Universities and the Knowledge-based Economy

CALIFORNIA STATE SENATE FISCAL RETREAT
Transcript of Remarks by President Richard C. Atkinson
University of California, Berkeley
February 3, 1996

This morning I want to talk about higher education and, in particular, the University of California. And my remarks are going to be focused on economic growth; that is, I am going to examine the role of the University of California in the economic growth of the state of California. In particular, UC's role in increased productivity of California workers, a higher living standard for Californians, and in general, faster economic growth.

Why do I want to focus on economic growth? There are a lot of economists here today. I may be treading on their territory and I hope they will be forgiving if I am not as precise as I should be. It's quite interesting if you look at the average annual economic growth in the United States in the years from 1973 to 1993. It ran at 2 percent in this twenty-year period, while in the previous part of the century--the previous seventy years--it was running at 3.4 percent. A big difference. Many of the problems that we've had in the last twenty years are related to that slower rate of growth. Someone's estimated that over that twenty-year period, if our productivity had remained at 3.4 percent, every American family would have earned an additional fifty thousand dollars in income. There would be no federal deficit. Rather, there would be a surplus--a large surplus that could more than fund health-care payments for the thirty-seven million Americans that are not covered at this moment.

So, what is the role of the University in fostering economic growth? Well, you're all familiar with the role of education in terms of the economy of the state. Clearly, we are not just interested in warehousing students, having them sit in classrooms for some period of years and then receive a diploma. We're interested in the quality of the product--the contribution that they can make to society when they graduate. I could spend the morning discussing education. I'd cover a lot of topics like the ratio of graduates to undergraduates, the importance of four-year degrees, the teaching load of faculty, and even my view of computer-based education as it will affect the future.

But this morning I'm going to focus on a different issue, namely, the role of research--university research--as it impacts on the economy of this state. In my judgment, the role of the University of California's research is comparable--and I use the term comparable deliberately--to the importance of the University's educational role. It's been unpopular in the United States in

recent years to talk about research universities and the role of research in our universities. It has often been said that if only the universities would stop doing research and focus on teaching, the problems of higher education would be solved. Believe me, I've been through the wars with regard to Senator Proxmire and crazy grants, the Golden Fleece Awards, and I can recite as many stories as anyone about frivolous research that's been done in universities. But that represents a small fraction of what goes on, and I think it's important to focus on what the research of American universities and in particular, the University of California, does for the country.

There is a development in economics called New Growth Theory; its origins are very much right here at UC Berkeley. New Growth Theory is getting widespread support from both the right and from the left. I'm not going to go through the details of the theory but I'll summarize it in one statement. This theory states, based on what I think is very careful research, that *50 percent* of the economic growth over the last forty years in this country--*50 percent* of the growth of our economy in the period since roughly World War II--has been due to the nation's investment in research and development. I am quite interested in this matter. I was the director of the National Science Foundation during the late seventies, and at that time, there wasn't much economic analysis of investments in research and their role in the economy.

There was lots of anecdotal evidence. One could, for example, point to the transistor and Bell Telephone Laboratories, but there wasn't hard economic data. In the late seventies the National Science Foundation mounted a program supporting research in economics focused on just this issue--to try to tie down the impact of research and development on economic growth. I have here a recent report of the President's Council of Economic Advisors. I'll just read one paragraph from the executive summary: "Increasing the productivity of the American workforce is the key to higher living standards and stronger economic growth in the future. Investments in research and development are the key to increasing productivity, accounting for half or more of the growth in output per person and to the creation of new products and processes."

That's the economic background. Now, how are research and development activities organized in the United States? The organization evolves from World War II. Those people who remember or have some feeling for that period will realize that American science was dominant in the war effort--just tremendously significant--much of it done here on the Berkeley campus. The development of atomic weapons, modern electronics, the computer, cryptography--there is a long list of scientific activities related to the American efforts during World War II. Near the end of the war, President Roosevelt turned to his science advisor, Vannevar Bush, for advice about the

future of American science. Vannevar Bush is one of the great individuals in American history and not well enough known. He managed the American scientific effort during World War II, ranging from electronics to the atomic bomb.

And near the end of the war, President Roosevelt turned to Vannevar Bush and said, "Look, we've had these experiences of science in relationship to the war effort. How can we translate those experiences into a peace-time economy?" Vannevar Bush was charged to write a report, which appeared shortly after President Roosevelt's death, entitled *Science: The Endless Frontier*. You can gather from the title that he viewed science as, literally, an endless frontier of opportunities. I view that report as one of the great documents in the history of this country because it set the stage for the modern era of science and technology in the United States. So what were the arguments that Vannevar Bush put forward? First of all, he said, "Who should fund the research and development effort of the United States?" Let me make a few distinctions here. I'm going to describe research on a continuum from basic research to applied research to development. There are problems in thinking about research and development as falling on a continuum, with one activity leading to the next, for in actual practice these activities are tightly intertwined.

