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S. HRG. 103-376

TECHNOLOGY AND ECONOMIC POLICY

HEARING

BEFORE THE

JOINT ECONOMIC COMMITTEE CONGRESS OF THE UNITED STATES

ONE HUNDRED THIRD CONGRESS

FIRST SESSION

JUNE 21, 1993

Printed for the use of the Joint Economic Committee

75-411 U.S. GOVERNMENT PRINTING OFFICE
WASHINGTON: 1994

For sale by the U.S. Government Printing Office
Superintendent of Documents, Congressional Sales Office, Washington, DC 20402
ISBN 0-16-043460-2

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[Created pursuant to Sec. 5(a) of Public Law 304, 79th Congress]

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MONDAY, JUNE 21, 1993

CONGRESS OF THE UNITED STATES,
JOINT ECONOMIC COMMITTEE,
Washington, DC.

The Committee met, pursuant to notice, at 10:00 a.m., in room 2359, Rayburn House Office Building, Honorable Lee H. Hamilton (member of the Committee) presiding.

Present: Representatives Hamilton, Wyden and Armey

Also present: Richard McGahey, Executive Director; Lee Price, Chad Stone, William Buechner, Steve Baldwin, Richard Clinch, Steve Rose and Ed Hudgins, professional staff members.

OPENING STATEMENT OF REPRESENTATIVE HAMILTON, MEMBER

REPRESENTATIVE HAMILTON. The meeting of the Joint Economic Committee will come to order.

Technical progress is one of the keys to economic growth and a rising standard of living. A rapid pace of technical progress in the 1950s and 1960s produced strong annual gains in productivity and a doubling of real wages and family incomes in the 25 years between 1948 and 1973.

A much slower pace of technological progress since 1973 has produced disappointing productivity gains and only grudging increases in the standard of living of the average American family. Restoring productivity growth is necessary if we are to achieve satisfactory growth in our standard of living over the next several years.

Certainly, reducing the budget deficit and increasing national saving and investment are very important. But so, too, is a technology policy that contributes to generating high-quality jobs and keeping the United States a leader among industrialized countries in generating new ideas and bringing them to market successfully.

The Clinton Administration recognized the critical importance of technology to economic growth when it introduced its technology policy initiative in February. We are fortunate to have two experts from the administration to discuss this policy today. Ms. Laura Tyson is Chair of the President's Council of Economic Advisers. Mr. John Gibbons is Director of the White House Office of Science and Technology Policy.

Each of you has a statement. That statement, of course, will be entered into the record in full, and in just a moment I will ask you to proceed.

First, I will ask if either of my colleagues have any comments they would like to make.

Congressman Armey, please proceed.

OPENING STATEMENT OF REPRESENTATIVE ARMEY

REPRESENTATIVE ARMEY. Well, thank you, Congressman Hamilton.

Let me begin by welcoming both of our distinguished guests this morning.

I can't help but just mention the Armey party line on productivity. It has been my contention for some time that productivity increases through the application of science and engineering knowledge in the production process. And when science and engineering knowledge is applied, productivity increases.

It has been my general belief that when legal and political knowledge is applied productivity tends to decrease, so I believe that the key to increasing the Nation's productivity is to keep the politicians and lawyers from driving the engineers crazy. If we can manage that, I think we can beat any nation in the world.

Thank you again, Congressman Hamilton.

REPRESENTATIVE HAMILTON. Congressman Wyden, please proceed.

OPENING STATEMENT OF REPRESENTATIVE WYDEN

REPRESENTATIVE WYDEN. Thank you, Congressman Hamilton.

First, I want to commend you for your many years of effort in this area. I happen to think harnessing information technology—specifically databases and computer networks—is absolutely critical to increasing U.S. productivity.

I think the question we really face is what is the proper role of government in this area and the three focuses that I would like to zero in on this morning.

First, its seems to me that it is critical that the Federal Government assist in the effort to help people learn how to use technology. The 1980s, for example, saw a $1 billion investment in technology by many businesses across this country, and yet, according to a recent article in *Business Week*, there was very little payoff. I happen to think one of the reasons that was the case is that we have not done what needs to be done to speed up the learning process in terms of how to use technology. I am anxious to explore that issue with Ms. Tyson today.

The two other areas that I am especially concerned about involve technology transfer and health care.

The Federal Government is making a massive investment in technology. The Federal Government funds a virtual technological treasure trove with $50 billion in health labs, DOE and agriculture labs, and for the most part, the gains that we have gotten in this technology transfer effort have been microscopic. There are very few results to show for these transfer efforts. I am interested in exploring that with Ms. Tyson and Mr. Gibbons who have worked with us on this issue over the years.

The third area I am very concerned about involves health-care technology. The Congressional Budget Office recently issued a report indicating that almost 50 percent of the rate of the growth in health care is due to technology-almost 50 percent.

