Is Reaganomics Good for Technology?

Reagan's economic program seeks to encourage industrial research and innovation, but it is based on a risky gamble

The economic program that President Reagan skillfully rammed through Congress on the eve of the August recess could have a sweeping impact on patterns of spending on research and development. It provides, in theory at least, massive incentives for industrial research and innovation, and it will shift a growing proportion of the nation's technological resources into military programs.

Economists disagree about the implications of these changes. Some believe that the Reagan economic program—dubbed Reaganomics by many commentators—will help revitalize the economy by spurring investment and encouraging innovation. Others argue that it will aggravate inflation, drive up interest rates, and provide little incentive for high-technology sectors of the civilian economy. Few would deny, however, that it represents a radical and largely untested departure from the economic policies of the past few decades.

The program came in two parts: a package of budget cuts that will strip some $35 billion from federal spending in the coming fiscal year while providing a huge boost in the defense budget, and a tax bill that will slash individual and corporate taxes by an estimated $750 billion over the next 5 years. Taken together, the two measures are designed to reduce sharply the influence of government spending in the national economy and to put more cash into the hands of individuals and corporations. The Administration and its economic advisers are gambling that the tax breaks will be plowed into productive investments rather than be frittered away in increased consumption.

This economic gamble will affect science and technology directly and indirectly. The budget package will reduce federal support for some research programs and shift the center of gravity of the government's R & D expenditures decisively toward military outlays. The tax cuts—if they work as the Administration intends—could offset some of this reduced federal support by stimulating industrial R & D and technological innovation.

Corporate executives from high-technology industries have mostly greeted the advent of Reaganomics with enthusiasm. Arthur M. Bueche, head of research at General Electric, for example, says that he is "just delighted" with the tax bill. He believes that the tax cuts will provide industry with more cash to invest in R & D and new equipment. But the view from the boardrooms of the semiconductor industry—perhaps the hottest of high-technology industries—is not so rosy. The tax bill, according to industry observers, could actually result in higher taxes for the manufacturers of computer chips. And university administrators are also less than enthusiastic. They are concerned that a further squeeze on the federal budget will shrink research support and they are disappointed that the tax bill did not provide more incentives for industry to fund academic research.

At the heart of the economic gamble is an unprecedented tax cut for individuals. Almost 75 percent of the $750 billion in tax relief will go to individuals, most of it to people earning high salaries. The acid test for Reaganomics will be whether this money flows into savings and investments or into holiday homes and luxury yachts.

The bulk of the tax cuts for corporations will come from a measure designed to encourage capital investment. The tax bill will permit corporations to write off investments in new plant and equipment more rapidly, thereby reducing their taxable income.

The Administration originally proposed a clean tax bill containing these two provisions and little else, but as the legislation worked its way through Congress it acquired numerous other clauses, ending up as a 194-page document. Among the measures grafted onto the bill was something that had long been sought by lobbyists from high-technology industries—a tax credit for some corporate expenditures on research and development.

The measure was added to the tax bill after intense lobbying from several industrial trade associations and it was eventually accepted by the Treasury Department. In essence, it will permit corporations to reduce their income taxes by an amount equal to 25 percent of their increase in outlays on R & D above the average spent during the previous 3 years. Thus, if a corporation spent an average of $100,000 a year on R & D in 1979, 1980, and 1981 and it boosted spending to $140,000 in 1982, it could claim a credit of $10,000 (25 percent of the $40,000 increase) against its 1982 taxes.

The tax credit applies to spending on wages, materials, and supplies—not equipment—and it specifically excludes R & D in economics and social sciences. "This Administration does not believe that the social sciences contribute to productivity," lamented one congressional staff member who had tried unsuccessfully to remove the prohibition.

When added to the already generous tax treatment of industrial R & D, the tax credits should, in theory, provide a hefty stimulus to industrial research. Under existing tax law, corporations can write off their research spending against income, thereby reducing, dollar for dollar, their taxable profits. Since profits are now taxed at a flat rate of 46 percent, every dollar spent on R & D reduces taxes by 46 cents. Thus, with the addition of a 25 percent tax credit, each extra dollar spent on R & D above the 3-year base level will reduce taxes by a full 71 cents. The idea is that this incentive should make incremental investments in research more attractive than, say, incremental investments in advertising.

Corporate executives have been pushing for R & D tax credits for years, arguing that they are needed to help overcome a slump in spending on industrial research and to provide American companies with some of the benefits enjoyed by their foreign competitors. In Japan, for example, companies can claim a 20 percent tax credit for incremental expenditures on R & D, and the West German government provides a 7.5 percent subsidy for investment in R & D plant and equipment. But these arguments fell on deaf ears in the Carter Administration, and even the Reagan Administration was a late and somewhat reluctant convert to the idea. One reason is that the credits may simply reward industry for what it would have done anyway.

