatory Council		R					R		
Increased manpower to monitor regulatory compliance				R					
Social incentives to reward innovative methods of compliance and exemplary health and safety records			R						
Evaluating social benefits and costs of regulation									
Analysis of regulatory impacts on industrial innovation		R	R				R	R	R
Use of benefit/cost/risk analysis in regulatory decision-making process	R	R	R	O			R	R	R
Congressional review and phasing out of regulatory programs in which social costs exceed benefits		R	R	O			R	R	
Broader legislative mandates to regulatory agencies from Congress		R	R						R

long-standing social problems of a serious nature. For example, environmental pollution is a classic example of an externality problem--that is, external effects, that occur as a byproduct of market activities, that are not directly captured in any market prices. Similarly, the rationale for intervention in the occupational and product-safety areas derives from the presence of externalities, as well as imperfect information concerning hazards on the part of consumers and workers. There is no real disagreement in the studies that improving the environment and the protection of health and safety are valid social objectives that require government policy attention.

There is some disagreement, however, on the appropriate boundaries for government regulatory intervention. The DPR Environmental, Health, and Safety report, for example, argues that there are many situations where it should be possible to modify the existing private voluntary standards process and the private insurance-product liability systems to meet regulatory objectives in the areas of health and safety with a minimum of legislative law and direct government participation. This industry advisory group points in particular to nonfood or nondrug products safety (as well as workplace safety) as an area where an improved voluntary consensus standards approach, buttressed by the sanctions of a product liability system, is likely to be a more attractive social policy alternative to direct regulation.

On the other hand, the DPR Labor and Public Interest Advisory Subcommittee reports are quite opposed to this general orientation. The DPR Public Interest report, in particular, argues that the voluntary industry consensus standards process should be subject to more stringent government controls and supports legislation to this end. Specifically, they argue that this process is frequently dominated by larger firms, lacks minimum due process safeguards, and promulgates standards that are often inimical to innovation, especially by smaller firms. They support legislation that would give an agency, such as the Federal Trade Commission (FTC), power to write and enforce procedural rules for trade standard groups and they also want to make the process more open to public participation and external appeals.

There is a large, apparent gulf between these two groups concerning the desirability of voluntary consensus standards in the product-safety area. Nevertheless, it should also be noted that the Consumer Product Safety Commission (CPSC), which has broad regulatory powers in the product-safety area, has recently moved in a policy direction that draws from both viewpoints. Specifically, the agency has been placing greater emphasis on <u>voluntary</u> rather than <u>mandatory</u> product standards for many products (such as ladder-safety standards) where long-run health hazards, such as carcinogenicity, are not an issue. However, these voluntary standards are developed with direct participation by members of the CPSC staff, as well as outside public and consumer groups. Hence, the process is designed to overcome some of the main criticisms mentioned in the DPR Public Interest report while gaining the advantages of industry participation and expertise in the standard-setting process.[2]

Another basic issue addressed in two of these reports is the desirability of using economic incentives (e.g., in the form of effluent fees or taxes) in place of direct regulatory controls and standards to accomplish regulatory objectives in the health, safety, and environmental areas. Both the NRC/NAE and CED reports have policy recommendations that strongly advocate the greater use of economic incentives, especially in the environmental area, as a means of accomplishing social objectives with minimal inhibition of innovation and market flexibility.

Regulation to date almost invariably has taken the form of direct and very detailed regulatory controls over firm behavior. In the case of environmental regulation, for example, the Environmental Protection Agency (EPA), in granting licenses to firms for new and existing plants, has in fact become directly involved in the production and investment processes at thousands of separate locations. In place of this system of direct regulatory controls, economists have almost universally advocated the more decentralized system of effluent fees to control pollution.[3] It is argued that this system would provide minimal distortions to market processes and, hence, would eliminate many of the inefficiencies and uncertainties associated with the current situation. It also would provide much stronger incentives for the discovery and adoption of new pollution-reducing equipment, since firms are in effect taxed on the residual amount of pollution remaining after a given control technology is applied.

The use of an effluent fee approach of course would not completely eliminate the need for regulation. The agency would still be responsible for setting an effluent fee schedule that would reduce pollution in the aggregate to social desirable levels and for monitoring the levels of pollution emitted at particular sources. Such an approach is also not suitable for all situations of pollution control. Direct regulatory standards would still be necessary in the case of extreme pollutions for which even small concentrations could produce catastrophic or potentially irreversible consequences.[4]

The substitution of economic incentives for direct regulatory controls advocated in both the NRC/NAE and CED reports has the advantage that it could be implemented gradually through a series of regional experiments. Perhaps the best place to begin such experiments might be in an area such as water pollution control, where a great deal of research and background information on the probable effects of an effluent system is already available, including information based on foreign experiences with such systems. Over the long run, if such experiments were successful the overall philosophy might gradually be shifted toward the greater use of economic incentives to accomplish regulatory objectives, not only in the environmental areas but also in the product and occupational safety areas.[5]

Proposed Reforms in Regulatory Procedures

While some major shifts in regulatory approach may be feasible and desirable over the long run, most of the reports focus on the policy changes in existing regulatory procedures that are the subject of several recurrent criticisms.

One basic concept advocated in a number of the reports is that agencies should concentrate on performance, rather than design or specification, standards. Performance standards have the obvious advantage of allowing much greater flexibility and scope for innovation by firms in meeting regulatory objectives. While the concept of performance standards was emphasized by a number of the reports (and not explicitly opposed in any report), this type of procedural reform would require legislative changes in many cases, because provisions mandating the use of "best available technology" and the like are contained in the relevant statutes governing environmental and other social regulatory programs. Recognizing this fact, President Carter indicated in his message on Industrial Innovation that he will direct the Administrator of EPA to determine what further opportunities exist to substitute performance for specification standards within statutory authority and to use specification standards only when they are clearly justified. Presumably, consideration should also be given by Congress to changing statutes in this regard where such changes are necessary to accomplish improvements in regulatory performance.

Another frequent criticism of the regulatory process is that changing objectives or uncertain standards of regulatory agencies have significantly added to the risk of industrial innovation in many situations. This point is given particular attention in the DPR Industry Advisory Subcommittee Report, but is also acknowledged as a potentially significant problem in several other reports, including the DPR Labor report.

President Carter has pointed to the creation of the Regulatory Council as a policy group designed to deal with regulatory uncertainty. In particular, this group, comprised of the heads of 35 agencies, is supposed to work to reduce the uncertainties arising from inconsistent or duplicative regulations across different agencies for particular situations. In addition, the Council publishes the Calendar of Federal Regulation, which contains information about major regulations under development, in order to reduce uncertainty concerning future agency actions. Furthermore, the President announced, in his message on Industrial Innovation Initiatives, that he will direct executive health, safety, and environmental agencies to prepare five-year forecasts of their priorities and concerns in their semiannual regulatory agendas as another way of reducing uncertainty about future actions.

There appears to be broad support in principle to these procedural policy measures initiated by the President. However, the DPR Environmental, Health, and Safety report recommends that membership in the Regulatory Council be expanded to include members of the academic and industrial community specially qualified in the innovation area.

The DPR Regulation report further calls for intraagency and interagency consultations and coordinating committees on a much more detailed operating level than the Regulatory Council to deal with inconsistencies arising from multiple statutes and agencies.

The President's message on Industrial Innovation Initiatives also contains a "fast-tracking" provision for highly innovative products. In particular, agencies are to identify those products that are most innovative or have exceptional social benefits and expedite their clearance reviews to the extent permitted by applicable statute. While this is a potentially significant policy action in reducing regulatory delays, there is no discussion of possible incentive problems in implementing such a provision or how it will be monitored or enforced within particular agencies.

Both the DPR Environmental, Health, and Safety and the DPR Labor reports strongly advocate increased federal support for scientific research on health and safety hazards. The Carter Administration has also stated the need for improving the underlying scientific base of regulation and has begun increasing the budgetary allocations for the support of long-run research efforts to this end. The President's message also proposes to bolster federal expenditures for the development of new regulatory compliance technologies.

Although the industry and labor advisory groups both support increased research to reduce uncertainty, these groups differ radically about how to proceed in the face of imperfect knowledge. The DPR Labor report supports setting of "technology-forcing" standards with the intention of forcing regulated employers to innovate--to come up with technology that will achieve the health objectives of the standards. On the other hand, both the DPR Environmental, Health, and Safety and the DPR Regulation reports recommend that the scope of regulation be confined within the bounds of existing knowledge and suggest that unrealistically short compliance times or excessively high requirements are likely to be counter-productive in nature or entail excessively high costs.[6] The sharp disagreement between these reports in this area obviously represents fundamental differences in their viewpoints concerning the process of innovation and/or differences in priorities regarding alternative social objectives.

A final theme touched on in several reports is the need to make the process of regulation less adversarial in nature. Many of the general policy measures discussed here, if implemented, are likely to have an impact on this characteristic of regulation. The DPR Regulation report, however, recommends the use of "social incentives" as a particular policy approach for ameliorating the present adversary relationship between business and the regulatory agencies. In particular, they would like to see greater use of social incentives in the form of awards for innovative methods of compliance, outstanding safety records, and/or contributions to the environment through new products and programs. The use of social merit awards is also contained in President Carter's set of policy measures for the general encouragement of innovation, but not specifically for the regulatory area.

Balancing the Benefits and Costs of Regulatory Actions

The legislative mandates of the regulatory agencies have typically been drawn in fairly narrow terms. In particular, they tend to be concerned almost exclusively with health and safety objectives in consumer products, the workplace, and the overall environment. As a consequence, these laws have not provided very strong incentives for regulators to give much attention to the potential impacts of their regulations on industrial firm productivity, or innovation, or the effects on consumers of higher prices or less product choice.

There has been, however, a growing effort in recent years to have the regulatory agencies consider the economic costs and other adverse impacts of their regulatory decisions. In 1974, President Ford issued an Executive Order requiring an inflation impact statement concerning new regulations. The scope of these impact statements has increased over successive years. There are also several legislative proposals now in Congress that would require the systematic use of benefit/cost analyses in the regulatory decision-making process.

In his Executive Order 12044, President Carter underlined the following main objectives in this regard for improving the regulatory process:

- tighten procedural requirements for analyzing and evaluating the risk/cost/benefits and alternative choices for proposed regulations before their enactment;
- systematically reevaluate existing regulations to determine their risk/cost/benefits, as well as the alternative choices for effecting their objectives;
- develop a better means for evaluating risk/cost/benefits and alternative choices.

Greater attention to the economic impacts of regulation, especially in the area of industrial innovation, is also highlighted and elaborated on in several reports. For example, the CED report gives the highest priority to the following recommendation:

Congress and the regulatory agencies should analyze each proposed regulation for its effect on innovation. Such analysis should take into consideration the probable effects on investment resources, through restrictions on business managements' ability and incentive to invest in research, development, and innovation. Only if the social benefits (including the avoidance of harmful side effects) of a regulation will outweigh its full costs should it be undertaken.

The DPR Environmental, Health, and Safety report would also require agencies to provide Congressional Oversight Committees periodically with an evaluation of regulatory impacts, including impacts on scientific innovation. Agencies would be held accountable for claimed results of risk/cost/benefit and failure to achieve results would be cause for invoking sunset legislation to deregulate or to find a better alternative. Both the CED and DPR Regulation reports endorse similar evaluative analysis of regulatory procedures to modify or phase out existing programs.