Virtually every proposal I have seen in the health-care area gives short shrift to the question of technology. I think the danger is that the Congress will huff and puff and produce a major reform, and we will get one-time savings. There will be one-time savings because underlying questions such as how to use technology will have been ignored. So I am anxious to explore that issue with Ms. Tyson as well.

I think this is one of our most important hearings, Congressman Hamilton. Again, I commend you for the important work that you have been doing for an awful long time.

REPRESENTATIVE HAMILTON. Thank you, Congressman Wyden. Before we begin, without objection, I would to have included into the record the prepared statement of Congressman Ramstad.

[The prepared statement of Representative Ramstad starts on p.40 of Submissions for the Record:]

Ms. Tyson, you will lead off. We are very pleased to have you and Mr. Gibbons with you. You may proceed, Ms. Tyson.

STATEMENT OF THE HONORABLE LAURA D'ANDREA TYSON, CHAIR, PRESIDENT'S COUNCIL OF ECONOMIC ADVISERS

MS. TYSON. Thank you very much.

I thought a sensible way for us to divide our task is for me to talk a little bit about the overall economic logic, linking technical change to economic growth and competitiveness, and then linking government policy to technical change, and then having Mr. Gibbons talk about some of the specifics of our technology policy. So let me begin with the link between technical change and economic growth and competitiveness.

I think the first step here is to define national competitiveness carefully. It is a two-part definition. It is the ability of a nation to produce goods and services that meet the test of the international competition, but at the same time providing sustained increases in the standard of living of its citizens.

This is a definition, incidentally, that goes back to the Commission on Industrial Competitiveness that was established by President Reagan.

If you look at U.S. performance on those two standards, producing goods and services that meet the test of international competition and sustaining real increases in the standard of living of the population, the United States, particularly in the latter half of the 1980s, has made some progress in the area of its international performance on world markets. We have had a combination of a lower dollar and industrial restructuring, and U.S. products have become more competitive on world markets. Our exports have more than doubled since 1985, and we have become the world's largest exporter once again.

Unfortunately, our improving trade performance, the first part of the national competitiveness, has not translated into a strengthening on the second dimension of national competitiveness. If you look at, say, the living standard for the average American family, you will see this. Average real median family income fell in 1991. It is still virtually unchanged from its 1978 level. So, for 13 years, real family incomes have stagnated despite a large increase in the number of two-earner households. So, by my definition of national competitiveness, which is now a decade old, the United States still has a competitiveness problem.

There is a widespread agreement among economists that the fundamental determinant of national competitiveness is indeed productivity growth and that the problem for the United States has been a slowdown in productivity growth since the 1970s, and the fact that the United States has had the lowest productivity growth among the major industrial countries since at least 1960. Our overall productivity growth has been below 1 percent for the last 20 years.

Now, how does this link up to technology? Technology contributes to national competitiveness in two ways. First, technology is really driving productivity increases. The ways that companies can restructure to make their work force more competitive and more productive revolve around the implementation of new technologies.

Second, new technologies also allow companies to compete not just on price but on the quality and innovative features of their products. So a company can use technology to both make its workers more productive and to enhance productivity growth in the United States.

A company can also use technology for new products and processes so that it can compete on the basis not of low price, which much too often translates into low wages, but rather compete on the basis of higher productivity and superior products. So this is the logic linking technical change, productivity and competitiveness.

Although scholars have an imperfect understanding of the process of technical change, there is widespread agreement, again, among scholars that spending on research and development is an important part of encouraging innovation.

There is also widespread agreement that private-market forces alone will tend to provide too little funding for the simple reason that not all the benefits from a research and development expenditure go to the company or the individual that finances the research. There are spillover benefits that are generated that far exceed the returns to the private investor, the private company making the R&D investment, the private individual making the R&D investment, or the private university making the R&D investment.

The spillover really stems from a variety of sources. It is very often quite easy to reverse engineer products. Patent protection is an imperfect way of allowing the investor in R&D to capture the returns to his investment. Oftentimes, when a company will undertake a project, its R&D will create knowledge. That knowledge rests or resides in its work force. The work force is mobile, moves on to other countries, and often starts competitive activities. So, again, the original R&D dollar generates benefits which go beyond the company into the broader economy.

There have been a number of studies of the spillover benefits, and they indicate that the benefits are very large. Private returns to research and development have been estimated to be on the order of 20 to 50 percent. But social returns to research and development spending have been estimated to be anywhere from 50 to 100 percent, so there is a wide gap between the private return to research and development and the social return to research and development spending.

And that is a very powerful justification or rationale for government policy to promote research and development spending, either through something like an extension of the research and expenditure tax credit, which is a very important mechanism for encouraging private investors to invest more in research and development, but also through government programs directly to support research and development spending.

