Public support for private R&D: The case of the research tax credit

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Abstract:

The U.S. government has long included in its tax code various special provisions designed to stimulate industrial R&D. In 1981, those provisions were substantially augmented by a special R&D tax credit, and various proposals are now under consideration to relax the antitrust statutes in order to encourage research through joint ventures. The case for any of these measures is difficult to establish, being based on assumptions that are not readily tested in objective terms. Nevertheless, one point is fairly clear: As between stimulating industrial R&D by individual firms and stimulating R&D joint ventures of such firms, the joint venture approach appears superior in its likely results.

Keywords: R and D | industrial research | joint ventures | tax credits

Article:*

INTRODUCTION

The federal government's role in supporting research and development (R&D) is well established. In 1982, a typical year, federal support accounted for 46.7% of all U.S. R&D expenditures, about $36.l billion.[1] Despite the fact that research universities have a prominent role in the U.S. R&D system, industry is the dominant R&D performer (at least in terms of dollars invested) and nearly half of all federal R&D expenditures is now allocated to the industrial sector.

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* The authors gratefully acknowledge the helpful comments and guidance of Ray Vernon and anonymous referees.

[1] National Science Foundation. *National Patterns of Science and Technology Resources, 1983* (Washington, DC: U.S. GPO, 1983).

Recent policy initiatives further accentuate the relative importance of the federal government in R&D performance. The R&D tax credit provision of the Economic Recovery Tax Act of 1981 aims at stimulating industrial R&D, and revisions of antitrust legislation are being proposed as an instrument for encouraging additional private sector spending for R&D. Nevertheless, although the interest in increasing private spending on R&D is widely shared, there is disagreement about the efficacy of the tax credit[2] and the likely effects of changes in antitrust provisions.[3] More basic, there is some dispute as to whether any added stimuli are needed in order to achieve an increase in industrial R&D.[4] These controversies over the efficacy of federal action are not entirely separable from a set of larger value questions about the proper role of government in supporting private sector research.

The purpose of this article is to explore arguments pertaining to public support of private R&D. The R&D tax credit provision of the 1981 tax legislation provides one focus for analysis of public support of private R&D. Considerable debate and analysis preceded the adoption of that legislation.[5] Policy research not only contributed to the legislation but also to evaluations of the impact of the tax credit.[6] That legislation offers an opportunity to focus on the larger issues pertaining to public support of private R&D.

Another measure that helps to provide such a focus is still in the proposal stage-a proposal for a tax credit to enterprises engaged in industrial research that represent a joint venture among a number of different firms. This proposal is particularly relevant for our purpose because it combines elements of two major policy themes, tax incentives for R&D and relaxation of antitrust statutes. Bills embodying these two features have recently been introduced in Congress.

PUBLIC SUPPORT OF INDUSTRIAL R&D

Public policies that stimulate or inhibit industrial R&D often are directed at quite different objectives, seemingly unrelated to R&D activities. Such diverse policies as health and safety regulations, pollution control, foreign trade regulations, and personal income tax provisions may have a substantial impact on patterns of industrial R&D. Our concern here, however, is with policies that are specifically designed to stimulate industrial R&D. These have usually fallen under two headings: tax incentives and antitrust relaxation.

Tax Incentives and Industrial R&D

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[2] Eisner, R. S., Albert, S., and Sullivan, M., "The New Incremental Tax Credit for R&D: Incentive or Disincentive?," *National Tax Journal, 37*(2) (1984): 171-183.

[3] Corrigan, Richard, "To Trust or Antitrust," *Technology Review, 86*(1) (1983): 49-68.

[4] Press, Frank, "Rethinking Science Policy," *Science, 218*(4582) (1982): 28-31.

[5] See, for example, Mansfield, Edwin, "Tax Policy and Innovation," paper presented at the National Science Foundation Colloquium on Tax Policy and Investment in Innovation, 1981, mimeo.