Nevertheless, for simplicity of expression, let me use the terms basic research, applied research, and development. Basic research is not focused on applications; the term "curiosity research" is sometimes used to describe it. It is driven by a sheer interest in the phenomena rather than potential applications. But at a certain point, basic research may reach the stage where there is potential for applications and accordingly a need for applied research. Then it goes into the development stage involving development of new products and processes. What was Vannevar Bush's argument? His first question was "Who should fund the research and development effort?" He argued that applied research and development should be done by the private sector, by industry. But he also argued that the private sector would not invest adequate funds in research at the basic end of the continuum. In essence, he argued that private market mechanisms ensured that industry would invest in applied research and development, but wouldn't adequately invest in basic research. His argument, which has been well supported by subsequent economic research, was that an investment in basic research by a particular company could often generate results that were just as valuable to a competitor company as to the company making the investment.

There was no question about the societal returns for basic research, but there was not the same return to the specific company making the investment. So he argued that the funding of basic research was an obligation of the federal government. The second part of the argument is

"Who should perform those activities?" When it came to applied research and development, he said, that's a private-sector responsibility. The private sector should perform that kind of activity. Who should perform the basic research? If you looked at the Soviet Union you would see it was done in institutes run by the central government. The French had the CNRS program federally run. The Bush concept, based on the experiences of World War II, was that American universities should be the principal performers of basic research. That is, basic research should be the responsibility of the nation's research universities.

Then there was a third part to Bush's argument. He argued that basic research should be funded through a peer-review process. Individuals should make proposals for what they thought was valuable work. A group of peers--leading scientists from around the country--should evaluate that proposal and decide to fund or not to fund. And Californians need to remember the term peer review because peer review has been wonderful to the state of California. It's now under attack by some members of Congress in large part because the state of California does so well in the peer-review process.

So that was Bush's argument, and that's how the research and development programs of the United States have evolved over these many years. There are lots of arguments about the future, but most people buy into the major aspects of Bush's proposal. It's interesting when you discuss basic research to wonder why the universities should be this central. If you look at companies like AT&T and IBM, for years they did superb basic research. But they are not doing it anymore. AT&T has virtually pulled out of basic research and so has IBM. Their research now is very focused on specific applications.

Both companies have come to the view that they are just not big enough and wealthy enough to support basic research. So, increasingly in this country, we're relying on the universities to do basic research. Now there is a very interesting aspect to all of this and again, this comes out of the New Growth Theory. When the country increases its investments in basic research, that's followed sometime later by industry's increasing its investments in applied research and development. When we cut back on basic research, it's followed by a cutback in industry's investments in research and development. There is a very simple reason. When universities are generating basic research, they're generating new ideas that industry can build on, and invest in as applied research and development. When basic research is cut back, then industry doesn't have that base of new ideas on which to invest in applied research. The point I'm trying to make is that the government's investment in university research is very important in driving industry's investments in research and development.

Where is the University of California in all of this? Ten percent--actually a little more than 10 percent--of all of the funds that are invested in university research by the United States government flow to the University of California. Berkeley is one of the big recipients but the University of California system as a whole is a major player. Now some of you, the legislators here, will say, "Well, after all, California is 10 percent of the national economy. You're not doing much better than the average." You've got to remember that in California we have Stanford, we have Cal Tech, and we have USC, and all three are major players. When you look at the state of California, we're a big winner along with the state of Massachusetts in terms of the federal funds that come to our universities for research.

Obviously, the federal budget for research may be impacted in future years. However, it's very clear observing the Washington scene that whether you're on the right or the left politically, there is strong support for basic research. The one thing that California has to worry about is science funding being driven by pork barreling rather than peer review. When quality determines what projects are funded, California does very well. So, our congressional delegation has to be alert to what is happening in Washington regarding federal support for research, and, in particular, insist on quality. That's all we require because the quality of the faculties that have been assembled in our universities will more than guarantee California's success.

The University of California's research programs are key in my thinking to California's economic future. Obviously, I want the education that we provide young people to be the very best in the world. But I also want to ensure that research at the University of California continues to be vigorous and vital. And that involves ensuring that the ideas developed in the University are transferred to the industrial sector. Vannevar Bush always believed that there had to be an active effort to transfer ideas from the University to the private sector. Before Sputnik, universities maintained very close, collaborative efforts with industry. But when Sputnik occurred, so much money poured into research in universities--they were so busy dealing with all the funds that were coming from the federal government for research--that we lost sight of our links with industry.