The U.S. Government played a very important role in the development of the Nation's science and technology during the postwar period. And it has been the major source of financing for research and development spending in the Nation. But, primarily, the channels for this have been government policy

to support basic science, on the one hand, or mission-oriented research, on the other hand.

These approaches have served us very well, but it is time to consider making some adjustments, because the nature of the challenge we face has changed and because the nature of the competition has changed.

It is my reading of industries that have been important to the U.S. economy—the computer industry, the commercial aircraft industry, the semiconductor industry—that if you go back to their birth, to their genesis, to when they started, indeed, to the first decade or 15 years of their lives, the government was very heavily involved in research and development spending support, and actually also in procurement support. The military channels of support are not going to be as significant as we look forward to the future because we are scaling back, correctly, our military effort. The Cold War has been won by us, so we have a different set of opportunities and challenges.

In addition, the reason we can't rely simply on mission-oriented approaches anymore is that the nature of the relationships between the military and civilian technologies have changed. It used to be the case that military technologies were generally perceived to generate civilian spillovers, so if you financed a military program of R&D support, you could expect commercial civilian benefits as an unintended consequence.

But, increasingly, it is the case that the military has been adopting R&D civilian technologies for their own use. So, instead of spin-offs, we have had more and more the phenomenon of spin-ons—that is, the military adopting from the civilian economy rather than the military creating technology for the civilian economy.

Finally, the last reason why I think we need a change is that we are in a different world now. We have competitor nations who are very strong in technologies—particularly in Japan, emerging strengths in East Asia, and uneven strengths throughout Europe. And in the competitor nations that we deal with on technologies, those nations are much more involved in civilian channels of support than we are. We can't really depend, it seems to me, on military channels hoping they will create unintended benefits, when we are dealing in a world where the rest of the world is doing civilian programs directly.

The challenge for us is to come up with a renewed commitment to increase government support for civilian research and development or technology programs.

Our general commitment, as an administration, is to try and shift the share of federal R&D towards commercial applications and away from military applications. Today, 41 percent of the federal R&D dollars fund civilian research. By 1998 we hope that the percentage will be at least 50/50.

Now, before I turn the floor over to Mr. Gibbons, who can give you the specifics here, just let me say that in thinking about how to accomplish this shift—the shift of the weight of federal support for R&D to civilian channels —we have to look for ways of doing this which are efficient and effective. We know there is a justification for the government to spend money on civilian R&D support, but we want to get the most efficient delivery mechanisms in doing that, and we actually know a few things about how to do so. We have tried some small experiments which have been somewhat successful.

Let me just mention the Advanced Technology Program of the Commerce Department. I won't go into it in detail, but, as an economist thinking about

an efficient delivery mechanism for federal support for R&D, the ATP programs have several characteristics which make them attractive. They are competitive. That is, there are proposals submitted and evaluated by a scientific panel for their technological potential. The private sector is involved in putting some money on the table, so, in that sense, the private sector is making a sign that this technological trajectory shows promise.

So you have competition, you have projects evaluated for scientific and technological merit, and you have the private sector involved cooperatively with the public sector. It seems to me that those characteristics, which also are shared, incidentally, by some of the cooperative research agreements between the federal labs and private sector, are very attractive mechanisms of delivery, and we should be looking for those kinds of approaches.

Let me just conclude by saying that, in my own reading of the importance of high technology to U.S. competitiveness, I have been convinced by the evidence that it is not an exaggeration to say that high technology industries' investment in basic science in the United States has been a primary driver of our economic performance during the postwar period. We now have a new era where we need to adjust how we spend our money, and we are working in this Administration to come up with efficient ways of doing that, and Mr. Gibbons can explain the ways.

[The prepared statement of the Honorable Ms. Tyson starts on p.44 of Submissions for the Record:]

REPRESENTATIVE HAMILTON. Thank you very much, Ms. Tyson.

Mr. Gibbons, you may proceed.

THE HONORABLE JOHN H. GIBBONS, DIRECTOR, OFFICE OF SCIENCE AND TECHNOLOGY POLICY

MR. GIBBONS. Thank you, Congressman Hamilton. I am delighted to be here before you today with my colleague, Laura Tyson.

I was just thinking to myself that in her presentation, which was independently prepared from my own, it is not 100 percent of the time that economists and scientists seem to see eye to eye, but I believe this morning that is the way it is going to come out.

This technology initiative, as you know, was introduced in February by the President at San Jose. It was called Technology for America's Economic Growth: A New Direction to Build Economic Strength. In that presentation, we focus on three central goals for the administration.

First is long-term economic growth, which both creates jobs and improves environmental quality. This arrives, or is derived, from a plan that focuses clearly on deficit reduction as a means, first of all, to get our own house in order and also to keep interest rates lower and more funds available for investment, and that deficit reduction, obviously, has to go at a measured pace. If you go too fast, you have near-term downside economic implications. If you go too slowly, it goes to the long side.