[6] Frame, J. D., "Tax Incentives in R&D Planning," *IEEE Transactions on Engineering Management, EM-31*(2) (May 1984): 50-54; Bozeman, Barry, and Link, Albert, "Tax Incentives for R&D: A Critical Evaluation," *Research Policy, 13*(1) (1984): 21-31; Barth, James, Cordes, Joseph, and Tassey, Gregory, "The Impact of Recent Changes in Tax Policy on Innovation and R&D," in *Strategic Management of Industrial R&D,* B. Bozeman, M. Crow, and A. Link Eds. (Lexington, MA: D.C. Heath Books, 1984), pp. 23-49; Eisner et al., *op. cit.*

Tax incentives for R&D have long been part of the U.S. tax code. For several decades large firms have been deducting most of their expenses for ongoing research expenditures as they were incurred, even when such expenditures represented outlays (such as capital equipment) that were not eligible for deduction if incurred for other business purposes, such as production or marketing. Moreover, the deductibility of R&D expenditures is only one of several longstanding measures for the preferential tax treatment of industrial research activity.

In 1954, an important step was taken with the adoption of Section 174 of the Internal Revenue code, which codified and expanded tax laws pertaining to firms' R&D expenditures. This provision permits businesses to deduct fully research and experimental expenditures in the year incurred, although expenses incurred in the application of the research results are excluded from such preferential treatment. If the firm chooses not to expense research and experimental expenditures in the year incurred, there is an option to capitalize R&D expenditures other than depreciable assets such as equipment, and to amortize those expenditures over a period of not less than five years, beginning with the month in which benefits are first realized from the expenditures. The depreciable assets, of course, can be depreciated over the years like any other depreciable property.

Although Section 174 is perhaps the most encompassing and widely used tax incentive for R&D, a number of additional elements of the tax code are also viewed as R&D incentives. Individuals and corporations are allowed to deduct contributions to educational and scientific organizations that are held to be operating in the public interest. Furthermore, scientific and educational organizations operating in the public interest are exempt from federal income tax.

In sum, well before the recent rash of proposals for R&D incentives began to develop, important incentives existed in the U.S. tax code. This is not, however, to diminish the importance of the more recent measures nor of the proposals under active consideration. The Economic Recovery Tax Act of 1981, for instance, adds measurably to the preferential tax treatment enacted in 1954.

The changes in tax treatment of R&D under the 1981 act include four major provisions: a faster depreciation of R&D assets; a two-year suspension of a Treasury regulation that had required U.S. multinationals to allocate some of their domestic R&D against income from foreign subsidiaries; an increase in deduction that taxpayers are permitted for contributions of new research equipment to universities; and finally, in addition, a provision for a special tax credit to corporations that have increased their R&D expenditures over levels prevailing in a prior base period.

The special tax credit for R&D expenditures entails particularly elaborate provisions. For a given tax year, the corporate taxpayer calculates its in-house expenditures for R&D wages and supplies, 65% of the amount paid for contract research and 65% of its grants to universities and scientific research organizations for basic research. The total is compared with expenditures in these categories, similarly calculated, that were made during a base period—a period that usually covers three prior taxable years. The corporate taxpayer is then permitted to take a special tax credit, ordinarily equal to 25% of the excess expenditure.[7]

[7] Numerous technical provisions add further complexity to the formula. Substantively important is the proviso that if annual expenditures in the base period are less than one-half that in the taxable year, the one-half figure is to be used

Antitrust Policy and Joint Venture R&D

Until recent years, industrial firms that were actual or potential competitors rarely engaged in collaborative R&D projects. With the increase in competition from foreign exports, however, U.S. firms have shown more interest in combining their R&D efforts.[8] One indicator of the increased willingness of U.S. firms to collaborate has been the explosion in the formation of new joint ventures among firms in the United States. Only once during the period from 1973 to 1980 were there more than 200 joint ventures. But in 1982, 281 joint ventures were reported and in 1983 the number increased to 348.[9]

