Commentary

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The organizers of this symposium asked me to focus on economic policies toward technology, the purpose being to supplement Barry Bosworth's interesting and comprehensive paper, which was meant to deal in considerable part with other matters. To begin with, I should say that Bosworth's necessarily brief treatment of R&D includes a great many of the major points that should be made. Specifically, I certainly agree with him that there may well be an underinvestment in civilian technology, particularly at the more basic end of the R&D spectrum. And I agree that there has been an overemphasis on R&D tax incentives in recent years.

For decades, economists have pointed out that a market economy is likely to underinvest in civilian technology because firms often find it difficult to appropriate the benefits that society receives from new technology. In particular, the more competitive the market and the more basic the R&D project, the less appropriable the benefits are likely to be. However, as has frequently been indicated, this is only a partial guide for public policy. Oligopolistic emphasis on product improvement as a form of rivalry (rather than direct price competition), government intervention that promotes R&D and technological change in industries like aircraft, and the incentives for firms in some industries to invest heavily in somewhat duplicative R&D (and inventing around patents) all are factors that may offset, partially or completely, whatever latent underinvestment in R&D is present in particular parts of the economy.

Since economists cannot rely solely on a priori theorizing to tell them whether there is an underinvestment in R&D in the private sector (and if so, where it is most severe), attention has been focused on empirical studies of the social and private returns from R&D of vari-

ous types. Of course, there are many problems in measuring the social benefits from new technology. But at this point perhaps a dozen major studies have been carried out, based on very detailed data regarding scores of projects and firms. (For a summary, see Mansfield et al [1982] and Mansfield et al [1977].) Practically all of these studies indicate that the average and marginal social rates of return from industrial R&D tend to be very high, often 30 percent or more. Without question, these studies are frail reeds on which to build policy conclusions. But recognizing this fact, it nonetheless is remarkable that so many independent studies based on so many types of data result in so consistent a set of conclusions.

Responding to evidence of this sort, as well as to other considerations, the federal government has adopted measures to encourage industrial R&D expenditures. In 1981, the Congress included in the Economic Recovery Tax Act a 25 percent tax credit for R&D expenditures in excess of the average R&D expenditures in a base period (generally the previous three taxable years). Expenditures qualifying for the new incremental R&D tax credit are in-house expenditures for R&D wages, supplies, and the use of equipment, 65 percent of the amount paid for contract research, and 65 percent of corporate grants to universities and certain scientific research organizations for basic research. The credit applies to expenditures made after June 30, 1981, and before 1986. Several months ago, Treasury officials expressed support before Congress for a three-year extension.[1]

The central question concerning the R&D tax credit is: How much effect does it have on firms' R&D expenditures? For the past 16 months, I have been engaged in a project financed by the National Science Foundation to help answer this question. At this point, very detailed and rich data have been obtained from a carefully selected sample of more than 200 firms in the United States, Canada (which in 1962 was the first major nation to adopt an R&D tax credit), and Sweden (which has had an R&D tax credit since 1973). Also, some econometric analyses of more aggressive data in each of these countries have been carried out. Although the results obtained to date are

1. Also, the Treasury recommended that the R&D activities that qualify for the credit be defined more precisely, that the base level of expenditures used to compute the amount of the credit be indexed so that credits are not awarded to firms merely for keeping up with inflation, and that the credits be altered to benefit start-up companies, which frequently do not have any income tax liability against which to apply the credit. See the statement of John E. Chapoton, assistant secretary of the Treasury, before the Subcommittee on Taxation and Debt Management of the Senate Committee on Finance, May 27, 1983.

highly preliminary and tentative, they seem to be the first and most extensive findings available on this score.