But, given that first focus on deficit reduction, then comes the inevitable need to invest. If we expect to go to the future and to regain our national strength and competitiveness, we simply can't do that without investment: investment in people, investment in infrastructure, investment in our production system.

So long-term economic growth that creates jobs and improves environment is the first of our three areas of focus.

The second is making government itself more efficient and more responsive. The old term is physician heal thyself.

And I can personally attest that when I went to the White House this morning, I thought I had two jobs—a science adviser and director of OSTP. I soon was also assigned the job of running the National Space Council and the National Critical Materials Council, as reflecting the Administration's concern about streamlining, beginning at the White House itself and becoming more user friendly and productive.

The third focus concerns world leadership in science, mathematics and engineering. In research we know we still hold the lead in most areas with respect to our competitors around the world, but that lead continues to shrink. And in education, we have much work to do, and I know the Committee understands that full well, not only in developing new scientists, new engineers, new specialists, but also in upgrading the skills of all of our people so that they can be more productive players in our economic future.

We are committed to moving in a new direction that recognizes the critical role of science and technology as it must play in stimulating and sustaining the kind of long-term economic growth that creates high-quality jobs and protects the environment.

The two previous administrations were, I think, committed more to the idea that government should support basic research and mission-oriented research then dominated by the military, but should not concern itself with civilian technologies that could be used to help create better competitiveness, new jobs, a better environment.

This Administration sees very important and long-neglected opportunities for new kinds of partnerships to be developed between the people through government and the private sector and the marketplace. We can no longer rely on the serendipitous application of defense technology spin-out to the private civilian sector. This, true it may have been in times past, is not true today, as Ms. Tyson also pointed out.

We seek more directly at our goals and our efforts on new opportunities before us, recognizing that government can play a key role in enabling private firms to develop and profit from innovations. In other words, not only to assist in the research area of new technology development, but also to lay the seed ground for a more attractive situation for private investment and innovation to occur.

The technology initiatives that we are working on encompass many efforts to directly aid companies in developing new technologies that apply to new products and services but also apply to improving the competitiveness and the quality of our existing industries.

There are a number of examples that we could talk about this morning. I would mention, to start, an example, whereby, if one can recognize the public interest in a particular area and its alignment with private interests in that area, then one has the basis for a partnership kind of development. And one we are working on quite diligently now is in the area of the so-called clean car in which we believe those interests are collateral and can be added together in a way that is a win-win situation.

But this, of course, represents a critical change of course for the United States in economic policy. Compared to Japan and our other competitors, our government support for civilian technology development has been minimal. The Administration intends to dramatically increase its attention in these areas for development of civilian technologies over the next five years.

The programs designed to strengthen government cooperation and to provide more federal support for commercial R&D include a number of areas. I would mention four very briefly to you.

First, instructions to the federal laboratories to devote an increasing percentage of their budget to the kinds of R&D partnerships that can be logically derived with industry. We have been mission-focused, and we want to maintain a mission focus to these laboratories serving the agencies to which they belong, and yet at the same time for the laboratories to become increasingly aware of the civil sector relevance of that work, and for the civilian sector to be able to more readily enter into partnerships with these laboratories so that the mission focus is then broadened with a kind of a dual-use capability.

Second, dramatic expansion of the ATP or Advanced Technology Program at the National Institute for Standards in Technologies. As Ms. Tyson pointed out, this is to be a peer-reviewed joint venture, mutually funded, so that one has a market test of these opportunities. This is a relatively small program—in 1993, about $68 million. The Administration proposes to expand this by a very substantial amount over the next four years.

Third, a new multi-agency program led by the EPA to fund the development and diffusion of new environmental technologies, so-called green technologies. There are many important opportunities here to apply sophisticated technologies to the provision of goods and services with less environmental impacts. And we believe there are very important international markets for these technologies, goods and services in years ahead.

Finally, expansion of the Small Business Innovation Research Program. This is where in small businesses the good new jobs come from. I think, if you are an arithmetician, you calculate that slightly greater than 100 percent of the good new jobs come from small- and medium-sized business, and you will find a focus on that sector of our economy strongly in the Administration's plans.

The technology initiative includes a number of programs also to accelerate the commercialization and use of new technologies. Let me give you two examples.

First, our regional technology alliances, and these are designed to help make it more attractive for firms and research institutions in a particular area of the country to exchange information, to share and develop technology, and to develop new products and markets.

The great strength of our economy, it seems to me, lies in the regional confluence of situations where ideas, finance, markets, educational institutions have a chance to come together, and we feel that these regional technology alliances are things that should be given every encouragement by public policy, certainly not discouragement.