U.S. firms seeking to promote collaborative R&D and other joint ventures are faced with provisions of antitrust laws which some view as an important barrier. The antitrust laws do not specifically prohibit joint venture R&D; legal strictures would apply only if the joint venture were accompanied by actual or threatened anticompetitive behavior. However, a standard of that sort does not always offer a clear guide to the parties involved. The start-up costs for joint venture R&D are such that the mere possibility of antitrust action may be sufficient to deter such arrangements. According to the chief executive of Microelectronics and Computer Technology Corporation, a research cooperative, "It isn't enough that the laws don't specifically prohibit joint venture R&D groups. Most companies don't put money into long-range research ... add to that the prospect of treble-damages [antitrust] suits and most companies decide that this present risk is greater than the unknown benefits down the way."[10]

While the general legislative intent of the leading antitrust statutes is fairly clear, the application of those statutes toward industry collaboration varies from one administration to the next. In recent years, a more relaxed interpretation of those statutes has prevailed and there is eagerness in some official quarters to promote joint ventures; but the exact form which such encouragement should take remains under dispute.

Several bills concerned with joint venture R&D were introduced in the 98th session of Congress, during the years from 1982 to 1984. One of these bills, sponsored in the Senate by Strom Thurmond, was particularly significant because it was said to reflect the official views of the Reagan administration. The legislation would have excluded R&D joint ventures from the existing provisions of antitrust law which provides for the award of treble damages in successful suits.

Other proposals in support of research joint ventures were also proposed in various bills. One proposal would require the Attorney General to issue "certificates of review" to research cooperatives that are approved by the Justice Department, the effect of which would be to exempt such cooperatives from antitrust constraints. An alternative to the certificate approach

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in calculating the excess expenditure. For an elaboration of the provisions of ERTA and their implications see Barth, James, and Cordes, Joseph, "The Economic Recovery Tax Act of 1981," 1982, mimeo.

[8] Rothwell, R., and Zegveld, W., *Industrial Innovation and Public Policy* (London: Francis Pinter, 1982); Moskal, X., "Joint Ventures: For Better or for Worse?," *Industry Week, 220*(4) (1984): 39-44.

[9] *Mergers and Corporate Policy Newsletter,* February 1984.

[10] Jacobs, B., "Up with Joint R&D, Down with Treble Damages," *Industry Week, 220*(4) (1984): 45-48. See, also, "Antitrust Rules to Spur Joint R&D," *Industrial Research, 25* (1983): 48.

was proposed in another bill, under which a joint venture group would qualify for antitrust immunity by meeting specific criteria pertaining to the participants' percentage of worldwide sales, control of the market, and receptivity to the admission of additional participants. This bill and a similar bill would impose a three-year limit on the cooperative's exclusive rights to the technology it developed; still another bill would extend the exclusivity period to six years. Plaintiffs that were unsuccessful in suits against such joint ventures would be required to pay the cost of the defending venture's legal fees. Other provisions of the bill would increase the rights of holders of process patents and would demand more rigorous proof of violation of antitrust laws in cases arising from joint R&D ventures.

TAX CREDITS FOR RESEARCH JOINT VENTURES

The growing sentiment for using tax credits and antitrust exemptions to stimulate industrial research suggests the possibility of combining both in a single proposal, that is, providing special tax credits for research joint ventures. Our contention is that if tax credits are to be used, the case for using such credits is much stronger for research conducted through joint ventures than for research conducted by the individual firm.