A major dissenting view to the increased use of cost-impact or cost-benefit analysis in regulating decisions is presented in the DPR Labor report. In particular, this report argues that the lives and well-being of workers, consumers, and citizens should not be subjected to any dollar trade-offs. Moreover, they point to the analytical difficulties of measuring the real costs over the long run of not eliminating life and health hazards compared with more immediate and more readily quantifiable costs associated with ameliorating these hazards.

The NRC/NAE report provides the most extensive discussion concerning the analytical strengths and weaknesses of benefit-cost analysis. This report concludes that there are too many uncertainties and conceptual problems in measuring benefits, risks, and costs in the health and safety area to use benefit-cost analysis in a rigid manner in making regulatory decisions. At the same time, it argues that considerable insight can be obtained from the exercise of quantifying all regulatory effects as precisely as possible. Benefit-cost analyses can also provide an important role in helping set agency priorities and directing limited resources to programs that yield relatively high levels of health and safety benefits. The NRC/NAE report cites several cases in this respect where agencies have undertaken regulatory projects with low benefit-cost ratios while declining or postponing action on projects with much higher benefit-cost ratios.[7] This results not only in wasted resources, but also lower health and safety benefits than could otherwise have been achieved from a given deployment of societal resources to health and safety improvements.

The NRC/NAE report argues that since the societal resources devoted to health and safety objectives are not unlimited in character, it is desirable to assess both the cost and benefit impacts of regulatory decisions as accurately as possible. At the same time, the uncertainties and associated conceptual problems in performing benefit-cost analyses should also be recognized and taken into acount in making regulatory decisions.

As noted at the outset, there are currently several bills in Congress that specifically address the issue of utilizing benefit-cost analyses in regulatory decisions. Some significant legislative changes, therefore, could be forthcoming in the immediate future, and this would appear to be the most important avenue for affecting policy changes in this area at the present time.

The Special Situation of Small Business Organizations

It is frequently pointed out that regulation is likely to have especially large, disincentive effects on small businesses, because such firms generally do not have the specialized staffs of large firms for regulatory compliance. In effect, the process of regulatory compliance is subject to threshold effects and economies to scale and the costs of compliance are disproportionately related to firm size. This point is of particular significance in the present context

because a number of academic studies have also found that small businesses historically have made a disproportionately large contribution to the innovational process in this country.[8]

Recognizing the special situation faced by small businesses with respect to regulatory compliance, several reports contain policy recommendations that deal specifically with this group of firms. Not surprisingly, the DPR Small Business report had the most extensive set of recommendations in this regard. This report supports many of the policy measures discussed in the previous two sections, but with special considerations given to ameliorating the impacts of regulations on small innovative businesses. The most far-reaching proposal, however, would be a special exemption of small business from regulatory procedures in many instances. Specifically, the report proposes a general exemption from the Occupational Safety and Health Administration (OSHA), except where the accident history of a particular industry or firm is substantially greater than average. Furthermore, it proposes statutorily defined minimum levels of impact for all regulatory activities that would in effect exempt small business, except in extreme cases. In all cases, the burden would be on the regulatory agency to establish a cause of concern before compliance by a small business.

The CTAB report, which is also specifically concerned with the situation of small innovative business, favors special tax deductions for regulatory advisory services to assist small firms in the area of regulatory compliance. Specifically, these advisory firms would provide small firms with computer data bases and experts for coping with the regulatory process. To encourage the development of such advisory service firms, as well as help offset the special regulatory compliance burdens of small firms, the CTAB report recommends that small businesses be allowed to deduct <u>twice</u> their payments for regulatory advisory services for compliance with federal, state, and local regulations.

The DPR Regulation report also recognizes the special burdens of regulatory compliance for small firms. Nevertheless, it advocates uniform <u>substantive</u> requirements across all-size classes, but supports modifying regulatory procedures and paperwork required for compliance to take account of variations in business size. It also advocates an Annual Report to Congress and the Administration that would highlight shifts in the statistical size structure of business and report on the state of small business.

The DPR Public Interest report would give regulatory agencies the responsibility of determining on a case-by-case basis whether there is an undue burden on small business. Where this is found to be so, it recommends that the federal government provide assistance in the form of grants and coordination between companies for the development of compliance technology of an appropriate scale.

In summary, there is clearly a widespread concern about the impact of regulation on the innovative capability of small business, but the specific policy recommendations advocated in this regard vary from exemptions to specialized regulatory procedures, to grants and special tax provisions for small businesses. At present, very little is

known, from a quantitative standpoint, on the relative effectiveness of these different measures or their overall costs to society. This would appear to be an important issue for further research. Further documentation of the impacts of regulation on small business innovation, which is advocated in a number of reports, is also an important priority area for further analysis.

Compensatory Policy Actions for Offsetting Regulatory Disincentives to Innovation

Finally, a number of recommendations in these reports are directed at compensatory policy actions for offsetting the adverse effects of regulation in innovation. These involve policies such as changes in patent policies, tax changes and subsidies for encouraging innovation, governmental financial assistance, etc. Since these policy measures are the subject of other panel discussions, we briefly consider here only those compensatory policies specifically directed at ameliorating regulatory disincentives. (Several of these policies as related to small business organizations have been discussed in the previous section.)

The NRC/NAE and DPR Environmental, Health, and Safety reports both advocate changes in the patent laws where effective patent life of a new product is significantly shortened by regulatory procedures. This recommendation is primarily relevant to products such as pharmaceuticals, food additives, medical devices, and pesticides, which are subject to premarket regulatory approval for safety and efficacy. Data on pharmaceutical products suggest, for example, that the effective patent life for a new drug now averages about 10 years rather than the nominal 17 years,[9] and that this is due, in considerable part, to the lengthy regulatory procedures associated with developing and gaining approval for a new drug. The DPR Environmental, Health, and Safety and the NRC/NAE reports recommend adjustments in patent policies governing such situations. For example, the effective date of the patent grant could be made to coincide with the date of regulatory approval for the products subject to premarket approval.

The DPR Environmental, Health, and Safety report also argues for financial compensations to businesses for which regulations impose requirements for major capital investments and divert funds from productivity improvements. In particular, they suggest that discretionary funds to meet the cost of compliance could be made available in a variety of ways, including direct subsidies and various tax credit allowances. The DPR Regulation report also supports such financial incentives, suggesting that they could be tax-oriented, such as accelerated depreciation or debt-oriented incentives, such as low-interest government loans.

The DPR Environmental, Health and Safety report further recommends consideration of either import protection or export enhancement policies in those instances where regulations place U.S. industry at a

cost disadvantage compared with less regulated, or unregulated, competitors.

All of these policy actions would require legislative action by Congress before they could be implemented. Obviously, there are a number of policy options that could be utilized to help offset the regulatory disincentives to innovation in particular circumstances. However, it would also seem important to gain greater quantitative knowledge of the relative efficacy of these policies in stimulating innovation, as well as the overall costs to the public. It is also desirable to consider these policy recommendations in the context of broader changes in these policy measures.

Concluding Remarks

The eight studies surveyed in this report contain a wide spectrum of perspectives and policy recommendations. As may be expected, agreement is easiest to achieve in the case of regulatory process issues, such as the use of performance, rather than design, standards or the need to eliminate inconsistencies in the regulatory decisions of different agencies. Agreement is more difficult to accomplish when more fundamental reforms in the regulatory process, such as the substitution of economic incentive measures for detailed standards, are considered. Agreement is also difficult in the case of issues involving the values that should be assigned to competing social objectives. Nevertheless, despite the differences in viewpoints on these type issues, the reports provide a stimulating set of policy proposals for further discussion and analysis.

FOOTNOTES

[1] For discussion of these different effects and a review of the empirical evidence for several industries, see Chapter 3 of the National Research Council monograph, The Impact of Regulation on Industrial Innovation (Washington, D.C., National Research Council, 1979).

[2] For an analysis of the voluntary standards approach, see Phillip Harter, Regulatory Uses of Standards: The Implications for Standards Development (Washington, D.C. National Bureau of Standards, 1979).

[3] The case for this approach is eloquently developed, for example, by Charles L. Schultze in The Public Use of Private Interest (Washington, D.C., The Brookings Institution, 1977).

[4] Charles Schultze, Ibid., analyzes why regulation in the United States has developed almost entirely along a "command and control" mode rather than a system of economic incentives. He also considers the condition under which each approach is likely to be more advantageous in accomplishing social objectives.

[5] Mark Green and Norman Waitzman raise a number of potential problems to the market incentive approach including the possibility

that firms may not be very responsive to incentive measures such as effluent taxes, but instead may simply pass on the increased charges to consumers in the form of higher product prices. However, this is precisely the kind of hypothesized effect that can be investigated through an experimental approach. Mark Green and Norman Waitzman, Business War on the Law: An Analysis of the Benefits of Federal Health Safety Enforcement (Washington, D.C.: Corporate Accountability Research Group, 1979, pp. 64-70).

[6] This point is stressed in the case study of auto emissions regulation by Edwin Mills and Laurence White "Auto Emissions: Why Regulation Hasn't Worked," Technology Review, March - April, 1978. At the same time, Nicholas Ashford indicates there are several cases where regulation has had a positive stimulus on organizational rates of innovation. See Ashford, et al., "The Implications of Health Safety and Environmental Regulations for Technological Change," January 15, 1979, Center for Policy Alternatives, Massachusetts Institute of Technology, Cambridge, Massachusetts.

[7] See in particular, the discussion on pages 23-31 of the NRC/NAE monograph and the references cited therein.

[8] In particular, case study analyses of the source of past inventions and innovations have frequently found that small firms have made a large relative contribution at the early, more inventive, but frequently less expensive, stages of the innovational process. In addition, however, there are also examples, particularly in the semi-conductor and electronics industries, in which entrepreneurs have successfully launched new firms to develop technical ideas originating in the laboratories of larger companies. See J. Jewkes, D. Sawers, and R. Stillerman, The Sources of Invention (New York, N.Y.; Macmillian Publishing Company, 1969); and R. Charpie, Technical Innovation: Its Environment and Management (Washington, D.C., U.S. Department of Commerce, January 1967).

[9] For further documentation of the evidence on this point and an analysis of the effects on the returns to drug innovation, see Henry Grabowski and John Vernon, "Substitution Laws and Innovation in the Pharmaceuticial Industry," forthcoming in the Journal of Law and Conptemporary Problems, Duke University Law School.

SUMMARY OF PANEL DISCUSSION

Strong support was expressed by the panel for recent administrative actions designed to improve the process of regulation, such as the creation of the Regulatory Council and Calendar. As Larry Linden of the Office of Science and Technology Policy observed, the federal government has enacted a fantastic array of new regulatory programs over the past 10 to 15 years for which there is a reasonable consensus concerning their social objectives. However, the programs were enacted and have been managed in a noncoordinated manner with a lot of inconsistenies. Everyone agreed that there has been some real progress in the past few years in improving communication and coordination across agencies and also in reducing the uncertainty associated with impending regulatory actions.

Industry and government participants also stressed the desirability of increasing government and industry interactions early in the regulatory development process, i.e., in the period before a proposal is formalized and published in the Federal Register. This was viewed not only as a means of improving regulatory decisions but also as a way of reducing the adversarial character of regulation. Steve Jellinek of the Environmental Protection Agency (EPA) acknowledged that such prior consultation may initially slow the regulatory process down, but at the same time he maintained that it may reduce total time for regulation development if the time devoted to judicial challenges and rulings is also considered.