The second area is manufacturing extension centers which work much in the same way that our historic work in agricultural extension has worked. It reflects some of the very successful work carried out presently by state governments—many of them through their land grant universities—to assist small

businesses in particular to access and to be able to obtain the advantages of access to advanced technology, especially in manufacturing their products.

We hope to see the recent few good examples around our country expand to, perhaps, as many as a hundred such centers, a true partnership between the states and the Federal Government. We know that Japan leads this area by nearly an order of magnitude compared to what we do here in this country, and it has worked very well for them in that regard.

I also want to mention a few things about our initiatives for defense conversion. And, as you know with the end of the Cold War—I am not sure we have won it yet—but it certainly has ended at this point. The biggest challenge for us as a Nation is no longer the threat of global military conflict, but the economic challenge now that mounts and pushes us to restore our competitiveness.

And, in turn, as Ms. Tyson points out, after this very woeful situation of the economic status of our families, our low- and middle-income families, falling rather than rising with our recovery, the technology initiatives in this area reflect a twofold—that is, a short-term and a long-term—approach for defense conversion. Workers and communities that have lost their economic livelihood due to federal actions deserve first rate help in the form of retraining, reemployment and community economic redevelopment programs.

The Administration's defense conversion package contains over $600 million of such assistance to communities and impacted areas.

Research and development programs that support dual-use technologies have an important place in President Clinton's vision as well. He has announced his intention to shift from the present ratio in federal R&D spending to more than 50 percent civilian and dual use by 1998, and that is a rather rapid change from the present situation as described by Ms. Tyson.

The Advanced Research Projects Agency has been given the responsibility for most of the technology programs in the defense conversion package that Congress passed last year, which the Clinton Administration is now aggressively implementing. This package includes over $900 million in fiscal year 1993 for investments in dual-use technology. The technology reinvestment project jointly operated by ARPA and our other agencies—now I believe it is five other agencies—accounts for most of this work, nearly $500 million in fiscal year 1993.

All of these programs, again, include, I think importantly, matching funds and merit-based decisions, as it were, market tests of the likelihood of the success of such ventures.

The most unusual feature of this technology reinvestment program is that all six of these agencies now are acting as a single unit in terms of the access of would-be interested parties from the private sector. They are accepting proposals for all of the component programs. At the same time, they will evaluate the proposals together, and then they will parcel out the management assignment of each of these resulting agreements to the agency that has the best capability to oversee it.

Those agencies, incidentally, include ARPA at the Department of Defense, the Department of Commerce, Energy, National Science Foundation, NASA, and now also EPA.

This effort embodies a second goal of the President's technology plan; that is, increasing government's own efficiency and responsiveness and user friendliness.

Now, while federal technology programs are important, they cannot succeed without change in other government policies. Many of our current fiscal regulatory policies stymie rather than encourage private investment in new technology and new products.

The Administration hopes to change the situation with the help of Congress by such actions as making the research and experimentation tax credit permanent rather than temporary. That will enable corporate decisionmakers to make long-term plans rather than short-term plans as they have to with only the temporary extensions of that tax credit. Others include reforming of procurement policies.

As you know, government—that is, federal and state—accounts for nearly 20 percent of the purchases made in our economy, and if procurement policies can be reformed and made more flexible to reflect broader needs and opportunities for drawing, making market pull for important new technologies and environmentally friendly products and services, this can have an enormous market pull demand in our economy.

And, finally, encouraging patient capital. One of our many problems has been that we have simply not had capital that is both available and patient in our economy, and the results of that paucity are really very, very difficult.

Let me turn for a moment to education and training. I think business leaders would agree with others in our economy, perhaps even more vociferously the business leaders, that their most important resource are the people that make up their organizations. Productivity and profits depend on having well-educated, well-trained, flexible employees.

And, for that reason, the Administration again is committed to trying to help all Americans have access to world-class educational and worker training opportunities in programs. This is a shared effort between private sector and public, but it is an effort all too frequently put on the backs of the private sector, to train their people and even get the high school graduates that come to them to have better than a seventh-grade equivalent education in mathematics.

So we intend to do several things, and I will quickly go through three of them.

First, to expand access to the Internet computer network that will connect more universities and community colleges and high schools to each other and to a broad range of information sources.

Second, to create an interagency task force that will establish software and communications standards in education and training that will coordinate the development of critical software elements that will support innovative software packages to be developed, to be again a demand pull to our national information infrastructure. And to collect information resources in more standardized formats and make them available to schools and teaching centers throughout the Nation using the communication networks.

We want to transfer some of the education and training technology developed in the military to the civilian sector so that it can be used in our schools, our factories and offices. Let me give you an example.

