

## Present Challenges of a Research University

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My topic is the role of the research university in the United State's economy. As late as the mid-1970s, there was no substantial economic data, no reliable economic analysis of the relationship between investments in research and development (R&D) and economic development. When I served as director of the National Science Foundation in the late 1970s, we were well aware of the importance of such data in making the case to the Congress for federal support of research, and of the gaps in our knowledge about how R&D affected economic growth. Accordingly, we initiated a special peer-reviewed grants program at NSF focused on just that issue--the relationship between investments in R&D and the growth of the American economy.

In the intervening 25 years, a substantial body of research has been conducted, which has in turn led to a development in economics called "new growth theory." This work was nicely summarized in a 1995 report of the President's Council of Economic Advisers: 50% of the growth in the American economy in the last 40 years has been due to investments in research and development. Obviously, the private sector is a major driver of R&D, but federally funded research at universities throughout the United States also plays a key role. The report points out that when federal investments in university research increase, there is--with an appropriate time lag--a corresponding increase in private-sector investments. There is now a well-researched link between university-based research and industries' R&D efforts.

Our German colleagues with us today will have to make their own judgments about whether this linkage also characterizes the German economy. I believe the economic evidence about the connection between R&D and American economic growth, however, is overwhelming. What surprises me is how few people are aware of these developments in economic theory, and of the critical role the discovery of knowledge plays in driving the American economy.

The State of California provides one of the best examples of this linkage. In the early 1990s, this state endured one of the worst recessions in its history. California in prior periods had entered recessions later, and come out much earlier, than the rest of the country. But in the 1990s this traditional pattern broke down. California suffered a brutal economic downturn fueled by tremendous cutbacks in defense and aerospace--a huge loss of jobs that resulted in a dramatic drop in the tax revenues of the state. California's economic hard times, I might add, had a direct and painful impact on the University of California. UC's budget today is about \$900 million less than it would have been if the State had been able to provide only normal cost increases--in other words, a barebones budget--in the early 1990s. This staggering figure equals the entire 1995 State-funded budget for three of UC's nine campuses.

What has happened in the past few years? California has come storming back from the recession. Why? New jobs have been created at a very fast rate. Where are those jobs coming from? From a particular type of activity: high technology. And these high-tech enterprises are not the vast IBMs of the world. The companies that are pulling California out of recession are small, entrepreneurial, high-tech ventures. These companies and their technologies can be traced directly to the research universities of the State of California. And by that I mean the various campuses of the University of California, Caltech, Stanford, and USC (University of Southern California). If you look at the biotechnology industry, for example, a booming area in California, you will find that its success--in fact its very existence--is directly traceable to research programs that came out of the universities of this state. Digital telecommunications is another case in point. It could not possibly exist at its current scale and scope without the California research universities that produce the new knowledge and educate the graduate students essential to keeping this industry on the competitive cutting edge. Multimedia, computers, and software are yet other examples.

As we consider new growth theory and our recent experience in California, it is crystal clear that research and graduate training will play an increasingly important part in ensuring the economic growth on which our standard of living depends. The University of California is very much focused on its responsibilities to help keep the California economy thriving and productive. We recently held a statewide conference on technology transfer, bringing people from the University together with colleagues in government and the private sector to examine how we can do more to facilitate the transfer of technology. We have also established a new program--the Industry-University Cooperative Research program--which seeks to mine the most promising research areas for new products that, in turn, create new jobs.

The Industry-University Cooperative Research program works like this. A UC researcher joins with a scientist or engineer from a private company to develop a research proposal. A panel of experts drawn from industry and academia selects the best projects for funding. At least half of the funding for each project comes from industry, with the remainder from the University.

The benefits to companies and to California are evident. The most important of these benefits is that the UC program involves graduate students in every aspect of the research it sponsors. Industry thus gets the benefit of some of the world's brightest young minds. Graduate students learn firsthand about industry's needs. As a result, they have an incentive to stay in California and continue contributing their talents to our economy.

We want to foster these kinds of exchanges between industry and universities. We clearly do not want to be involved in turning the University of California into a "job shop." But we do want to be involved in speeding the transfer of ideas developed at the University to the marketplace.

More than 50 years ago Vannevar Bush, President Franklin Roosevelt's science adviser, argued in his landmark report *Science, The Endless Frontier* that the national interest demanded federal investment in research performed at universities--basic research that would lay the groundwork for new products and new processes. Events have proved him right. The partnership among government, universities, and industry that Bush envisioned and helped create has been a remarkable success.

Nonetheless, you often hear that the federal government in the United States is reducing its commitment to the support of research universities and scientific research generally. Some forecast that support of university-based research will decrease as much as 25% in the next five years. But it has also been true--despite difficult budgetary problems at the federal level--that federal budgets for university-based research have remained relatively robust. It is my view that from a political perspective, most people in the United States who have thought about these issues have concluded that support of our research enterprise is critical to the national interest. And Democrats and Republicans alike have come to the view that the research university plays a key role in keeping our R&D enterprise thriving and vital.

There may be differences of opinion about whether science policy in the United States should be driven by the federal government, or whether we should have a national science policy at all. But I believe there is agreement on the importance of research and development to the economic future of this nation. And when the history of the last half of the twentieth century is written, the vital role research universities have played in the American economy will be regarded as one of the truly great accomplishments of the post-World War II era.