One of the administration's proposed new reforms, "fast tracking" the clearance of innovative new products, was the object of some concern by industry participants. In particular, it was argued that in setting priorities in this area, regulatory officials would have to decide on levels of innovativeness, which is ultimately a market function, and also the decision time expended in doing so may slow down the approval of most products to speed up only a few. The fast-tracking approach has in fact been used by the Food and Drug Administration (FDA) in recent years for some of its new drug approvals deemed as important therapeutic advances by the FDA. This provides some basis for examining these hypothesized effects. In the case of EPA review of new chemicals, Steve Jellinek indicated that the agency would not try to make a judgment as to whether the particular innovation was a good or bad one, but the criteria would instead be based on a risk basis. Specifically, low- or no-risk chemicals would be faster tracked compared with chemicals for which there was some safety question. This is a different concept of fast tracking than

that put forth in President Carter's Message to Congress on Industrial Innovation, but one that may be more feasible to implement at most agencies.

Another goal of recent administrative reform efforts has been to make the regulatory process more flexible and cost efficient in nature. Frank Lindsay offered, as a general operating principle in this regard, the idea that regulators should not prescribe how a goal is to be achieved, but rather they should set the regulatory objectives and leave it to industry to find the best and most economical way of achieving them. While this was not seen by all the panel members as always possible, there was agreement on the desirability of instituting performance, rather than design, standards. The recent initiatives by EPA to make the regulatory process more flexible through programs such as the "bubble" concept and emission offsets were also viewed by the panel as positive steps forward.

Professor Paul Smith, an audience participant, argued that the development of better quantitative measures of health benefits should be a priority item for future work. He observed that we now have a system of "under the table" value judgments by regulatory officials, including medical and scientific personnel, who are technically competent but who are often very poor judges of health benefits and satisfaction. Mr. Wolcott pointed out that EPA has recently contracted with the University of Wyoming to conduct a health-benefit assessment that involves surveying residents of matched pairs of cities to identify their welfare value of improved air quality. There are also a number of other research projects now being undertaken with similar objectives.

The panel agreed that one of the most important things that needs to be done at the present time to improve benefit-cost evaluations is to enhance the scientific base of knowledge underlying regulatory decisions. As Larry Linden remarked, much of our regulation has been done in the short-run, with little information, and we have moved from one short-run problem to another. A high-priority task now is to begin planning the kind of research programs that will reduce this uncertainty and provide for sounder regulation in the future. Otherwise, benefit-cost evaluation can be used to support almost any position.

George Lockwood graphically articulated the special problems and difficulties encountered by small innovative businesses in coping with the regulatory process. He noted that small firms generally do not have the experts, engineers, and lawyers needed to engage in the development process of new regulations or even to interpret these regulations once they are made law. He further argued that small firms have similar disadvantages with regard to plant inspections and judicial appeal. He observed that in the case of his firm, Montery Abalone Farms, there are 42 different regulatory agencies of the government to deal with and that he spends between 50 to 70 percent of his time ministering to the affairs of government.

Mr. Lockwood stated that 90 percent of the recommendations of the Small Business Industry Advisory Group are now embodied in two

legislative proposals--HR 5670 introduced in the House by Congressman Smith and SB 1806 introduced in the Senate by Senator Gaylord Nelson (with 20 cosponsors). He viewed passage of these bills as the most important action for reducing the regulatory burden on innovativeness of small business.

Richard Bergman stated that there are already a number of administrative actions involving the regulation of small business. He noted that the Small Business Administration (SBA) has been added to the Regulatory Council. Furthermore, President Carter has directed all the heads of regulatory agencies to review the effect of regulation on small businesses and consider the areas where special treatment of small business is warranted and legally possible. A White House Conference on Small Business is scheduled for January 1980.

The panel agreed that regulatory impacts on small business are an important area for policy attention. It was proposed by Monte Throdahl, after the session, that a workshop in this area be sponsored by the National Academy of Engineering. This workshop would bring together principles from innovative small businesses and labor and environment groups to examine in a nonadversarial atmosphere the ways in which laws and regulations might be altered to lessen the impact on small business, without sacrificing the goals of health and environmental quality. The consensus could then be presented with the NAE's endorsement to Congress and the regulatory agencies for action.

There was insufficient time for a general panel discussion of compensatory policies for offsetting regulatory disincentives. A few issues in this area were considered, however. One was whether the retrofitting of existing plants should be financed by public funds. Some members of the panel and some participants in the audience argued that government funds should be used for retrofitting because an excess financial burden would otherwise be placed on the owners and shareholders of the plants involved. They also maintained that this policy approach is equitable because the general public received many of the benefits of the unregulated situation, in the form of excessively low product prices, and thus should share in the costs of retrofitting plants. Whatever the merits of this equity argument, such a policy of retrofitting can create undesirable incentive effects if new and old plants are treated differently with respect to government financing. In particular, firms trying to decide between continued prodution in older facilities or conversion to new ones may be biased against the new ones and this could, thus, retard rather than promote innovation.

On another matter, Mr. Wolcott noted a current problem with Section 169 of the IRS tax code, which grants rapid depreciation on capital purchased and utilized for reducing pollution. He stated that if a company chose to use Section 169, they are precluded from declaring or obtaining an investment tax credit on that capital. He advocated legislative changes in this provision to allow the investment credit if this was to be an effective policy instrument.

Finally, Mr. Allen Smith from the Office for Economic Cooperation and Development (OECD) commented negatively on the DPR advisory report proposal that recommends either import protection or export

enhancement in those instances where regulation places U.S. industry at a cost disadvantage compared with less-regulated or unregulated competitors. He observed that parallel policy options exist for all other members of OECD and any moves by the U.S. in this direction would certainly bring countermoves by these countries. The end result of such dynamic process could leave everyone worse off than they were originally.

Monte Throdahl noted that although there were obvious differences among the participants' perspectives and priorities, there was also considerable agreement on many of the basic substantive issues. There was a reasonable understanding of the need for consistency in regulatory decisions and the need to develop a better underlying scientific knowledge base to reduce regulatory uncertainty. In addition, there was broad support for recent regulatory reforms such as the bubble concept and a willingness to experiment on the margin with more market-oriented approaches for accomplishing regulatory objectives. There was also strong concern expressed about the disproportionate effects of regulation on small innovative firms and need for public policies to address this situation. Hence, there does appear to be an emerging consensus on many of the important areas for policy action.

VI. PATENT AND INFORMATION POLICY

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ANALYSIS

In the Domestic Policy Review, patents and information were considered by a single advisory group. Although these two subjects intersect and overlap, they also involve issues that are quite disparate; thus, they have been analyzed separately and will be so treated in this report.

Patent Policy

The Franklin Pierce Law Center, through its Patent, Trademark and Copyright (PTC) Research Foundation, conducted an analysis in the area of patent policy of recent studies by governmental and private agencies bearing upon policy options aimed at rejuvenating industrial innovation in the U.S. This analysis was conducted by law students and faculty at the Law Center and supervised and edited by PTC Director, Harry Saragovitz; PTC Senior Fellow, William Yates; and Robert H. Rines, PTC Chairman. The Law Center's clinical lecturer, Ms. Nancy Metz, and law/science researcher, Cedric Richeson, also assisted.

The Studies Considered

In the area of patent policy, fourteen reports were studied to determine viewpoints on patent policy and its impact on industrial innovation. These studies are listed in Table VI-1.

While some of the studies contained little specific discussion of patent matters, they did underscore the importance of invention incentives and the usefulness of the patent system. More significant to this analysis were reports 1, 6, 7, and 14, but studies 2-5, 8-10, and 12 also contain important insights.

TABLE VI-1 Studies on Innovation and Patent Policies

1. Domestic Policy Review: Advisory Committee on Industrial Innovation, Report of the Advisory Subcommittee on Patent Policy, December 20, 1978.
2. Domestic Policy Review: Advisory Committee on Industrial Innovation, Statement by Labor Advisory Subcommittee, December 22, 1978.
3. Domestic Policy Review: Advisory Committee on Industrial Innovation, Report of Public Interest Subcommittee, December 28, 1978.
4. Domestic Policy Review: Advisory Committee on Industrial Innovation, Report of Advisory Subcommittee on Information Policy, December 20, 1978.
5. Domestic Policy Review: Advisory Committee on Industrial Innovation, Report of Advisory Subcommittee on Direct Federal Support of Research and Development, December 21, 1978.
6. Committee for Economic Development Report on Technology Policy, September 19, 1979. (CED)
7. Report to the Panel on the Impact of Antitrust Policies and Practices on Industrial Innovation, Committee on Technology and International Economic and Trade Issues, Assembly of Engineering, National Research Council, and Office of the Foreign Secretary, National Academy of Engineering, August 15, 1979. (NRC/NAE)
8. Workshops on Technology and Social Policy (American Bar Association, Experimental Technology Incentives Program of the National Bureau of Standards, and the Franklin Pierce Law Center), February 16, March 12, and April 16, 1977.
9. IDEA: The Journal of Law & Technology - Vol. 18, #3, Fall 1976, PTC Seminar on Innovation (Franklin Pierce Law Center, PTC Research Foundation and the Academy of Applied Science).
10. IDEA: The Journal of Law & Technology - Vol. 18, #4, 1977, Arbitration of Patent and Other Technological Disputes (Conference of Franklin Pierce Law Center, PTC Research Foundation, the Academy of Applied Science, and the Law-Related Studies Program of the Massachusetts Institute of Technology, in cooperation with the American Arbitration Association, the Licensing Executives Society and the Technology Assessment Committee of the American Bar Association Science and Technology Section).
11. Recommendations for Creating Jobs Through the Success of Small, Innovative Businesses (Commerce Technical Advisory Board, U.S. Department of Commerce), December 1978. (CTAB)
12. The Effects of Domestic Policies of the Federal Government Upon Innovation by Small Businesses (Advisory Committee to Secretary of Commerce), May 1, 1979.
13. Industrial Innovation and Its Relation to the U.S. Domestic Economy and International Trade Competitiveness (Hearings, Subcommittees of Senate Committees on Commerce, Science and Transportation, and Banking, Housing, and Urban Affairs, and House Committee on Science and Technology, October 13, 1978.
14. Proceedings, January 24, 1979, on Domestic Policy Review of Industrial Innovation Public Symposium on Patents.

The White House initiatives announced on October 31, 1979, contain two recommendations consistent with the more significant studies:

1. Request Congress to resolve the various existing agency rules on licensing to industry those inventions arising from federal research funding to enable exclusive marketing rights to be granted;
2. Seek legislation to authorize the Patent and Trademark Office to recheck the novelty of patents "to reduce the patent's vulnerability to court challenge."

These two recommendations are among the more salient raised by the above studies.

Invention and the Innovation Process

The process of innovation is generally interpreted as consisting of all the steps from the conception of an idea by an inventor through the research, development, engineering, marketing, and commercialization of a product or process incorporating the original idea. The patent system is generally viewed as a valuable means of encouraging the innovation process, which in turn contributes to the public good. More specifically, the patent system addresses that part of the innovation process that comprises the creation and dissemination of useful ideas, with patents providing incentives to disclose inventions and to invest risk capital.