Last year, the Navy Training Systems Center and the Army Simulation Training and Instrumentation Command together invested a billion dollars in

training systems. We want to see to it that some of these experiences and capabilities can be transferred and utilized in our civilian sector as well, and our colleagues in the Department of Defense, as well as in the Department of Education, are very excited about these opportunities of making better use of resources developed in our defense community, and now more hopefully made more applicable and actively used in our civilian sector.

The President has repeatedly emphasized the need to improve the country's infrastructure. Today, that not only means roads and bridges and the likes and highways, but also high-speed telecommunication networks and computer systems that together form our national information infrastructure. We hope that this extraordinary rapidly moving development will make possible many, many different advantages of these changes, not just to the experts but to people across the land.

The infrastructure clearly is going to be built and run by the private sector, but the government has a couple of very key roles to play. One is working with industry to develop and demonstrate the technology needed for this information infrastructure to really hum and sing. Second, to formulate forward-looking telecommunications and information policies that will promote competition and investment, while ensuring that the information infrastructure will benefit all Americans.

Before concluding, Congressman Hamilton, I would like to just very briefly mention the President's commitment to world-class science, mathematics and engineering. Our basic science program provides an ongoing sense of adventure and exploration while improving the knowledge base. It also lays the foundation for new technologies.

None of the innovations in technology proposed for our initiative will be funded at the expense of basic science. Our proposed budget ensures that support for basic science remains strong and that stable funding is provided for projects that require continuity. We will not allow short-term fluctuations in funding levels to destroy critical research teams and activities that have taken years to assemble, but stable funding requires clear priorities.

In recent years, rather than canceling less important projects when research budgets have been tight, the agencies have tended to spread the pain and to squeeze a little bit here and there, resulting in disruptive cuts and associated schedule delays in hundreds of very important programs. We believe that improved management of basic science can ensure sustained support for the high priority programs, but this clearly will mean that some triage will have to be used in our research decisions. If we want to make room for the new, we must give way with some of the old.

In conclusion then, as you can see, the Administration has, we believe, a comprehensive and proactive technology policy that will, hopefully, provide many benefits to American business, especially over the longer term. And in doing so, it will provide huge benefits to the American people in terms of new, higher paying jobs, a cleaner environment and a higher quality of life for not only ourselves but our children.

We certainly look forward to working with this Committee in helping achieving these goals, Congressman Hamilton. Thank you.

[The prepared statement of The Honorable Mr. Gibbons starts on p.48 of Submissions for the Record:]

REPRESENTATIVE HAMILTON. Thank you, Mr. Gibbons. We will proceed now under the 10-minute rule, with questions from members.

Let me just begin by trying to get an idea where this technology policy fits. I think all the economists that come before this Committee tell us the single most important thing we have to do is get the level of productivity up.

Ms. Tyson, you hit upon this. We have the lowest productivity growth among major industrial countries since, at least, 1960. Where does technology policy fit in all of this? We hear that you have to get savings increased, you have to increase investment.

When the President talks about his economic program, I don't hear him talking much about technology policy. I hear him talking about savings and investment and getting the deficit down and so forth. Where does technology policy fit in? How important is it in getting productivity up, as compared with other things, getting the deficit down, getting savings up and investment up and so forth?

MS. TYSON. I might begin by suggesting that the way to think about that question is to think about the United States as having to deal with an insufficiency of investment on several measures. If we look at our private investment rate in plant and equipment, for example, that investment rate has been relatively weak compared to the rate in a number of other advanced industrial nations.

Our investment in civilian technology support programs, which is a public investment, has also been relatively weak relative to many of our competitor nations.

Our investment in infrastructure is another area, but let me focus on the civilian technology part. If you think about the problem for the United States as being primarily a need to increase investment and then recognize that there is private investment and certain kinds of public investment, like support for technology programs that feed into productivity increases, then you can get technology policy and deficit reduction to be means to the same end. The end is to increase investment.

Deficit reduction is designed to increase the available funds for the private sector to invest more in plant and equipment and for the private sector to invest more in its own technology development program.

REPRESENTATIVE HAMILTON. Is it more important to get savings and investment or more important to have a technology policy, or do the two complement each other?

MS. TYSON. I think they complement each other. You would not want to generate savings at the expense of support for technology. So, basically, what we are looking for is a way to generate additional savings out of the federal budget without undermining the government support for technology programs. So they are complementary.

If our ultimate goal is investment, it would make no sense to cut support for technology programs as a way to get investment, because we would, in fact, be cutting a very important kind of investment; namely, the government support for research and development which, as I have indicated, study-after- study shows to have a very high rate of return.

This is a kind of public investment where the empirical evidence on returns is really quite strong, so I view them as complementary. And if you tried to cut technology support as a way to get investment, you, in fact, would be cutting

investment to get investment, so you really wouldn't end up where you wanted to be.

MR. GIBBONS. If I could add just briefly, I think productivity is, obviously, a very important issue when we speak about our economic future. Of course, the ultimate——

REPRESENTATIVE HAMILTON. Is it the most important issue?