As noted earlier, joint ventures are not an uncommon form of organization for industrial firms. According to a recent Conference Board Report, about half of the U.S. industrial firms with more than $100 million sales are involved in joint ventures.[11] Some joint ventures transcend national boundaries and involve firms from two or more countries. Firms enter into joint ventures for any of a number of reasons, including the desire to penetrate new markets, to procure raw materials or an export base, or to take advantage of attractive government policies in another state or nation. Many joint ventures are vehicles for the sale or licensing of technology. However, one of the most common motivations for joint ventures is the desire to share, and hence to reduce, economic risk.[12] A tax credit for joint venture research might prove an effective means of encouraging the distribution of risks among firms and thereby facilitating riskier research.

If one were thinking of applying the tax credit approach to joint ventures and withholding the privilege from individual firms, the main features of the legislation for doing so would be fairly evident, being strongly suggested by the 1981 legislation and by the subsequent proposals submitted to the Congress. It would entail a 25% tax credit for firms participating in joint venture research with other firms (not including universities, or not-for-profit organizations). Specific criteria could be set that limited participants to certain firms, criteria pertaining to participants' market share, and other factors reflecting competitiveness. Activities qualifying for the tax credit might be identical to those qualifying currently under the U.S. tax code, namely, research costs "in the experimental and laboratory sense," including "all such costs incident to the development of an experimental or pilot model, a plant process, a product, a formula, an invention, or similar property, and improvements to already existing such property."[13] It would specifically exclude expenditures for the testing or inspection of materials or products for quality control, management studies, and marketing and promotional studies.

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[11] Janger, A., *Organization of International Joint Ventures* (New York: The Conference Board, 1980).
[12] Ewing, K., "Joint Research, Antitrust and Innovation," *Research Management, 14*(1) (1981): 25-29.
[13] See Sections 17 4 and 162(a) of U.S. Tax Code.

It has been pointed out that a potential problem with the joint venture tax credit proposal is that firms could conceivably pay other firms to enter into a joint research venture (perhaps even a sham venture) in order to benefit from the tax credit.[14] Joint ventures that entailed such payments, however, could be ruled out by legislation.

The justification for granting tax incentives to joint venture research in preference to the individual firm, however, is that such a choice. will improve the output of the research mix. What are the grounds for such an expectation?

Joint research reflecting the collective decision of a group of firms would generate more stable and more predictable R&D effort.[15] Moreover, the effort is likely to yield research near the basic end of the applied-basic spectrum, to a greater degree than the tax credit to individual firms. That result is to be expected on the basis of both experience and theory. Evidence from British research associations indicates that joint ventures tend to produce a higher portion of basic research than individual firms,[16] while formal models of joint venture research activity leads to the same conclusion.[17]

Joint ventures can be expected to emphasize basic research to a greater degree than individual firms because the interests of the participating firms will probably push joint ventures in that direction. For one thing, basic research tends to be more uncertain in outcome than applied research, hence better undertaken through a risk-sharing arrangement such as a joint venture.[18]

In addition to being more risky, basic research tends to require larger, "lumpier" commitments to resources,[19] which may more readily be provided by a group of firms. Another consideration is that the rewards generated by applied research are more easily appropriated by the innovating firm than the rewards generated by basic research, a difference that will tilt the joint venture more strongly toward the basic research needs of the industry. Beyond that, basic research generated by a joint venture is less vulnerable from an antitrust viewpoint than is applied research, a consideration that the participants are unlikely to overlook.[20] All these considerations argue for the likelihood that joint ventures will emphasize more basic research than would result from a similar level of activity within individual firms.

Our assumption, of course, is that the stimulation of basic research would generate more value for the U.S. economy than the stimulation of applied research. That assumption stems from the