The problems and recommended solutions contained in the reports reviewed fall into four main categories. These categories and some of the more salient observations are:

1. Climate for invention
   a) additional incentives are needed for individual inventors, university inventors, and inventors employed by large and small corporations
   b) tax incentives are needed
   c) conveniently accessible data banks are needed to determine the state of the art
2. Patenting the invention
   a) significant improvement is needed in the performance of the Patent and Trademark Office, in particular in restoring the integrity of the search files and extending the examiner's time for searching
   b) institution of a statutory system of reexamination with opportunity for opposition
   c) elimination of interference proceedings by providing, in the case of conflicting patent applications, that priority be awarded on the basis of application filing dates (known as a "first to file" system)
   d) provide an adequate level of financial support for the Patent and Trademark Office and adjust filing and other fees as necessary

e) remove the Patent and Trademark Office from the Department of Commerce and institute it as an independent agency

3. Bringing the invention into the stream of commerce
   a) create tax incentives, e.g., accelerated depreciation, and remove tax disincentives
   b) remove regulatory obstacles
   c) increase availability of venture capital
   d) reconcile antitrust policy with innovation needs
   e) provide incentives to use technology developed at government expense, e.g., limited exclusive licenses under government-owned patents
   f) create incentives for the export of technology--organized labor disagrees with this recommendation
4. Patent enforcement
   a) the attitude of courts toward patents needs improving--standards of validity should be clarified
   b) patent litigation should be speeded up and its cost reduced
   c) alternative methods of resolving patent disputes, such as arbitration, should be investigated
   d) there should be a single court of appeals for patent cases
   e) the term of a patent should be extended to compensate for delays in commercialization resulting from governmental regulations
   f) the relationship between the patent and the antitrust laws should be clarified
   g) licensee estoppel should be permitted, i.e., the parties to a patent license should be permitted to agree not to contest the validity of licensed patents
   h) patentable subject matter should be clearly defined to include computer programs and living organisms; also, the law should permit the enforcement of a domestic patent against a product made in a foreign country by the patented process
   i) compulsory licensing is opposed by some but favored by others as a mechanism for promoting utilization of new technology.

Of the problem areas identified, the following seem to be the most significant. General agreement has been expressed with regard to possible remedial action.

Uncertainty in Patent Validity

The degree to which one may rely upon patent protection directly affects the incentive to invent and the availability of risk capital. This risk is, in part, a measure of the confidence on the part of

inventors and potential investors in the patent validity dispute resolution process. The high cost and length of time necessary to resolve patent validity disputes through litigation, and the inhospitable attitude of many courts toward patents, significantly decrease the attractiveness of innovation as a business investment. There is near unanimity of opinion across all interest groups--big business, small business, labor and public interest--as to how the uncertainty may be decreased and the reliability of patent protection increased.

First, the Patent and Trademark Office (PTO) lacks the funds necessary to perform its statutory duties. Search files need improvement and examination time should be increased. Fees may need adjustment but inventors should not bear the full cost.

Second, by empowering the PTO to re-examine issued patents in controversy in light of prior art not previously considered by the PTO, litigation can be simplified, expedited, and rendered more uniform in treatment. The PTO is better equipped than a trial court to handle more validity issues.

Third, a single court of patent appeals would unify judicial tests of validity, play down "forum shopping," and introduce a greater measure of predictability in the outcome of patent litigation. Current procedures have resulted in nuances, as well as outright differences, among the courts of appeal on patent validity issues. These would be eliminated by a national court of appeals for patent cases.

Fourth, legalizing the use of arbitration for patent and antitrust dispute resolution might serve as a substitute for or adjunct to present judicial remedies.

Conflicting Government Policies

Government agencies continue to have conflicting policies as to the rights of contractors to inventions made while performing research and development contracts with federal funding. Also, the available rights under government-developed inventions to would-be innovators also vary among the agencies.

This subject has been debated for nearly 30 years with two schools of thought on each subject. On the first, one side has traditionally urged the "title policy," which would award titles to inventions to the government; the license advocates would leave title with the contractor and give the government only a license to use. On the second, one side has urged that only nonexclusive rights be granted to would-be users, while others argue that without exclusivity risk capital will not be invested.

The studies strongly support a policy that leaves title to contractors and which makes exclusive licenses available, for a limited time, under government patents. Private sector groups, in fact, seem to be unanimous and have urged legislation of this type for many years.

Although President Carter's recent initiatives are largely supportive of these policies, he would put title to contractor-made inventions in the government and grant an exclusive license to the contractor in fields he chooses to commercialize. This attempt to compromise the title-license dispute was strongly criticized at the NAE symposium by private sector spokesmen and one congressman. Even a White House spokesman stated that the private sector view was preferred but not believed politically viable since some who do not understand how patents work view the license policy as a giveaway at government expense.

New Technologies and Minor Inventions

The Supreme Court has not clearly resolved the patentability of several new technologies, i.e., computer programs and microorganisms. In the case of computer programs, the court has stated that the extent to which the patent system should be available should be decided by Congress. Congress, however, has not acted. The first case on the microorganism issue has yet to be heard by the court. These uncertainties should be resolved.

Inventions that do not meet the strict test for patentability under the patent laws have no statutory means of protection available, even though they may have significant commercial importance. This lack of effective protection for minor inventions has been noted, and some have suggested a system of petty patents as provided in some other countries.

Information Policy

The only report studied in the area of information policy was that of the Working Group established by the Subcommittee on Patent and Information Policy in the Domestic Policy Review. This group made recommendations on government information policy designed to stimulate industrial innovation. The report of the Working Group formed the basis of the discussion at the NAE Symposium and is reported below. The analysis was performed by W. K. Lowry, former Director of Library Services at Bell Telephone Laboratories.

Patents as a Source of Information

Although patents serve as legal documents, they are also intended to promote the "useful" arts by making accessible information that could stimulate others to invent and innovate. This accessibility is hampered by lack of adequate indexing, classification, and searching systems. A well-conceived automated system to correct these deficiencies would also serve to improve the validity of an issued patent, since it would retrieve many more relevant patents than does the present system. Due to deficiencies in our present patent

services, a number of organizations and societies are developing specific classifications and search systems for their particular technologies. As recommended in the President's initiatives, the Patent Office should work in partnership with these efforts while it is improving its own system.

To increase the relevance of patent information to innovation, the Patent Office should require that a cover sheet accompany each patent to provide additional information. This information would include a more descriptive title, index terms to be used in the search system, a statement describing ways to make use of the invention, and a clearer description of what the invention is about. This will aid entrepreneurs in determining if the invention offers prospects for innovation and profit.

As automation of the patent files is increased, the opportunity for remote access to patent information also becomes possible. It is important in the interim that the present Patent Office depository libraries be improved to provide more than just a patent number approach to depository collections. The value of patents as information sources for innovation requires not only a better searching system but also greater awareness of the patent literature. In addition to its own efforts, the Patent Office should encourage private firms to work with it in providing patent services to specific technologies. The Patent Office should also consider providing subsidies for smaller companies using the patent files for innovation possibilities, possibly in conjunction with the Small Business Administration, as outlined in the President's memorandum of October 31, 1979.

Foreign Market and Technical Information

In recent years, significant changes have taken place in the balance of trade between the U.S. and foreign countries in products deriving from high-technology areas. Part of this stems from increased research and development efforts abroad and, in part, is due to the inability of American business and industry to obtain the timely foreign marketing information required for exportation. In addition, improvements are needed in obtaining information required to meet foreign governmental regulations, technical standards, and product certification. An improved flow of foreign technical information to U.S. business and industry would also reveal new international trade opportunities for U.S. firms. To achieve these goals, industry and government should work together in developing appropriate international mechanisms to increase our foreign trade. In the President's memorandum of October 31, 1979, provision is made for increasing the amount of foreign technical information collected by the National Technical Information Service (NTIS). Of particular importance is the coordination of the NTIS program with that of the Office of Technology Assessment in areas of high technological activity and the issue of foreign patents in these areas.

The Working Group expressed a growing concern about new impediments to the international transfer of information. Recent U.S. controls on technology exports, the imposition of extra customs duties on products developed with foreign funds, restrictions on international cross-licensing agreements, and laws that adversely inhibit transborder data flow are examples. The inevitable result of such restrictions is not only loss of access to foreign information but also inability to proceed smoothly with the quid-pro-quo associated with technology transfer.

Assistance to Users

There exist in government and industry many types of information services that might provide assistance to users and stimulate innovation. There appears to be no pressing need to set up additional services. The private sector offers many information products and services that have value for innovation. What does appear to be needed is better knowledge of and access to the existing information service apparatus; a guide or directory service to point to the proper source of innovation possibilities. Government and the private sector should study and develop such a service with special attention to the needs of small businesses.

Training of technological entrepreneurs is currently being supported by the National Science Foundation at a number of universities where innovation centers have been established. Review of the success of these programs should be made, and if found to be successful they should be expanded.

Regulatory Impediments Including the Freedom of Information Act

Information dissemination through computer and telecommunication networks has increased greatly in recent years, and interactive communication systems for point-to-point communication are much in evidence. However, federal communications policy has been fuzzy on many aspects of communications networks, which has caused uncertainty and hesitancy among data base developers and information publishers. They are reluctant to invest large sums for this purpose until clear-cut policy is established by government. Resolution of the confusion surrounding network administration would do much to encourage the useful exploitation of this new technology.

Another problem affecting both the development and dissemination of information concerns the data rights policies for information developed by government contractors. Except for certain trade secret information and security classified matter, such information is generally published and made available to the world. This liberal policy is not followed by most foreign countries, and they are able to use our technological information base for increasing their competitive advantage. In view of this, the Working Group recommended that the U.S. Data Rights Policy should be revised to ensure that U.S. firms are treated on an equal basis with their foreign competitors.

A third problem concerns the Freedom of Information Act enacted, in 1966 to curb the practice of inordinate secrecy regarding federal agency operations. Although exemptions for trade secrets and certain privileged information are allowed, individual agency interpretations of the Act may result in disclosures that could adversely affect foreign market sales significantly. The lack of assurance that proprietary information submitted to the government will be protected will result in unwillingness in the private sector to spend the heavy resources for product development and marketing required for success. Amendments to the Act are recommended.

Protection of Data Bases and Software

The Working Group recognized the importance of software for information processing and deplored the present uncertainty surrounding copyright and patent laws as protection devices for this intellectual property. Under present law, software developers are forced to protect their investment by restricting its use through nondisclosure agreements or withholding it completely. Similarly, data base developers and services are reluctant to invest heavily in offering new information services in view of present ambiguities in the law.

As a means to gain added protection, the recommendations of the National Commission on New Technological Uses of Copyright Works (CONTU) were endorsed. These recommendations call for amendments to the Copyright Law of 1976. In addition, the Patent and Trademark Office should establish guidelines for software patent requirements.

Government as a Creator and Distributor of Information

The government generates and makes available vast amounts of information, some of which offers possibilities for innovative enterprise. However, there is government reluctance to make publicly available certain types of information that might be attractive to private sector entrepreneurs. Repackaging of such information, combined with vigorous marketing techniques, could add value for business and industry. Examples of the type of information not readily available are unpublished research reports and report services of the Congressional Research Service and reports of commercial attaches held by the Commerce Department.

Another aspect of government policy that directly impacts the private sector information industry is government competition with that industry. There is need for the government and private enterprise to develop jointly a collaborative effort that will ensure that information created for government purposes is made available promptly and in format packages demanded by market requirements. Only where a clear public need exists should government compete.

SUMMARY OF PANEL DISCUSSION

Patent policy issues have been discussed for many years. In the mid 1960s, a presidential commission made recommendations for many wide-ranging changes in the law; however, few changes have actually been made because few proposals received broad support.

Now, however, there seems to be a strong consensus on many issues and proposed policy changes so that, as one spokesman noted, Congress has almost as many patent-related proposals as it can handle at any one time.