MR. GIBBONS. That is why I want to raise a question that maybe we could have a dialogue about a bit. If you have the ultimate of productivity, which is that one person can do everything and the rest—I am not sure what the rest of the people will do—and this was raised by Harry Bridges many, many years ago.

So productivity per se is an important thing when we try to have our people compete with others who are willing to work at a much lower wage scale, and we have to make up the difference if we are going to have higher paying jobs with productivity.

At the same time, I don't think we ought to lose sight of the imparity for market share for new products. All of these things reflect the quality of our goods and services, the technical sophistication and attractiveness, the innovation that can come out of a technology-rich environment.

And so market share of new products, it seems to me, needs to be laid right beside productivity, in terms of the measures that will enable us to get to our desired future.

REPRESENTATIVE HAMILTON. I think the thing we hear so much, and I am sure you do, too, is that it is not so much that there aren't jobs, but there aren't good paying jobs. Good paying jobs, good wages is what people are really concerned about.

How does technology policy relate to the desire of the ordinary American to have a decent job at a good paying wage, and how long is it going to take before this technology policy translates into better wages for our people?

MR. GIBBONS. Let me start out, and then let someone who knows probably more about this than I do correct me or add to my comment.

Technology provides the opportunity for a worker to extend himself or herself in their workplace so that the output, in terms of value, is much, much higher than otherwise. A bulldozer operator does more work using that technology than a man with a pick and a shovel, and therefore you can afford to pay the bulldozer operator more. And the bulldozer also requires skilled technicians to keep it repaired and on the way. So an economy of people who have bulldozers rather than picks and shovels can afford to pay their people more as a consequence.

And that reflects right down the line, where technology coupled with human ingenuity provides the only opportunity for our folks, as it were, to be paid more than the folks across a number of other borders.

REPRESENTATIVE HAMILTON. But the bulldozer also puts a lot of people out of work.

MR. GIBBONS. That is the dilemma that Bridges talked about. Namely, if you go to the ultimate in productivity, you have a very, very well-paid person doing all the work. That is an ultimate result. That is kind of silly, but it bears keeping in mind that as we and the Japanese and the other very advanced industrial countries move to the future, the pinnacle on which we hope to sit gets

narrower and narrower. And that is why, it seems to me, it is terribly important to have coupled with productivity a society that is very innovative and capable of thinking about new ways to deliver goods and services.

REPRESENTATIVE HAMILTON. Are you telling us that you are not going to get those good paying jobs unless you have a technology policy?

MR. GIBBONS. I believe that is the case.

REPRESENTATIVE HAMILTON. Do you agree with that, Ms. Tyson?

MS. TYSON. Yes, I do. I try to think about it by thinking about the way a company in international competition can choose to compete. One competitive strategy is to compete on price. If you are going to compete on price, you either have to compete on wages primarily; that is, holding down the growth of wages and compensation packages, or you compete on productivity so that you can afford to pay your workers growing wages because they are becoming more productive at what they do. That is one competitive strategy, competing on price either through lower wages or higher productivity.

There is another way of competing, which Mr. Gibbons mentioned, which is very important, and that is competing on the basis of innovation. If you have a product which no one else has or you have a product feature which no one else has, then you have a very good position in which to gain market share, and basically that is the way you are competing, so you can afford to pay yourself and your workers pretty attractive wages. I look at this in terms of high technology industries in the United States. They pay premium wages. Their average wage is 22 percent higher than the rest of manufacturing. They can afford to do that because they are competing in markets where they often have a product advantage on the basis of either something nobody else can do or something they can do better. It seems to me that technology plays into both competitive strategies.

If you want to compete on price and offer high wages, you are going to have to use technology to enhance the productivity of your workers. If you don't want to compete on price and you want to compete on innovation, you still need technology because that is how to generate the innovation. Under either strategy, if you are going to pay high wages, you have to get productivity.

Now, as far as this concern about, "if you add to productivity, where are the jobs going to be?" I think that as long as the world economy grows—and think about the prospects for continued growth, think about the market opportunities in China, for example, that will evolve over the next 10 to 20 years, tremendous market opportunities—if U.S. workers become more productive at what they do, there can be more jobs because the United States can claim a larger share of this growing global market. Each worker is more productive, but you can afford to hire more of these more productive workers because you are grabbing, or taking, or achieving larger and larger shares of the world market. So I don't see any tradeoff between increasing productivity and the number of jobs. It is a way to get more jobs by getting market share.