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[14] An anonymous referee for this journal pointed out the potential for such payments.
[15] Bozeman and Link, *op. cit.*
[16] Johnson, P. S., *Cooperative Research in Industry* (New York: Wiley, 1973).
[17] Joglekar, P., and Hamburg, M., "An Evaluation of Federal Policies Concerning Joint Ventures for Applied Research and Development," *Management Science,* 29(9) (1983): 1016-1026; Bozeman, B., and Link, A., *Investments in Technology: Corporate Strategy and Public Policy Alternatives* (New York: Praeger, 1983), pp. 117-120.
[18] Bozeman and Link, *ibid.*
[19] Link, A., *Research and Development Activity in U.S. Manufacturing* (New York: Praeger, 1983); Mansfield, E., "Composition of R&D Expenditures: Relationship to Size of Firm, Concentration, and Innovative Output," *Review of Economics and Statistics, 63* (1981): 610-614.
[20] U.S. Department of Justice, *Antitrust Guide Concerning Research Joint Ventures* (Washington, DC: U.S. GPO, 1980). The U.S. Department of Justice recently took the position that the closer any activity in a research joint venture is to the basic end of the research spectrum, the more likely it is to be acceptable under the antitrust law.

fact that much of what individual firms undertake under the heading of applied research and development consists of little more than differentiating their products from the products of competitors; wholly new products or improved processes usually arise out of research of a more basic character, which largely explains why trends in measured productivity growth are highly correlated with trends in basic research spending.[21] As one of the leading analysts in the R&D field has observed, the 1981 tax credit provisions "would be likely to encourage the same kind of R&D that is already being done .... "[22] Hence, there are good grounds for the argument for directing tax credits toward entities more likely to engage in such basic research.

PUBLIC SUPPORT OF PRIVATE R&D

If one were prepared to grant that more joint research might be superior from the national viewpoint to more individual firm research, the problem would remain of justifying any kind of public support for private R&D activity, whether in joint ventures or individual firms. The rationale for any such policy follows some fairly traditional lines in the economic literature, lines that are worth briefly reviewing here.

Traditional Rationales

The economic argument for government support of industrial R&D is based in large part on theoretical criteria that have developed as a guide for allocating the production of goods and services between the public and the private sector. When government "intervention" in the marketplace is justified in mainstream economics, that justification is usually based on the premise that the market has somehow "failed." Market failure, according to this approach, can arise from a number of sources, such as barriers to the entry of new participants in the market or the high cost of undertaking transactions in the market.[23] In the case of R&D, especially basic research, market failure is often a result of features intrinsic to the production of information.[24] Several economists have suggested that a market economy will often underinvest in the production of knowledge[25] because the firm that produces the knowledge is unable to capture all the profits that arise from its creation; as a result of the firm's inability to appropriate fully the benefits accruing from research, investment will tend to be at a level less than the social optimum. Because there is some evidence in support of this claim, it is argued that government

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[21] See Mansfield, Edwin, "Basic Research and Productivity Increase in Manufacturing," *American Economic Review, 70* (1980): 863-873; Link, A., "Basic Research and Productivity Increase in Manufacturing, Additional Evidence," *American Economic Review, 71* (1981): 1111-1112.

[22] Mansfield, Edwin, "Tax Policy and Innovation," paper presented at the National Science Foundation Colloquium on Tax Policy and Investment in Innovation, 1981, mimeo, p. A13.

[23] A summary of market failure arguments is presented in Steiner, Peter, "The Public Sector and the Public Interest," in *Public Expenditures and Policy Analysis,* R.H. Haveman and H. Margolis, Eds. (Chicago: Markham Publishing, 1970).

[24] Arrow, Kenneth, "Economic Welfare and the Allocation of Resources for Inventions," in *The Rate and Direction of Inventive Activity,* Richard Nelson, Ed., National Bureau of Economic Research (Princeton, NJ: Princeton University Press, 1962), pp. 609-625.

[25] Griliches, Z., "Research Costs and Social Returns: Hybrid Corn and Related Innovations," *Journal of Political Economy, 66*(4) (1958): 259- 283; Minasian, J., "Research and Development, Production Functions and Rates of Return," *American Economic Review,* 59(2) (1969): 185-201.

should provide resources for R&D up to the socially optimal level.[26] To guide the public sector in determining whether the situation warrants such expenditure, various criteria are usually mentioned: the existence of underinvestment in R&D; a low rate of technical progress; the presence of institutional barriers created by government regulation such as the antitrust laws; and finally, the possibility that the research undertaken will generate results that will benefit society.