The issues on which strong consensus was noted include improving the Patent and Trademark Office examination process by providing adequate funding and by instituting a patent reexamination system. A single court of patent appeals was also strongly recommended, although it was noted that some fear that such a single court might become too sterile and too propatent. There was also strong support for arbitration as a dispute-resolution process for patent cases.

All panelists and spokesmen supported a clarification of government patent policy. The view was expressed that maximum utilization of government-funded inventions will result if, in the case of a private contractor, title to inventions is vested in the contractor and if, in the case of a government-made invention, exclusive licenses are made available. Although there was support for the recommendation in President Carter's initiatives for exclusivity, no one supported the specific mechanism proposed for contractor-made inventions, i.e., exclusive licenses for the contractor with title in the government.

Other generally supported proposals included a clear statement that the patent laws embrace new technologies, establishment of the Patent and Trademark Office as an independent agency, and extension of patent term for inventions, the use of which has been delayed by governmental regulation.

Although there was some support for the elimination of patent interference proceedings by the adoption of a first-to-file patent system, this continues to be a controversial proposal.

Overall, there was clear support for strengthening the patent system to enhance industrial innovation.

VII. RECENT STUDIES OF ANTITRUST POLICIES

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ANALYSIS

This paper offers a comparative analysis of the antitrust aspects of several recent studies of national policies affecting industrial innovation. The studies in question and the abbreviations by which they will sometimes be cited are as follows:

1. Domestic Policy Review, Advisory Committee on Industrial Innovation, Advisory Subcommittee on Regulation of Industry Structure and Competition, Draft Report, December 20, 1978. (DPR Regulation)
2. Domestic Policy Review, Advisory Committee on Industrial Innovation, Public Interest Advisory Subcommittee, Draft Report, December 28, 1978. (DPR Public Interest)
3. Domestic Policy Review, Advisory Committee on Industrial Innovation, Labor Advisory Subcommittee, Draft Report, December 22, 1978. (DPR Labor)
4. Domestic Policy Review, Advisory Committee on Industrial Innovation, Report of the Small Business Members, May 1, 1979. (DPR Small Business)
5. Commerce Technical Advisory Board, Recommendations for Creating Jobs Through the Success of Small, Innovative Businesses, December 1978. (CTAB)
6. Committee for Economic Development, Stimulating Technological Progress, Draft Statement, September 19, 1979. (CED)
7. Congressional Research Service, Industrial Innovation and Its Relation to the U.S. Domestic Economy and International Trade Competitiveness, October 13, 1978. (CRS)
8. Ginsburg, "Antitrust, Uncertainty, and Technological Innovation," Report to the Panel on the Impact of Antitrust Policies and Practices on Industrial Innovation, of the Committee on Technology and International Economic Trade Issues, Assembley of Engineering, National Research Council, and Office of the Foreign Secretary, National Academy of Engineering, August 15, 1979. (NRC/NAE).

As their titles suggest, many of these reports deal with a variety of specific topics under the general head of the relationship between government policies and industrial innovation; others are directed toward the creation of jobs and the stimulation of technological progress through government policies; and one deals exclusively with the relationship between antitrust policies and technological innovation. Each, however, deals with issues of antitrust and industrial innovation to some degree and is to that extent only examined in this paper.

There are five points of tangency among the various papers. They are dealt with here in the following order: further research needs, joint R&D ventures, "no-fault" liability for internal expansion, horizontal mergers, and foreign competition. The recommendations made by the various reports on these subjects are synopsized in Table VII-1.

The issues discussed in this comparative analysis and the studies under consideration herein were also the subject of a panel discussion at the NAE Colloquium on Industrial Innovation, held in Washington, D.C., on December 5 and 6, 1979. That panel discussion is abstracted, with particular attention to points of agreement and disagreement, at the conclusion of the chapter.

On October 31, 1979, the President announced certain policy initiatives based on the Domestic Policy Review of industrial innovation, for which many of these studies were done, and sent a message on industrial innovation to Congress stating that in some areas specific legislative proposals would follow. Two of the measures announced by the President concern antitrust policies. First, he directed the Department of Justice to "issue a guide clearly explaining its position on collaboration among firms in research." This was recommended in the NRC/NAE paper under review here and is discussed below.

Second, the Department and the FTC are "to initiate discussions with industry about innovation, antitrust policy formulation, and enforcement." The purpose is to dispel the perception that antitrust policy inhibits innovation and to improve communication between industry and the enforcement agencies. This measure addresses the general theme of the NRC/NAE study--a concern for the effect of antitrust uncertainty on innovation; whether it implies any substantive changes in enforcement policy, however, is not yet clear.

Further Research Needs

To date, most of the research relevant to the relationship between antitrust policy and technological innovation has been concerned with the impact of industrial market structures on innovaton. The relevance of market structure to innovation was pointed out most suggestively by Schumpeter, who hypothesized that large size and some monopoly (i.e., market) power are prerequisites for economic growth through technological progress; in perfectly competitive markets, no single firm would be a large enough factor in its market to generate the super normal profits necessary for investment in technological

TABLE VII-1 Comparative Summary of Recommendations

Issues and Recommendations	NRC/NAE	DPR Regulation	DPR Public Interest	DPR Labor	DPR Small Business	CED	CTAB	CRS
Further research needs	Indices of innovation; relationship between market structure and innovation, pp. 14-19.	–	Indices of innovation, p. 10; economic benefits of innovation (implicit recommendation), p. 10.	Congressional examination of innovation and role of big business, p. 23.	Indices of innovation (implicit recommendation), p. 4.	–	–	–
Joint ventures	DOJ should clarify controls, pp. 38-44.	Relax controls, pp. 38-44; consider relevance of foreign joint ventures, p. 41.	–	–	–	–	–	–
"No-Fault" liability for monopolization	Oppose deconcentration legislation, pp. 30-34.	Oppose no-fault deconcentration legislation, pp. 32-34.	–	–	–	–	–	–
Horizontal mergers	Clarify showing required for waiver of guidelines, pp. 35-37.	Waive guidelines by applying more liberal test, pp. 37-39.	More vigorous enforcement of current laws; new laws aimed at conglomerates, pp. 29-32.	Break up concentrated industries, perhaps large firms, pp. 23-24.	–	–	–	–
Foreign competition	Consider foreign trade impact of deconcentration legislation, pp. 31-32.	Study foreign trade practices, consider protectionism or relaxing Sherman Act in response, pp. 40-41. Reconsider Clayton Act insofar as it encourages foreign, and discourages domestic, acquisitions, p. 42.	–	–	–	–	–	–

progress as, for example, through research and development expenditures. Firms facing a horizontal demand curve could not make sales above the prevailing market price, which would just equal the marginal cost of production.

The NRC/NAE paper reviews the extensive economics literature directed toward identifying the effects of market concentration on innovation and the optimal market structure to generate and sustain a high rate of innovation. The author finds that this literature has been largely inconclusive. In summary, however, the NRC/NAE paper implicitly endorses the view that some structural concentration, which would not be found in perfectly competitive markets, is conducive to innovation, whereas highly concentrated markets or those to which entry barriers are high will be less likely to exhibit a rapid rate of technological (or other) innovation.

An important element in the NRC/NAE paper's approach to the literature in question is its emphasis on the imprecision with which innovation has been measured by economists and other students of industry. The process of innovation may embrace a wide range of activities from the generation of an idea by an inventor to its subsequent commercialization by an entrepreneur. Furthermore, as stated in the DPR Public Interest report, "innovation encompasses not only 'hard science' technology, but also changes in our methods and institutions" (p. 12). Innovation, in other words, denotes not only invention in the sense associated with new products and processes, but also the development of new managerial techniques.

Because of the difficulties of quantifying "innovation," broadly understood, it has, according to the NRC/NAE paper "become customary for students of innovation to study only the invention component of innovation, and often further to narrow their sights by using research and development (R&D) efforts as a proxy for inventive activity because at least rough quantitative data on R&D inputs and outputs are available to them" (p. 15). According to the same paper, these data limitations have severely limited the utility of even such studies as seem to reach significant conclusions. The NRC/NAE paper therefore calls for further research to improve our understanding of the relationship between industrial market structure, on which antitrust policy operates, and the propensity for technological innovation; particular attention is drawn to the need to develop more adequate indices of innovation that economists have yet devised (p. 4). More particularly, the NRC/NAE paper cautions against acting to prohibit conglomerate mergers before we have a better understanding of the effect that corporate diversification across product lines has on a firm's propensity for innovation and the efficiency of its R&D spending.

The other reports that address the problems of measuring innovation and relating rates of innovation to market structure share the NRC/NAE paper's generally skeptical view about the state of our knowledge in this area. Thus, the DPR Small Business paper acknowledges that we are "(w)ithout precise indices for small business innovation," as a result of which we are remitted to such imperfect proxy measurements as labor productivity and even the personal

observations of "experienced entrepreneurs" (p. 4). In a related vein, the DPR Public Interest paper observes that "the 'economic' benefits of innovation have never really been measured" (p. 10). And the DPR Labor report suggests that although R&D is highly concentrated among the largest firms in our economy, while innovation "may depend far more on the health of smaller, high-technology companies," comprehensive information on the "structure and operation" of the firms that account for a high percentage of private sector R&D is "woefully lacking" (p. 23). The DPR Labor reports thus calls for a "full-scale congressional examination of the American economy. . . to provide Congress and the public with the facts on innovation and the role of big business in advancing and/or retarding innovation in the U.S.A.": (p. 23). Without awaiting such an investigation, however, the DPR Labor report simply asserts that "(s)ome business mergers have been aimed at acquisition of innovation--others at suppressing innovation" (p. 24). No support whatsoever is adduced for the proposition that acquisitions have been made in order to suppress innovation.

A Congressional investigation may not be a very good forum for a dispassionate exploration of the "facts" relating innovation to firm size or industrial practices. If the unfounded allegation quoted in the prior paragraph is widely believed, however, such an investigation might be warranted in order either to confirm or, more likely, dispel such suspicions. The disadvantage of conducting a serious inquiry into innovation and market structure in a political forum is obvious. Academic investigators, however, do not have the power to subpoena witnesses and documents, and while antitrust plaintiffs can engage in extensive discovery, it is plausible that an acquision aimed at "suppressing innovation" would successfully avoid the light of day in court.

Joint R&D Ventures

Both the DPR Regulation and the NRC/NAE papers deal with the antitrust problems of joint R&D ventures. According to the former report, wartime experience has shown that collaborative projects "can produce major and dramatic innovation" where the size or difficulty of the undertaking would preclude any one of the cooperating firms' undertaking the task (p. 35). As both reports acknowledge, however, joint R&D ventures can also be put to anticompetitive uses, as for example, when the joint venturers exchange price or other competitive information beyond that necessary to their cooperative research enterprise.

According the the DPR Regulation report, "(t)he Department of Justice and the courts have generally addressed the relevant factors" in analyzing the competitive consequences of a proposed or actual joint venture against the standards of the antitrust laws. But, the report continues, the important "question is the weighting of these factors" (p. 35). Here, DPR Regulation would urge the Department to give special recognition to the need for joint or cooperative research

(even among large competitors) in the case of "high-cost, high-risk 'breakthrough'-oriented projects." Present policies are criticized as overestimating the research capabilities of individual firms and assuming too optimistically that the proposed research would be undertaken effectively by an individual firm if the joint project is disapproved by the government. Of course, decisions must be arrived at on a case-by-case basis, but it is urged that "appropriate weight" be given to the encouragement of rapid technological development (p. 36).