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In that regard, it is worth noting that the perceived slump in industrial research support is almost totally due to a decline in federal R & D contracts. The amount of research funded by industry itself rose steadily during the 1970's even after inflation is taken into account. According to an analysis by the American Association for the Advancement of Science, industry-funded R & D rose by 55 percent in real terms between 1967 and 1981, while the amount of corporate research funded by the federal government dropped by 32 percent. Thus the tax credits, which will apply only to the additional amounts that industry spends on R & D from its own resources, seek to encourage more investment in an area that is already growing relatively fast.

Increased spending on R & D will only be useful if laboratory findings work their way into the economy in the form of industrial innovation. "It is more important to increase the demand for the products of R & D than it is to increase R & D itself," notes Edward E. David, Jr., president of Exxon Research and Engineering. In that regard, the Reagan plan to allow corporations to write off capital expenditures more rapidly is designed to spur investments in new, technologically more sophisticated equipment.

In essence, current tax laws permit corporations to write off plant and equipment over their anticipated useful life. The Reagan tax program, however, permits cars and trucks to be written off in 3 years, machinery to be written off in 5 years, and buildings in 10 years. These schedules are generally much shorter than currently allowed, which should provide an incentive for capital investment.

Critics of the plan point out, however, that the new schedules provide larger tax breaks for buildings than for machinery, and that some high-technology industries which can now write off equipment very rapidly will in fact be hurt by the new tax bill. Writing in a recent issue of *Technology in Society*, for example, General Telephone and Electronics president Thomas A. Vanderslice notes that although he supports the thrust of the new law, "unfortunately it provides a stronger incentive for new factories than for new machines in existing buildings, and favors, for instance, the steel industry, which has a great deal of heavy equipment, over electronics, which does not."

In fact, the semiconductor industry could end up paying more taxes under the new law than it did under the old tax codes. Because the technology for making computer chips changes so rapidly, chip makers can now write off capital equipment in an average of 4 years, but under the new bill they will have to write it off in 5 years. This means that they will enjoy less tax relief on capital investment at a time when they are planning to spend heavily on new plant and equipment to meet an anticipated boom in demand and to stave off growing competition from Japan. "The depreciation schedules are really disappointing," says Michael Ayres, vice president for corporate relations at National Semiconductor Corporation. Although he says he likes the overall thrust of the tax bill, Ayres complains that "nowhere in this bill is there any recognition of the needs of the semiconductor industry." Even George A. Keyworth, II, President Reagan's science adviser, acknowledged to *Science* that "I don't think we fully appreciated the impact on high-technology industries" of the changes in depreciation schedules."

One thing that Reaganomics will clearly accomplish is a substantial shift of resources into military programs.

Enactment of the tax bill fulfills one of President Reagan's most prominent campaign pledges. The boost in military spending—which could soak up as much as $800 billion during the Administration's first term—fulfills another. But the two pledges together may be incompatible, according to some analysts. If the combination of smaller tax revenues and increased defense expenditures are not matched by cuts in federal spending on civilian programs, the result will be a growing budget deficit, which in turn would send interest rates soaring.

This possibility will put a hefty squeeze on many areas of the federal budget, including support for science and technology. Research and development in fact fared relatively well in this year's round of budget cuts. With the exception of support for science education and the social sciences, few areas of basic research were seriously cropped. But as the pressure to cut the budget mounts in future years, research support may be more vulnerable.

Partly for this reason, university administrators were hoping that the tax bill would include special incentives for industry to support academic research. A group of university presidents, including Derek Bok of Harvard and Paul Gray of Massachusetts Institute of Technology, met with Secretary of the Treasury Donald Regan and science adviser Keyworth in early July to plead the universities' case. The Association of American Universities and other academic organizations also lobbied hard in Congress for changes to the tax bill.

The efforts were partially successful. The final version of the bill allows industry to include grants to universities for basic research in its calculations for the R & D tax credits. It does not, however, provide any special incentive for corporations to spend money on university research rather than putting it in their own laboratories.

Keyworth, who says he thinks the universities may be unduly pessimistic about the prospects for federal research support, nevertheless agrees that "we have a problem of declining quality of life in academia." But, he adds, "It is a big problem, and we are not going to solve it with a single tax bill."

One thing that Reaganomics will clearly accomplish is a substantial shift of resources into military programs. The military share of the federal budget is slated to increase from 24 percent in 1981 to 32 percent in 1984. The shift in R & D spending will be even more marked. According to figures compiled by the National Science Foundation, defense will claim 57 percent of all federal R & D spending in fiscal year (FY) 1982. These trends will have major implications for the economy in general and for high-technology industry in particular.

The Department of Defense is planning to boost spending on research, development, testing, and evaluation, from $13.5 billion in FY 1980 to $21.3 billion in FY 1983. The amount going to industry will rise from $8.9 billion to $14.9 billion over this period, an increase which will certainly reverse the trend of declining government support for industrial research.