These traditional economic criteria have intuitive appeal. But they prove of limited use for the evaluation of concrete provisions such as the 1981 law and the joint venture proposals outlined earlier.

The question of whether underinvestment exists, for example, is not settled easily. The several studies undertaken to assess the merits of the 1981 law reached no consensus about the existence of underinvestment.[27] Regardless of the measure one chooses for determining the adequacy of investment, no measure will lead inexorably to the conclusion that R&D expenditures must be increased or that additional government intervention is required.

Despite the difficulties of measuring underinvestment, it is crucial to the evaluation of any tax proposal to stimulate R&D. A McGraw-Hill survey undertaken at the time of passage of the 1981 tax credit provided evidence that firms intended to raise R&D spending by 17% in the succeeding year even if no stimulus were provided.[28] In another study, a panel of vice presidents responsible for R&D in their respective firms forecast that the percentage of R&D allocated to basic research would increase steadily through 1990.[29] Thus, it is not possible to determine definitely, even after the fact, whether the tax credit provided by the 1981 law actually increased R&D expenditures; much less is it possible to determine the more complex issues of underinvestment.

The question whether institutional barriers exist that inhibit innovation is also very difficult to answer. Those difficulties are well illustrated by the controversy surrounding the effects of government regulations on innovation. Studies of some individual cases suggest that government regulations act as a barrier to innovation[30] while others suggest that regulation can spur innovation.[31] Taken all together, the research aimed at assessing the effects of government regulation on innovation under various circumstances is inconclusive.[32]

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[26] Nelson, R., Peck, M., and Kalachek, E., *Technology, Economic Growth and Public Policy* (Washington, DC: The Brookings Institution, 1967).
[27] Barth, Cordes, and Tassey, *op cit.* "Eisner et al., *op. cit.* Weiss, J.M., and Blumenfrucht, I., "ERTA's Incentives for R&D," *Management Accounting,* 63(1) (February 1982): 22-30; Angell, R., and Link, A., "Evaluating Recent Tax Proposals for Stimulating Innovative Activity," 1983, mimeo.
[28] McGraw-Hill Publishing, "27th Annual McGraw-Hill Survey of Business Plans for Research and Development Expenditures, 1982-1983," 1982, mimeo.
[29] Bozeman and Link, *op cit.*
[30] See, for example, Peltzman, S., "An Evaluation of Consumer Protection Legislation: The 1962 Drug Amendments," *Journal of Political Economy, 81* (1973): 1049-1091.
[31] See, for example, U.S. Office of Technology Assessment, *Changes in the Future Use and Characteristics of the Automobile Transportation System* (Washington, DC: U.S. GPO, 1978).
[32] Ashford, N ., *Environmental/Safety Regulation and Technological Change in the U.S. Chemical Industry* (Cambridge, MA: Center for Policy Alternatives, Massachusetts Institute of Technology, 1979); Steward, H., "Public Policy and Innovation in the Drug Industry," in *Providing Health Services,* D. Black and G. Thomas, Eds.

The difficulties of determining if institutional barriers exist are further illustrated by the case of the joint venture proposals. Analyses of individual industries suggest that existing antitrust legislation has quite different implications for innovation in different industries. A research tax credit for joint ventures, it appears, might well increase research in particular industries and market segments while decreasing research in others.