The NRC/NAE report notes that the Department of Justice has articulated a large number of criteria by which it will decide whether to invoke the antitrust laws to prevent joint or cooperative research, and the report implicitly accepts the relevance of those criteria (pp. 39-41). The Department's statements for the guidance of industry are criticized, however, as providing little guidance that can be applied to any particular joint R&D venture being considered by firms, and the report suggests that the lack of such guidance and the burdensomeness of the formal procedure available for obtaining a specific ruling on a proposal may inhibit firms from coming forth with proposals for joint efforts.

The thrust of the NRC/NAE point is closely analogous to the DPR Regulation observation that the crucial policy decision is made in the weighting of the factors that the Deparment considers on a case-by-case basis. While the emphasis of the NRC/NAE report is on uncertainty and its inhibiting effect, however, DPR Regulation emphasizes the substantive need for resolving such uncertainty in favor of joint ventures that are likely to produce technological advances. Accordingly, the DPR Regulation report goes on to point out that an effective policy to encourage joint ventures must allow the venturers to realize the fruits of their efforts by enabling them freely to allocate intellectual property rights without, for example, compelling them to license the resulting patents to their competitors (p. 36).

From the foregoing summary, it is apparent that both papers agree that in some areas the use of joint ventures for R&D may increase technological innovation (although the DPR Regulation report is clearer in advancing this proposition), that the Department of Justice is legitimately concerned with the antitrust implications of particular joint ventures and their modes of operation, and that the Department's criteria for evaluating joint ventures are basically sound but insufficient by themselves to resolve particular cases and to do so in a manner calculated to foster innovation.

The DPR Regulation proposal that the Department of Justice adopt a more understanding attitude "in the case of high-cost, high-risk 'breakthrough'-oriented projects" raises certain problems of administration with which it does not deal. Most important, it is not clear how the Department could assess the riskiness or 'breakthrough'-oriented nature of any particular proposal. To the extent that these concepts imply a scientific or technical evaluation--that is of scientific or technical risk or breakthrough--the Department is not presently equipped, nor is it

clear how it could become equipped, to make such an analysis. Alternatively, to the extent that a 'breakthrough' is something of importance in a dimension other than the scientific or technical--such as an energy 'breakthrough' might be, due to the foreign policy implications of national reliance on imported oil--the Department might not be the appropriate agency to make such a judgment; even if it acquired the technical competence, that is, it would not have the institutional competence to do so.

The DPR Regulation report also proposes that the "extent to which foreign competitors engage in joint research activities among themselves should be both (a) a factor in Department of Justice consideration of proposed joint research activities by American firms and (b) a defense in antitrust proceedings arising out of such activities." Foreign cooperative research efforts are said to be relevant here for two reasons: "because of the obvious issues of international competition (and) because the selection of such areas for collaboration by foreign firms and governments is relevant to assessing the necessity for joint research efforts in those fields" (p. 41). Unfortunately, however, the "issues of international competition" are neither obvious nor obviously tractable within the Department's antitrust administration.

One suspects that the concern here is that a number of foreign firms are being allowed by their governments to pool their research efforts, with the result that they may innovate a new technology that will enable them to penetrate the American market more readily or at a lower cost than American firms could do. That is a net benefit to Americans as consumers, but it may have an adverse impact on the same or other Americans as producers, i.e., on domestic employment and the balance of payments. Again, however, there is good reason to doubt that the Department of Justice either could or should attempt to accommodate such considerations in its antitrust enforcement policy.

On the other hand, the second point advanced by the DPR Regulation report may be sufficiently powerful by itself to support the recommendation that Justice look to foreign practices in considering a proposed joint research venture. Such foreign practices may reflect the best thinking of other industrialized nations about the scale and resources necessary to accomplish a particular research goal. To that extent, their conclusions should be probative in making U.S. antitrust enforcement policy. A difficulty arises, however, because foreign practices may also reflect a generally less firm commitment to the maintenance of a competitive economy. Since the DPR Regulation report is not suggesting any relaxation of the commitment, but only a realistic appreciation of the limitations of a competivie approach to some situations, the report would presumably agree that a foreign practice must be evaluated for its economic justification before its relevance to U.S. antitrust policy can be established.

"No-Fault" Liability for Internal Expansion

The DPR Regulation and NRC/NAE papers both address the problems that are created when antimonopolization laws are applied to firms whose dominant share of a market has been achieved through internal expansion. As interpreted to date, the present antitrust laws would not penalize, much less require the dismemberment of, a firm that achieves a dominant or monopoly market position by reason of offering lower prices or superior products and without engaging in exclusionary or unfair trade practices. Any attempt to extend the antitrust laws to such cases raises the possibility that firms will be inhibited from engaging in technological innovation to improve their products or lower their costs and prices for fear that they will thereby obtain too large a share of a particular market.

The DPR Regulation paper addresses the most extreme sort of proposal to extend the antitrust laws in this direction, viz., those proposals for "no-fault" monopolization legislation that would preclude consideration of the extent to which market success is attributable to technical achievement (p. 34). It takes the view that such legislation "would strongly discourage leading firms from promptly introducing new technology and from passing on technology-based cost savings through price reduction." And, as the report points out, it would make little sense for antitrust policy to encourage a firm that can reduce its costs through innovation to maintain its preinnovation pricing, thereby holding market share constant while reaping higher profits and conferring no additional benefit on consumers (p. 33, note 7). The DPR Regulation's analysis is premised on the riskiness and uncertainty inherent in the innovation process. If the decision to invest in innovation is made even riskier by the introduction of potential antitrust exposure--indeed, exposure that would increase with the significance and success of a resulting innovation--then "the risk/reward ratio will have been skewed against the introduction of new technology" (p. 33).

The NRC/NAE paper takes up the somewhat less drastic, but more frequently advanced, proposal under which large firms in concentrated markets would be required to show, if they are to avoid dismemberment, that they have been sufficiently, technologically innovative to explain their success and thus to justify their continued existence. Although less drastic on its face, the NRC/NAE report sees in this proposal much the same hazard that the DPR Regulation report finds in a no-fault approach that would not allow the defense of technological superiority. According to the NRC/NAE report, the burden of mounting such a defense, and the prospect thereof, "would seem to be precisely what is needed to deter the moderate-sized firms in a concentrated industry from attempting to gain market share by aggressively innovating in technology to produce a more attractive product or a more cost-efficient production process that would enable it to lower its prices" (p. 31).

In order to illustrate their point about the way in which successful technological innovation, i.e., that which enables a firm

to capture a significant market share, may be deterred by antitrust sanctions, both papers discuss the presently pending action of the Federal Trade Commission (FTC) against E. I. duPont de Nemours in connection with that firm's production of TiO_2. The NRC/NAE paper analyzes the case at some length, remarking that it is "difficult to determine whether the Commission, in seeking to deconcentrate the market for TiO_2, is not also penalizing a form of technological innovation that made it possible for duPont to obtain its present market share" (p. 33). It concludes that if "duPont's dereliction, in the Commission's view, really consists of no more than its rapid expansion of capacity to exploit what the company claims (and the FTC does not dispute) is a new and cheaper way of making TiO_2, then the line between successful technological innovation and unlawful means of commercializing and exploiting that innovation will have been dismally blurred" (p. 34).

Indeed, according to the DPR Regulation report, this effect is already taking hold: "the current Federal Trade Commission action against DuPont . . . is being interpreted by the business community as a warning that the acquisition of market share by passing through the cost advantages of improved process technology, and building capacity to support that share, is hazardous. To many executives the moral appears to be that that FTC would prefer a leading company to hold prices, restrict output, and reap higher profits" (p. 34).

Both reports agree that the FTC presumably neither intends to encourage firms to increase profits rather than engage in price competiton nor to deter technological innovation, but that the latter effect (if not both) must surely result if the FTC is able to force duPont to divest itself of part of its TiO_2 capacity.[1]

Horizontal Mergers

Five of the reports reviewed here address at least some aspects of merger policy under the antitrust laws as it might affect technological innovation. The DPR Regulation and NRC/NAE reports deal particularly with horizontal mergers--i.e., mergers between firms in actual or potential competiition with one another--whereas the DPR Labor, Small Business, and Public Interest reports advert more generally to the acquisition by large firms of smaller, technologically innovative companies.

Under current antitrust policy respecting horizontal mergers, the Department of Justice applies mathematical market share guidelines to determine whether a horizontal merger should be restrained under Section 7 of the Clayton Act. These guidelines severely limit the ability of firms in actual or potential competition to merge with one another in the absence of some extenuating circumstance. The Department's Merger Guidelines specifically indicate that a more relaxed enforcement policy will apply where the firm to be acquired is a "failing company" that, in the absence of acquisition, would probably disappear from the marketplace anyway. In addition, officials of the Department of Justice have indicated that the Merger

Guidelines would be waived to permit a market-concentrating acquisition "where significant R&D gains would be achieved" through the merged company and that factor outweighs "any possible competitive losses which might also result in the transaction." The Department of Justice has not indicated, however, the type of showing that would have to be made in order to justify such a merger on the ground that resulting gains in technological innovation would outweigh competitive losses. Accordingly, the NRC/NAE paper urges the Department to elaborate on this subject as it has elaborated, through the Merger Guidelines, on the general issue of its enforcement policy respecting mergers. Failing such action, it is said, businesses may fail to pursue unobjectionable mergers with the result that innovations of great promise may not be commercialized (p. 37).

While the NRC/NAE paper calls for clarification of what the Department of Justice claims is present antitrust policy concerning horizontal mergers and technological innovation, the DPR Regulation report seems to call more directly for some substantive alteration of that policy. The focus of concern is "the acquisition of small, advanced-technology firms by established firms in similar or related fields" (p. 37). The DPR Regulation report explains its focus on small firms on the ground that while small firms have played an important part in major innovations, they often face greater obstacles than large firms in completing and commercializing their innovations. It would of course be preferable, from the point of view of maximizing competition, if the small firm could acquire venture capital to grow as an independent competitor. Alternatively, the firm might be acquired by a larger company that does not compete with it and that would supply it with the needed capital to further its innovative efforts. Neither of these alternatives may be a realistic possibility in some cases, however, and it may therefore be necessary, if the innovation is to reach the marketplace, for the innovating firm to be acquired by an actual or potential competitor (pp. 38-39). It is in this case that antitrust policy may prevent the firm's acquisition and thus preclude commercialization of the innovation. Furthermore, the report points out, the above described conflict between antitrust policy and technological innovation may have a general deterrence effect: "the prospect of acquisition is one of the most important incentives for entrepreneurs in organizing new firms to exploit novel technology." Preventing the innovative entrepreneur from selling his firm (where only an actual or potential competitor could be found to acquire it) will lessen the incentive for individuals to found innovation-based enterprises (p. 37).

In order to resolve this dilemma, the DPR Regulation report recommends that "(i)ssues related to innovation should be given great weight" by the enforcement agencies when a small, advanced-technology firm proposes to merge with an actual or potential competitor. Except in degree, this proposal is not clearly different from the Department of Justice's present policy. There is at least an implicit conflict, however, between this proposal and the NRC/NAE paper's call for the Department of Justice to clarify its policy by the issuance of further guidelines respecting mergers that would further innovation. The

conflict, if it exists, arises from the apparent preference of DPR Regulation for case-by-case analysis on the part of the enforcement agencies. Thus, the DPR Regulation report appears to be suggesting that the Department of Justice or the FTC determine, in each particular case, whether the small, innovative firm could realistically have acquired funds to grow as an independent competitor or, alternatively, have found a merger partner that was not in actual or potential competition with it. While the NRC/NAE paper does not actually suggest that the enforcement agencies dispense with case-by-case analysis, its emphasis upon clarification by the issuance of guidelines of general application does suggest that the necessity for detailed analysis of each proposed merger transaction could be obviated; if the guidelines were of any utility, they would indicate clearly that some proposals need not be made, while others would almost certainly be unobjectionable to the enforcement agencies. (The NRC/NAE paper does concede that there would be difficult problems involved in drafting useful guidelines to this end.)