Since none of the United States' industrial competitors, with the exception of the United Kingdom, puts such a large share of its technological resources into the military, a central question is whether this military buildup will spill over into the civilian economy. If not, the

rising defense expenditures will drain critical technological resources away from more productive economic sectors.

"The shift from energy into defense doesn't bother me from the standpoint of R & D," says Arthur Bueche, "for it will stimulate high-technology industry." Lester Thurow, professor of economics at MIT, is less certain. "If you put more dollars into defense and less into the civilian economy, that can't be a positive thing for civilian industry," he says. Moreover, Thurow argues that "military R & D is moving farther away from the civilian economy than it used to be." At one time, it was possible for Boeing to develop the 707 for military needs and then market it to commercial airlines, but most weapons development now has little commercial potential: "Nobody has yet figured out what to do with a submarine in the civilian economy," Thurow points out.

As far as international competition is concerned, it should be noted that until the late 1960's, the United States devoted a far higher share of its GNP to research and development than any of its foreign competitors. The Western industrial countries are now devoting about the same proportion as the United States, however, which means that in terms of nonmilitary R & D, they are spending at higher levels.

President Reagan's crushing victories on the budget and tax bills have thus moved the U.S. economy into relatively uncharted waters. If the Administration's assumptions about what people will do with their tax breaks is correct, then industrial R & D and technological innovation could be big winners. If not, then the whole economy will be in for some tough sledding.

—COLIN NORMAN

FAA Plans to Automate Air Traffic Control

In the future, computers will take over air traffic control decisions. Human controllers will no longer have stressful jobs.

As the United States gears up to replace striking air traffic controllers, the Federal Aviation Administration (FAA) is making plans to significantly change the nature of many air traffic controllers' jobs. In 10 years, and at a cost of $1 billion, the FAA hopes to have computerized en route air traffic control to such an extent that at least 50 percent fewer controllers will be needed and those that are needed will be computer managers. The stressful aspects of the job may, thereby, be reduced.

The FAA wants to develop a system, called Automated En Route Air Traffic Control (AERA), in which sophisticated transponders on airplanes communicate with air traffic control computers. The computers would be programmed to determine optimum flight patterns, to ensure that planes do not collide, and to clear planes along their routes. The advantages of such a system would be fuel savings, increased safety, and increased productivity. Congress has so far authorized funds for the development of AERA but the FAA has not yet requested funds for its implementation.

Aircraft today frequently fly at low altitudes, which wastes fuel, or on circuitous routes simply because there is a limit to the amount of information the mind of a human air traffic controller can handle. Because computers can keep track of more airplanes than humans can and can be programmed to design optimum flight paths for all of the planes, the automated air traffic control system should save substantial amounts of fuel. Even a 3 percent savings in fuel could translate into a 30 percent increase in airline profits, according to Edmund Koenke, deputy director of the FAA's Office of Systems Engineering Management.

In addition, an average of 1.5 air traffic controller errors occurs each day. Half of these errors are caused by lack of coordination between controllers, or by controllers' inattention, lack of communication, or poor judgment. Such errors would presumably be eliminated by AERA.

What AERA would not do is control aircraft at terminals. "No one is really talking about helping aircraft take off or land automatically or worrying about ground-to-ground collisions," says a Washington area consultant. "Terminal control is not amenable to automation in our lifetimes," he remarks.

The use of computers in air traffic control is nothing new, but computers so far have been used to aid humans in making decisions rather than to make decisions for them. For example, computers now are used to keep track of where planes are and where they are expected to be. If the computer predicts that two planes may get too close, an alarm goes off to alert the traffic controllers. Computers also monitor planes' altitudes and warn the controllers if a plane may be flying too low over a mountain range or too close to the ground. But if the computers used today fail, the controllers can continue their jobs without them. This may not be possible when computers actually make the decisions that air traffic controllers make today. Koenke explains that the computers would "handle traffic automatically and possibly differently than the human mind would. If the computer fails, the controllers can't go back to the old way."

If pilots are to depend so totally on computers, it is essential that the system be reliable. But even with the best computers and the best computer programming available, no computer is completely fail-safe. Therefore, says Koenke, there must be dependable backup strategies such as plans for adjacent computer centers to take over if one center's computers fail. The aircraft also would be provided with monitors so that, at the very least, they would not collide if the computers fail.

Despite this heavy burden of reliability, the FAA and its consultants, which include the aviation industry, are optimistic that the task is feasible. "We've never really done an automatic real-time command and control system before. But the technology is there," Koenke remarks.

The FAA has contracted with Mitre Corporation to design the software for the system. To do this, Mitre is using computer simulators. One computer acts as the airplane and is programmed with actual flight plans. Another computer is the controller and is supplied with data on other planes in the airspace, weather conditions and other pertinent data. In this way, the Mitre programmers can test

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