The criteria that social value must be generated by an R&D credit is perhaps the most nebulous of all. Practically any activity that generates knowledge about production may be said to have some social value. The issue, then, is how much social value is enough to warrant public support. This is not easily determined. Estimating the social value of a tax credit becomes even more difficult if one considers the possibility that the credit may divert some firms' funds from other productive activities. The 1981 tax credit, for instance, may well have influenced firms to divert funds from improving their manufacturing processes or replacing their capital equipment in order to capture a more rapid return on investment from increased R&D expenditures. A credit for joint venture research could produce similar shifts. Any such shift, whether toward more applied research or more basic research, would have uncertain effects on the generation of social value.[33] In all likelihood, such effects—assuming they could be measured—would vary from firm to firm and industry to industry.

In sum, while the more familiar economic criteria for public support of industrial R&D provide some insight, they are not adequate to guide the wide range of choices that confront R&D policymakers. Nevertheless, as we have already observed, there are a number of considerations that can help the policymaker decide in what form R&D credits would be desirable; and, in this respect, joint venture research appears superior to that of individual firm research as the target for tax credits.

FROM "HOW MUCH?" TO "WHAT FOR?"

The traditional economic approach to public policy choices in the United States characteristically has the analyst concentrating on the question "How much?" The validity of that question, however, depends on whether what is being counted-such as the amount of R&D output-is homogeneous in nature. When that is not the case, as with R&D, the analyst is commonly pushed to making distinctions that are difficult to incorporate in the traditional economic approach; he is pushed toward addressing the question "What for?" in addition to "How much?"

The 1981 tax credit largely ignored the "What for?" issue, being based on the same traditional logic as virtually all R&D tax incentives policies: that favorable treatment of R&D expenditures will lead to a growth in R&D activity; that the growth of R&D activity will lead to more R&D "success"; that R&D success will lead to more innovation and commercially beneficial products which, in turn, will lead to higher standards of living through technological change. There is

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(London: Croom Helm, 1977); Rubenstein, A., and Ettlie, J ., "Innovation Among Suppliers to Automobile Manufactures: An Exploratory Study of Barriers and Facilitators," *R&D Management,* 9(1) (1979): 35-45.

[33] Joglekar, P., and Hamburg, M., "An Evaluation of Federal Policy Instruments to Stimulate Basic Research in Industry," *Management Science,* 29(9) (1983): 997-1015; Joglekar and Hamburg, "An Evaluation of Federal Policies ... " *op. cit.*

increasing recognition that this chain of assumptions is highly vulnerable, hence, that merely increasing the amount of R&D effort may not generate the desired results. Equally important in assessing the results of R&D efforts are the industry-specific effects,[34] the complementarity of public and private R&D,[35] the sources of firms' technical knowledge,[36] and the relation of innovation to stages of technology.[37]

An alternative to a policy of increasing total R&D effort indiscriminately is a policy of selecting targets, of "picking winners." The U.S. government has been known to follow such a policy at times, by sponsoring such projects as landing on the moon, developing a manned space shuttle, and planning for a permanent space platform. But for various reasons, any policy of attempting to pick winners as a regular practice would be unlikely to garner support in the United States.

For one thing, there is widespread skepticism among U.S. politicians, scholars, and science policymakers of whether the U.S. government would be able to distinguish between winners and losers before the fact.[38] The skepticism is easily understood by those with even a passing knowledge of the history of science, a discipline that is replete with studies underscoring the importance of serendipity in discovery[39] and the nonlinearity of scientific progress.[40]

Perhaps more fundamental is the ideologically based distrust among scientists and technologists of policies that smack of planned and managed science.[41] Both scientists and science policymakers have much sympathy for the notion of a "republic of science," even going so far as to agree[42] that "any authority which would undertake to direct the work of the scientist would bring the progress of science virtually to a standstill."[43]

Policymakers who are oblivious to the norms and ideological assumptions of scientists might find another basis for opposing a "picking winners" approach. There is a deep-seated preference in the United States for styles of governance that exercise public policy on a nonselective, nondiscriminatory basis-for instance, extending subsidies on uniform terms to all persons or firms that appear similarly situated. This approach is built into the administrative practices and

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[34] Nelson, R., and Winter, S., *An Evolutionary Model of Economic Change* (Cambridge, MA: Harvard University Press, 1982); Feinschreiber, R., "Technical Issues Affect Research Credit," *Tax Executive,* 34(4) (1982): 291-296; Tombillo, N., and Yen, A., *Study of the Economic Recovery Tax Act of 1981 and Automotive Research and Development* (Washington, DC: U.S. GPO, 1983); Hendershott, P., "Taxes, Mortgage Instruments, and Housing," *Public Finance Quarterly,* 10(2) (1982): 131-141.