Whereas both the NRC/NAE paper and the DPR Regulation report state that the relationship of firm size to innovative output, although extensively studied, remains ambiguous (e.g., DPR Regulation, p. 37), the DPR Small Business report asserts (on the Summary page) that "(s)mall businesses make a disproportionately large contribution to innovation." These firms, it is said, "are often more adventuresome and have a greater propensity for risk taking, and accordingly are able to move faster and use resources more efficiently than large companies" (p. 2). Accordingly, the DPR Small Business report is concerned with a perceived trend toward the acquisition of existing small, innovative companies by large corporations (p. 8). Although it is not entirely clear, the DPR Small Business report seems to be adverting here to horizontal mergers inasmuch as it refers to these acquisitions "forcing concentration."

Whereas the concern of the NRC/NAE and DPR Regulation papers is that antitrust policy may prevent horizontal mergers that would, if permitted, contribute to technological innovation, the gist of the DPR Small Business report's recommendations is to relieve small firms of the special burdens under which they are said to operate and which, presumably, lead them to seek larger merger partners. For example, changes in the securities laws are suggested in order to remove obstacles for innovative enterprises seeking to acquire capital. Since these recommendations do not implicate antitrust policy we need not deal with them further here.

The DPR Labor report deals only briefly and indirectly with the impact of horizontal mergers on technological innovation, but it is clearly animated by a concern that mergers--seemingly of all kinds, horizontal, vertical, and conglomerate--tend to impair the ability of businesses to innovate. The DPR Labor report's brief treatment of this subject begins by suggesting that "innovation in America may depend far more on the health of smaller, high technology companies than on the well-financed, highly organized operations of the corporate giants which dominate the U.S. economy to an extraordinary degree" (p. 23). As previously noted in another context, this report

asserts that "(s)ome business mergers have been aimed at acquisition of innovation--others at suppressing innovation" (p. 24). The report concludes its brief discussion of industry structure and competition (including mergers) with a number of recommendations outside the antitrust area and a very generally couched call for "specific antitrust legislation aimed at concentrated and interlocked industries." The implication would seem to be that firms in concentrated industries should at the very least be prevented from making further market-concentrating acquisitions and should, perhaps, be dismembered on the theory that increasing competition and reducing scale will enhance innovation.

The DPR Public Interest report takes at least as zealous a view of the need for antitrust enforcement against horizontal mergers in the interest of technological innovation. It states that, "Despite all of (the) touted advantages of small businesses in spurring innovation, very little has been done to foster small business for this purpose. One of the best things the government can do to this end is to foster competition. . . ." The DPR Public Interest report is also concerned with mergers of all types. It refers both to the "horizontal and vertical integration which is so inimical to competition" and to "mergers that threaten to result in the dominance of the entire economy by a few giant conglomerates" (p. 32). Clearly the focus of the concern here is not with the merger of small or innovative firms into others, however. Rather, it is with the protection of small business from "power and control over markets, entry, products, and capital" in the hands of large firms, whether integrated or conglomerated.

In summary, the DPR Regulation and NRC/NAE papers were concerned exclusively with antitrust prohibitions that might inhibit innovation-fostering mergers; the DPR Small Business report is concerned with the regulatory and other governmental policies that make acquisition attractive to a small, innovative firm; and the DPR Labor and Public Interest reports are concerned with industrial concentration and conglomeration generally on the ground that small firms and, hence, innovation are inhibited in such an environment.

Foreign Competition

The DPR Regulation report deals at length with the subject of foreign trade practices' impact on U.S. antitrust policy as it might affect technological innovation, and the NRC/NAE and CRS reports advert to the subject.

The DPR Regulation report recommends that the Adminstration initiate an intensive, one-year study to determine the extent to which foreign firms engage in practices such as market division and concerted strategies that would, if subject to U.S. jurisdiction, violate the Sherman Act, and the extent to which such practices in fact give foreign firms advantages over their American competitors. If the study reveals that foreign companies have significant advantages as a result of such restrictive trade practices, DPR

Regulation recommends that the Administration seek legislation either (1) to protect the American market "from incursions of the products of such firms," or (2) "to place American firms on a more nearly equal footing," or (3) alternatively, that the Administration explicitly determine to take no action in light of (or despite) the study's findings.

The DPR Regulation report's discussion of these recommendations is uncharacteristically opaque. First, the relationship between foreign trade practices and foreign competitive advantages on the one hand, and domestic technological innovation on the other, is not explicity stated. Since reference is made to the "relative erosion of American technical and cost leadership" (p. 39), it will be assumed here that the unarticulated premise is that American firms' loss of international market share is depriving them of the profitability and/or scale economies necessary to support substantial investments in technological innovation. This is akin to the view related by CRS (p. 39) that American antitrust policy has hurt the international competitiveness of the U.S. steel industry by prohibiting mergers of domestic steel companies "to take advantage of the economies and new technology attuned to a much larger scale of operation." It is also resonant with the NRC/NAE report's suggestion that industrial deconcentration legislation could deprive U.S. firms of the ability to realize scale economies necessary to meet competition abroad (p. 31).

Second, while the discussion in the DPR Regulation report acknowledges the "disadvantages which attach to protectionist legislation in general" and the "obviously undesirable" nature of a "lowest common denominator approach to international antitrust laws," it does not make clear what advantages are to be sought in protectionist legislation or relaxation of the Sherman Act, respectively. Assuming that foreign companies do have a significant advantage over their American competitors by reason of trade practices that are prohibited to American firms under the Sherman Act, and that the consequence is a loss of both domestic and international market share for American firms, it still does not follow that either of the prescriptions set forth above should be implemented either in the pursuit of technological innovation or of any other policy.

The relationship between protectionist legislation and fostering technological innovation is particularly obscure. Is the purpose to impose sanctions on foreign firms in this manner because they cannot be reached directly through the antitrust laws, hoping thereby to deter what would otherwise be antitrust violations, and thereby to gain for American consumers the advantages--in technological innovation, price competition, etc.--of competition that is now being suppressed? Is it to protect the American producers, and if so why and how would such protection relate to the policy of fostering industrial innovation? One can readily imagine the arguments that might be made for either protectionist legislation or relaxation of the Sherman Act on grounds of "fairness" to American firms (but not consumers) or in the interest of restoring the American trade balance. Neither of these concerns is linked in any obvious way, however, to policies that encourage innovation. Unless these

questions can be answered in terms that do relate to innovation, one cannot imagine that the proposed study would yield any result, justified in terms of innovation policy, other than "an explicit policy determination to take no action." Therefore, until these questions are addressed in terms of innovation policy, it remains unclear how undertaking the proposed study could contribute to technological innovation in the U.S.

Because the Clayton Act prohibits mergers that might tend to reduce competition in any section of the U.S., the DPR Regulation report characterizes its effect as giving "preference to acquisitions (of American firms) by foreign firms," as opposed to American firms. A foreign firm that is not an actual or potential competitor in the U.S. does not further concentrate a U.S. market when it acquires an American firm, whereas the merger of two American firms engaged in competition has precisely that effect. Therefore, the DPR Regulation report acknowledges the "pro-competitive short-range domestic effects" produced by what may seem to be disparate application of the antitrust regime to American and foreign acquiring firms. It suggests, however, that these desirable effects "be weighed against two additional factors: (1) the long-range competiveness of the surviving American firms in both American and international markets and (2) the international market position of the foreign acquiror" (p. 42). These two factors are said to be "particularly critical where the acquired firm has a strong position in new or advanced technology."

Again, and notwithstanding the just-quoted reference to technological lead, the DPR Regulation report fails to relate its proposal explicitly to a concern with American technological innovation. It is said that foreign acquisitions of American firms "have unquestionably increased (the acquiring firm's) relative strength world-wide, particularly where the acquisitions afford them access to new technology and innovative capability." The concern here is explicity said to be the potential for "a long-term shift in the international competitive balance, the ultimate consequences (of which) may prove detrimental both to competition in the American market and to the strength of the American economy." As in the case of the previously discussed proposals, this recommendation bears only an implicit, if not tenuous, relationship to American technological innovation. The intention here may be to suggest that foreign acquisitions will lead, in some unspecified way, to a lessening of competition in the American market, which in turn will retard innovation by firms (presumably both American-owned and foreign-owned) in that market. But in the absence of some specific indication of how this effect might be brought about, it is impossible to analyze the DPR Regulation recommendation in a meaningful way.[2]

Concluding Remarks

This paper has compared and contrasted the significant antitrust discussions found in the various studies under consideration. It should not go unremarked that, because the papers are written from

disparate perspectives in which the relationship between antitrust and technological innovation plays a role of varying significance, the papers do not in general join issue at a board philosophical level. While their attention to particulars makes comparison more tractable, at the same time, their relative inattention to philosophical underpinnings makes it more difficult to understand precisely why various reports arrive at the conclusions they reach. Any useful discussion of policies affecting technological innovation must, of course, ultimately reduce to particulars; policy is not implemented at the level of abstraction. Still, an informed discussion of particulars is facilitated when the discussants have an appreciation of each other's premises. To some degree reflected in this comparative effort, discussion may have been impeded for want of such foundational understanding of the various points of view being analyzed.

FOOTNOTES

[1]Since these two reports were written, an Administrative Law Judge dismissed the FTC case against duPont; the Commission staff has now appealed to the full Commission, however. It is not likely that the Commission will issue its decision before the second quarter of 1980, and, of course, it could take much longer.

[2]The DPR Regulation report also recommends that the extent to which foreign competitors engage in joint research activities among themselves be a factor in the Department of Justice's consideration of proposed joint research activities by American firms. This recommendation was dealt with above in the section on joint R&D ventures.

SUMMARY OF PANEL DISCUSSION

The panelists for this discussion were the Honorable Ky P. Ewing, Jr., Deputy Assistant Attorney General, U.S. Department of Justice and Robert B. Shapiro, Esq., Vice-President and General Counsel, G. D. Searle & Co. Professor Douglas H. Ginsburg, Harvard Law School, who had prepared a comparative analysis of recent studies of antitrust policies affecting industrial innovation, also participated. The panel discussion was chaired by William J. Casey, Esq.

Mr. Casey opened the discussion by emphasizing the degree to which the participants were in agreement on the appropriate and positive role that antitrust law plays in stimulating innovation. He observed that the problems and the areas of disagreement occur "at the margin"--where there is an opportunity for incremental adjustment in the antitrust regime so as to better accommodate the national interest in industrial innovation. Mr. Casey indicated that such national interest was heightened by the generally adverse economic situation. Mr. Ewing and Mr. Shapiro were quick to agree with the marginal nature of the subject under discussion, but Mr. Shapiro did observe that there is no "general theory that would enable (one) to predict the consequences of a change in antitrust policy upon innovative behavior." As a result, he was concerned that antitrust policy could have unintended side effects that adversely impact innovation in ways that would not be visible at the margin.