Put very briefly, these results suggest that the R&D tax credit has had only a modest effect on American firms' R&D spending. Specifically, the results suggest that, without the credit, company-financed R&D would have been about 0.3 percent lower in 1981 and about 1 percent lower in 1982 than in fact was the case. The extra R&D stimulated by the tax credit seems to be considerably less than the revenue loss to the Treasury, which has been estimated by the Treasury to have been about $0.6 billion in 1981, and which is expected soon to be about $1 billion per year. These results are not very different from those I obtained for Canada and Sweden, where such credits have been in existence for many years. Also, if my analysis of experience in these other countries is a reasonable guide, the tax credit will result in substantial increases in the ***reported*** R&D figures, due to the reclassification of activities as R&D. The above percentages, based on data obtained from the firms themselves, pertain to actual changes in R&D, not spurious changes in the reported figures.

Tax credits are not the only way that the government can influence civilian technology. Among other things, the government can, of course, increase its contracts and grants for R&D. One important and longstanding question about this way of stimulating civilian technology is: To what extent will government support merely substitute for private support? A number of recent studies, most of them in the process of being published, indicate that on balance, government-supported R&D is mildly complementary to company-financed R&D. For example, Lome Switzer and I found that, for each dollar of increase in federal support for energy R&D, firms increased their own support of energy R&D by about 6 cents per year for two years after the increase in federal funds. (See Mansfield and Switzer [forthcoming].)

Based on experience in other countries (and the United States), there are a number of pitfalls in direct government expenditures on civilian technology. First, there often is a temptation to focus such a program on economically beleaguered industries. The fact that an industry is in trouble, or that it is declining, or that it has difficulty competing with foreign firms is, by itself, no justification for more R&D. Additional R&D may not have much payoff there or, even if it does, the additional resources may have a bigger payoff somewhere else in the economy. Second, government agencies sometimes

become involved in the latter stages of development work. In general, this is an area where firms are far more adept than government agencies. In my opinion, a government program of this sort should be concerned with the reduction of key scientific and technological uncertainties to the point where firms can use the resulting information to decide when and if they should devote their own funds to commercial development of a new technology. Third, government programs of this sort often fail to effect a proper coupling between technology and the market. Information transfer and communication between the generators of new technology and the potential users of new technology are essential if the technology is to be of the right sort and if it is to be successfully applied. There are great problems in having applied R&D, particularly of a relatively short-term character, conducted by organizations that are not in close touch with the production and marketing of the relevant products.

In general, the evidence suggests that government expenditures tend to be most effective when they are focused on long-term and relatively basic R&D. Moreover, the available evidence suggests that work of this sort can have a disproportionately large impact on productivity. Holding constant the amount spent on R&D, an industry's rate of productivity increase between 1948 and 1966 seemed to be directly related to the extent to which its R&D was long-term. Also, there is some indication that a firm's rate of innovation is directly related to the percentage of its R&D devoted to basic research when its total R&D expenditures are held constant. (See Mansfield [1980, 1981].) Fortunately, there are signs that industry is reversing the trend away from long-term R&D and basic research that characterized the late 1960s and much of the 1970s. Nonetheless, industry's support of R&D of this sort is small compared to the government's, and it is very important to the growth and international competitiveness of the American economy that such R&D be supported adequately.

Finally, returning to Bosworth's paper, I would like to second a number of his other conclusions concerning both capital formation and technology. Without question, the variation in tax rates on different sorts of capital may result in substantial waste. Also, as he points out repeatedly, better stabilization policies are extremely important in promoting the future growth of the economy. The creation and maintenance of a favorable climate for domestic investment and innovative activity — one that entails neither severe inflation nor

severe recession — would do a great deal in this regard. But my reason for being here is not to address these questions, which others have studied far more intensively than I have. What I have to say can be summarized very simply:

(1) The available evidence, limited though it certainly is, points toward some underinvestment in civilian technology, particularly at the more basic and long-term ends of the R&D spectrum.

(2) Based on my preliminary findings, the R&D tax credit seems to be having only a modest effect on firms' R&D expenditures. Moreover, this seems to be true as well in Canada and Sweden, both of which have had such credits for many years.

(3) If Congress or the executive branch wants to encourage and increase R&D of this sort, more attention should be devoted to measures other than the tax credit, at least in its present form.

References

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