[35] Carmichael, J., "The Effect of Mission-Oriented Public R&D Spending on Private Industry," *Journal of Finance, 36* (1981): 617-627.

[36] Bozeman and Link, *op. cit.*

[37] Utterback, J., and Abernathy, W., "A Dynamic Model of Process and Product Innovation," *Omega, 3* (1975): 639-656.

[38] Krugman, Paul R., "Targeted Industrial Policies: Theory and Evidence," in *Industrial Change and Public Policy* (Kansas City, KS: Federal Reserve Bank of Kansas City, 1983), pp. 123-176.

[39] Blackwell, Richard, *Discovery in the Physical Sciences* (Notre Dame, IN: University of Notre Dame Press, 1969).

[40] Laudan, Larry, *Progress and its Problems* (Berkeley, CA: University of California Press, 1977).

[41] Bozeman, Barry, "Straight Arrow Science Policy and its Dangers," *Public Administration Review, 2* (March/April 1979): 116-121; Blissett, Marian, *Politics in Science* (Boston: Little, Brown, 1972).

[42] Bozeman, Barry, and Kim, D., "Governing the 'Republic of Science': An Analysis of National Science Foundation Officials' Attitudes about Managed Science," *Polity, 14(2)* (1981): 183-204.

[43] Polanyi, Michael, "The Republic of Science: Its Political and Economic Theory," *Minerva, 1* (Autumn 1962): 54-73.

statutory provisions of the U.S. government[44] and is likely to determine how a tax credit policy would be administered.

Just as important as administrative tradition is the political tradition of interest group liberalism.[45] Political exigencies often dictate that benefits of public programs be distributed as widely as possible. Indeed, such broad-based distribution of benefits is often the price of legislative and constituency support. Consider, for example, the case of the Model Cities program in which the initial focus of the program—implementation in just a few cities to gain broader political support for the legislation. Virtually every city and even some rural areas qualified as "model cities."[46] This overriding preference in U.S. administrative and political practice suggests why a tax credit to research joint ventures may prove preferable to a tax credit to individual firms, such as has been provided by the 1981 act. Limiting such a credit to joint ventures would probably not be regarded as a violation of the principle of nonselectivity and nondiscrimination. Yet, at the same time, it would tend to bend the research output toward the basic end of the spectrum, the superior results when measured in terms of social value.

While the social value of a joint venture R&D tax credit is an issue that deserves much more careful scrutiny, the proposal illustrates one approach to moving toward "What for?" questions. Whether the time has come for extending credits to joint ventures, the time has surely come to move beyond the question of amount of investment to the question of quality of investment in R&D. That calls for a basic reconsideration of the research tax credit in the 1981 act.

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[44] Waldo, Dwight, *The Enterprise of Public Administration* (Novato, CA: Chandler and Sharp, 1980); Karl, B. C., *Executive Reorganization and Reform in the New Deal: The Genesis of Administrative Management, 1900-1939* (Cambridge, MA: Harvard University Press, 1969); Kaufman, H., "Administrative Decentralization and Political Power," *Public Administration Review,* 29(1) (1969): 3-15.

[45] Lowi, Theodore, *The End of Liberalism* (New York: Norton and Company, 1969).

[46] Ripley, R. B., *The Politics and Economics of Human Resource Development* (Indianapolis, IN: Bobbs-Merrill, 1972).