It's only in recent years that we've begun to again realize the importance of close links to industry in order to ensure that the ideas developed in our laboratories are transferred into the private sector. It's quite interesting that universities like Cambridge University and other European universities almost all take the view that university research should be divorced from any contact with the private sector. If you're a professor at Cambridge University, at least twenty years ago, the view was that you didn't want to demean academic research by interacting with industry. That just was not part of the culture of Cambridge University, a culture that

eschewed commercial incentives. Interestingly enough, in the United States there's always been a tendency to build bridges between universities and industry--look at places like Silicon Valley or, in an earlier period, Route 128 in the Boston area. The faculty of American universities have always been prone to be entrepreneurial in this regard. But we have to expand our efforts in building bridges to the private sector.

Until about 1982 the federal government owned the licensing and property rights for research funded by the federal government. So whatever intellectual property that came out of a research project funded here at UC Berkeley was owned by the federal government. As a result, there were not enough incentives for transferring those ideas into the private sector. In 1982, however, a bill was passed in Congress called the Dole-Bayh bill. It reassigned the property rights for federally funded research to the institutions doing the work, that is, to universities. So, now, intellectual property rights, instead of residing with the federal government, reside right here with the University of California. The Dole-Bayh bill caused universities to rethink how they would deal with the private sector. We did it rather badly for a number of years. Our technology transfer efforts were not as good as they should have been, but we are now getting our house in order and successfully moving intellectual property into the marketplace.

The University of California receives more money on patents than any other university. We now have 500 patents that are pending and another 700 patents are in active development. This effort has become a priority of the University. A second priority of the University is fostering interchange with industry. On each of the campuses there are efforts to bring venture capitalists and people from the industrial sector together with university scientists and engineers to move research ideas into application. I could go into some detail on various projects of that sort. I won't this morning, but obviously, there are some downsides. There's the potential of abuse, the potential for work done at the University at taxpayer's expense yielding an opportunity for an individual or a company not rightfully deserved--but these are matters that are being worked out and we are learning very quickly how to correct them.

To give you a sense of the impact of the University of California on the economy, one can look at any number of areas--telecommunications, electronics, computer services, multimedia, agriculture. I have a brochure here called *When It Comes to Biotechnology UC Means Business* which describes the UC Critical Linkage Project -- the idea of linking up with industry--and it lists a few interesting facts. One in four U.S. biotech companies are within thirty-five miles of a UC campus. Six of the ten best-selling biotech drugs stem directly from UC research. Forty percent of California biotech companies were started by UC scientists, including the

world's three largest: Amgen, Chiron, Genentech. These three companies alone provide 7,000 jobs for Californians, 283 million dollars annually in state and federal taxes, 249 million dollars annually in local construction, 3.7 billion dollars in sales. And this is just one industry. The University has recently published a pamphlet entitled *UC Means Business* in which we make the case for our impact on the California economy. The point is that UC is doing quite a good job for the economy of this state.

There is one last point that I want to make. In the proposed state budget for the University of California, there is a program called the Industry-University Cooperative Research Program. The University has had a great deal of experience in cooperative research programs. Many of you have heard of the UC MICRO Program, which is in microelectronics. There is the STAR Program in biotechnology. Let me explain how these programs work. A scientist or engineer from one of our campuses will link up with a scientist or engineer in a company -- it could be a very small company or it could be an IBM or AT&T. They will join together and present a proposal for research that they believe could yield significant progress toward a new commercial product. This work tends not to be basic research but research that builds on University research which is at a stage where, with some additional work, it could create a new product or process--and in turn create new jobs. A panel of experts drawn from industry and from the University--a peer-review group--make a judgment on each of these proposals and the very best are funded. And the funding arrangement is that the University and the company will each fund its share of the project.

We've had experience with this type of program and can point to a great many successes. The idea in this budget year is to encompass all of these early efforts into one program to be called the Industry-University Cooperative Research Program. I hope that we will receive a good response from the legislature because I believe the program is very important to the future economy of the state. I should mention that the governor has included in his budget a tax credit for the support of university research by the private sector. He's raised the tax credit from 12 to 24 percent for this kind of activity. That should help us foster the involvement of industry in these cooperative programs.

I'm going to end there. I hope that you won't judge that I have downplayed the importance of the educational component of the University. There can be no question about that, but I do think that there are too many Americans who don't understand that in this country, unlike almost any other country, universities play a key role in basic research. And, in a very real sense, basic research is the engine that drives the whole research and development effort. And there can be no question that research and development is a dominant factor in the economic success of this nation.