Mr. Casey observed that it would certainly be significant if the antitrust laws encourage the exploitation of American patents abroad or make it easier for innovative companies to be acquired by foreign companies than by domestic ones, as some have asserted. Mr. Ewing assured the panel that the Department of Justice is aware of the international nature of many markets in which American companies compete and reported that the Department is trying to understand better how its enforcement efforts affect American business "on an international basis." Mr. Shapiro objected, however, that the antitrust laws do in fact make it easier for foreign firms to acquire small, innovative companies than for American firms to do so. Without doubting the short-range procompetitive effect that introducing more competitors into the American market may have, he expressed concern that in the long run the "locus of innovative talent may be shifting (abroad) and that acquisition policies may make it simpler for that locus to shift." As Mr. Shapiro explained, a foreign firm whose access to technological innovations made in America is facilitated by the antitrust laws may then gain a worldwide competitive advantage in

the commercialization of that technology. In Mr. Casey's phrase, "You are losing part of your root seed."

The foregoing remarks elicited the first substantive disagreement among the parties, in that Mr. Ewing objected to the idea that foreign companies have an unfair advantage in acquiring domestic firms; actual or potential competitors of the firm to be acquired are given a very hard look regardless of national origin. Any departure from that stance, in Mr. Ewing's view, would constitute a departure from free trade principles into isolationism. Mr. Ginsburg tended to agree, in that he saw no present mechanism in the antitrust laws for responding to the problem of technology transfer, nor did he think that the responsibility for responding to that problem should be lodged in an antitrust enforcement agency.

Mr. Ginsburg doubted the ability of the Department of Justice to evaluate technological claims made on behalf of mergers that would otherwise run afoul of antitrust norms. Mr. Ewing believed that outside consultants could aid the Department in coping with such claims, but that the Department would have to place primary reliance upon its "structural" approach to market analysis, i.e., looking primarily to market share and concentration ratios, for example, "rather than the intention of particular managements" to pursue innovation-oriented strategies. Mr. Shapiro strongly took issue with this point of view, reiterating his premise that not much is known about the impact of antitrust policies on economic behavior--making reliance upon structural characteristics therefore somewhat arbitrary, although convenient--and emphasized the importance of good technical input to policy. "(I)f you don't understand the underlying technological issues in an industry, then you don't understand the economic or competitive issues in that industry as well."

Mr. Casey noted that the recent studies of antitrust and its impact on innovation generally agreed that joint ventures can facilitate innovation by pooling experience and sharing of funding among the cooperating firms, and he observed that the Administration stated that it would issue guidelines respecting antitrust policy as it applies to joint ventures, a step he noted that the NAE task force on this subject had urged. Mr. Casey was particularly interested in whether these guidelines would accord special weight to the innovative potential of a joint venture in determining whether to approve it. Mr. Ewing stated that the guidelines will specify innovative potential as one of the factors that the Department of Justice will consider in its analysis of joint ventures. Mr. Shapiro was skeptical, however, about the significance that the joint R&D guidelines might have.

According to Mr. Shapiro, "most research oriented American companies" prefer to engage in individual research or, if they take a partner, it is from outside their own industry. In the exceptional case where intraindustry joint R&D is preferred, he did not believe that most businessmen would have much to disagree with in the present, stated policies of the Department of Justice. They would be most concerned, he thought, that adequate recognition be given to the difficulty of a single firm doing research in many important "break-through areas." It was in precisely these areas that he

thought a set of guidelines would not be terribly helpful inasmuch as "key decisions are going to be made on a case-by-case basis."

Mr. Ewing noted also that the Administration had committed the Department of Justice and the Federal Trade Commission to a dialogue with industry concerning the application of antitrust principles, and that this would occur not only with respect to the research area under discussion but also to the commercialization phase of the innovation process. In Mr. Ewing's view, that dialogue should occur, to the extent possible, with the business people responsible for R&D and marketing, etc., rather than solely with their antitrust counsel. While Mr. Ginsburg expressed some skepticism about the dialogue circumventing counsel, he thought that it could be a useful supplement to the guidelines effort. He agreed with Mr. Shapiro that, ultimately, decisions will be called for on a case-by-case basis, but thought that the business community would be better able to plan its collaborative efforts and propose them to the Department in light of the guidelines, particularly if a dialogue had been established with the Department.

Mr. Casey inquired whether the decision to give innovative potential special weight in passing upon joint R&D ventures would be extended also to the process of approving horizontal mergers. When Mr. Ewing indicated that his prior discussion of acquisition policy was meant to indicate that innovative potential would be given special attention, Mr. Shapiro objected that the Department was being assigned, by the logic of the antitrust laws, "a task beyond human capacity." Specifically, he believed it impossible for the Department to predict the innovative consequences of a merger and to compare them with the predicted consequences of disallowing the merger or of the acquired firm being merged into a company other than the one proposing to acquire it. While Mr. Ginsburg thought that the Department would only rarely be put to the necessity of evaluating technological arguments in defense of mergers, and Mr. Ewing emphasized the marginal nature of merger control on any grounds, Mr. Shapiro remained concerned with the potential deterrence exerted by merger controls--an effect that would not be revealed in the statistics showing a high percentage of approvals.

Mr. Casey pointed out that one of the studies under consideration had argued for a need to protect the American market from the incursions of foreign firms that engage in market-sharing or concerted strategies that would violate the Sherman Act; the study suggested that the Administration consider legislation to put American firms on an even footing with these foreign firms. Mr. Casey was concerned about the protectionist thrust of this proposal. Mr. Ginsburg expressed the same concern and also doubted the relevance of foreign anticompetitive activities to the specific problem of fostering technological innovation by U.S. industry. When it was suggested from the floor that the national defense may be implicated if certain domestic markets are dominated by foreign firms, Mr. Ginsburg suggested that a valid national defense interest be protected as such and not under the guise of technological innovation. He pointed out that goverment loans were extended to Lockheed precisely in order to

keep the aircraft industry competitive in the interest of national defense supplies.

Another speaker from the floor suggested that certain antitrust actions against companies that have been extremely innovative and have achieved dominant market positions by reasons of their innovation may deter a company from seeking market share growth by innovation. At the same time, current thinking about business strategy emphasizes the importance of gaining early market share leadership. In response, Mr. Shapiro suggested that "experience curve economics...is fundamentally antithetical to many of the core concepts of antitrust." He noted the difficulty of determining what innovative decisions are not being made by leading firms for fear that their market share increase may attract antitrust attention, but expressed serious concern that antitrust law may be deterring firms from taking the innovation offensive.

In summarizing the discussion, Mr. Casey noted a "latent disagreement as to whether antitrust is worthwhile at all or obsolete." At the same time, he saw little patent disagreement with respect to substantive policies at the margin of the present antitrust regime. Questions of administration, attitude, and the standards for determining whether and how antitrust policy might respond to competitive forces from abroad seemed more able to divide the participants--perhaps along the lines preordained by their disparate perspectives.

Mr. Casey seemed to have the agreement of all participants in his conclusion that the formulation of enforcement guidelines and the establishment of a continuing dialogue between the enforcement agencies and the business community would be the most helpful steps toward resolving the differences between them. As he pointed out, dialogue is by its nature a reciprocal process; as the Department of Justice can explain its premises and positions, so too can it learn as the business community explains more of how the innovation process works. Those who have an appreciation for its frailties, and the environment needed to sustain innovation, may then have a real effect on the efforts of the Administration to accommodate antitrust policy to the needs of the nation for a renewed climate of innovation.

The panel discussion synopsized herein was not directed toward, nor did it yield, specific recommendations for action either by government or by industry. Discussion clearly did, however, reveal general support for the Administration's commitment to an antitrust dialogue with industry and to the issuance of guidelines respecting enforcement policy. On the basis of recurring disagreements of varying intensity among the participants, it can be seen that further consideration should be given to the international market implications of domestic antitrust policy. The issues do not seem to be well understood, nor entirely agreed upon, let alone ripe for resolution. Finally, as Mr. Shapiro suggested, there is an underlying intellectual confrontation between antitrust policy and the new learning respecting experience curves and market share. None of the participants addressed this conflict outright, nor was this the forum in which to do so. The issues do need to be addressed explicitly, however, in a nonadversarial setting such as National Academy of Engineering may undertake to provide at another time.

APPENDIX A

LIST OF DOCUMENTS

The following documents were reviewed in preparation for the Colloquium on Industrial Innovation and Public Policy Options. Since reference is made to them throughout the text, they are listed here with full publication information. The abbreviations used in the text appear in the left-hand margin. The publications are grouped according to sponsorship.

The White House:

President — "The President's Industrial Innovation Initiatives." Washington, D.C.: Office of the White House Press Secretary, October 31, 1979.

Advisory Committee on Industrial Innovation, Domestic Policy Review, Department of Commerce:

DPR R&D — Draft Report on Direct Federal Support of Research and Development. Springfield, Virginia: National Technical Information Service, December 21, 1978. (PB-290 407)

DPR Industry — Draft Report on Economic and Trade Policy. Springfield, Virginia: National Technical Information Service, December 20, 1978. (PB-290 415)

DPR Environmental Health and Safety — Draft Report on Environmental, Health, and Safety Regulations. Springfield, Virginia: National Technical Information Service, December 20, 1978. (PB-290 405)

DPR Procurement — Draft Report on Federal Procurement Policy. Springfield, Virginia: National Technical Information Service, December 22, 1978. (PB-290 417)

DPR Information — Draft Report on Information Policy. Springfield, Virginia: National Technical Information Service, December 20, 1978. (PB-290 404)

DPR Patent Policy — Draft Report on Patent Policy. Springfield, Virginia: National Technical Information Service, December 20, 1978. (PB-290 403)

DPR Regulation — Draft Report on Regulation of Industry Structure and Competition. Springfield, Virginia: National Technical Information Service, December 20, 1978. (PB-290 409)

DPR Public Interest — Draft Report: Review and Recommendations of Policy Alternatives of the Public Interest Advisory Subcommittee. Springfield, Virginia: National Technical Information Service, December 28, 1978. (PB-290 411)

DPR Labor — Draft Report: A Statement of the Labor Advisory Subcommittee on Industrial Innovation. Springfield, Virginia: National Technical Information Service, December 22, 1978. (PB-290 413)

DPR Small Business — "The Effects of Domestic Policies of the Federal Government upon Innovation by Small Businesses." Unpublished document made available through the Department of Commerce, Washington, D.C., May 1, 1979.

Commerce Technical Advisory Board:

CTAB — "Recommendations for Creating Jobs Through the Success of Small, Innovative Business: A Report to the Assistant Secretary of Commerce for Science and Technology." Unpublished document made available through the Department of Commerce, Washington, D.C., December 1978.

Committee for Economic Development:

CED — "Stimulating Technological Progress." Unpublished report made available through the Committee for Economic Development, Washington, D.C., September 19, 1979.

Committee on Technology and International Economic and Trade Issues of the Assembly of Engineering, National Research Council, and the Office of the Foreign Secretary, National Academy of Engineering:

NRC/NAE Reports

Cordes, Joseph J.: The Impact of Tax and Financial Regulatory Policies on Industrial Innovation. Washington, D.C.: National Academy of Sciences, 1980.

Ginsburg, Douglas H.: Antitrust, Uncertainty and Technological Innovation. Washington, D.C.: National Academy of Sciences, 1980.

Grabowski, Henry G. and Vernon, John M.: The Impact of Regulation on Industrial Innovation. Washington, D.C.: National Academy of Sciences, 1979.

Technology, Trade, and the U.S. Economy. Washington, D.C.: National Academy of Sciences, 1978.