REPRESENTATIVE HAMILTON. Before I go to Congressman Armey, let me go at this question of industrial policy. I want you to distinguish between industrial policy and technology policy for me. We used to hear testimony on industrial policy in this Committee, and then suddenly everybody stopped using the words. It got to be a bad word, industrial policy, and nobody supported it. Now, are you coming in here and giving us an industrial policy under another name? What is the difference? What about this argument about picking

winners and losers? Why can't technology development be left to the private sector? What is all this talk about market failure, and the free-rider problem, and first-mover advantages, and these fancy words that the economists throw around. I don't know what they mean? Just tell me what they mean, and why is it we can't let the market do this? Can government pick winners and losers? Is that what you are asking government to do?

You see the mix of questions that come up on technology policy.

MS. TYSON. That is pretty much worth a book. How do you want to start?

MR. GIBBONS. It is interesting how many of our national arguments do seem to wind up being more semantic than fundamental. I would say the following. You can make an argument that our Nation has had an industrial policy ever since we began as a Nation, with the Constitution providing for protections of intellectual property and encouraging the practice of the useful arts, to the early establishment of federal programs related to safety of exploding boilers, to the establishment of land grant universities and fundamental underpinnings, to what is one of our historic, most successful industries— namely, agriculture—to the development of aviation, which was a long-term partnership between the government and the private sector in aeronautics, to electronics and computers, which clearly, again, were outcomes of public-private partnerships over the years; to, perhaps most recently, biotechnology and many of the areas of modern health care and medicine. Again, multi-decade periods of partnerships of various sorts between public and private sector, each choosing to make its investment out of its own sense of self-interest in the outcome. I have felt this for many years, that the argument about industrial policy versus technology policy are perhaps more words than deep meaning.

Surely there are notions that are probably inappropriate; namely, somehow the government ought to pick one firm over another, but it seems to me that is a straw man that can easily be knocked over because that is not what we are talking about.

MS. TYSON. I guess I would add to that. I think you might think of industrial policy as a policy which has, as its explicit objective, the promotion of a particular industry, a particular sector of the economy, and I do agree with Mr. Gibbons that we have had intended industrial policies. For example, in agriculture, one would have to say that we have a series of policies designed to enhance or promote agriculture. In real estate, we also have policies designed to promote residential construction through the way we treat interest payments on home mortgages. That is a kind of industrial policy. We have also had a number of unintended industrial policies; meaning that the commercial effect was unintended, so we didn't intend to create the premier commercial aircraft industry in the world. We just happened to do that by promoting our technologies for military aviation.

We happened to create a premier computer industry because we were interested in the capabilities of computers for defense. So we have had both intended and unintended industrial policy. I do think that what Mr. Gibbons talked about today is not industrial policy primarily, or even by definition. Our technology policy measures are not designed to promote particular industries. They are designed to promote spending on research and development. In some cases, as in the clean-car initiative, I would argue not to promote a particular initiative, but because we care about the environment. We want to promote a technological trajectory that will generate new technologies, which will

meet our commitments on improving the environment and reducing pollution. In some sense, the spillover argument that an economist would make for the clean car technology is the standard spillover argument on the issue of pollution control.

As far as market failure and what economists say about first mover advantage and all the rest, I think the best argument, in terms of what we are talking about here, is really the argument that I talked about in my testimony, without using the jargon of economists—the appropriability problem, or the argument that if I spend a dollar on research and development, I might get 30 cents back as a return, but the knowledge that I create in that process of spending a dollar might create another 25 cents for my competitors.

REPRESENTATIVE HAMILTON. That is the free-rider problem?

MS. TYSON. That is the free-rider appropriability problem. Now, the 25 cents for my competitors is not in my interest. I don't particularly like that. That is an unintended effect of my spending a dollar, but we as a Nation should like that because the 25 cents goes someplace into the economy to create jobs and activities for other individuals, so it is the fact that there is an additional 25 cents that should lead the government to encourage me to spend my dollar in the first place. I might not spend it otherwise, because I am only looking at the 30-cent return. I may decide that I want to do something else with my money. But if I look at the 30 percent, the government looks at the 25 percent. Then the government gives me some boost to make the investment, and I create benefits for the national economy as well as for myself. That is the simplest argument and it is one, again, which is very well documented by economists, using a wide range of techniques, case studies and econometric analysis.

REPRESENTATIVE HAMILTON. Congressman Armey.

REPRESENTATIVE ARMEY. Thank you, Congressman Hamilton. As usual when you hold a hearing, I can come in here with what I think are three or four very exciting questions, and just the sheer dynamics of your hearings always create new questions and more exciting questions. I have such exciting notations here as wage equals value of marginal product, which carries me back to my childhood. I have even gotten esoteric enough to write down Euhler's theorem; then subsequently to write down a reminder that that applies if I have a linear homogeneous production function, which is, of course, a very exciting part of my early adulthood.

REPRESENTATIVE HAMILTON. Don't blame me for those now, Congressman Armey.

REPRESENTATIVE ARMEY. You inspired those. I must tell you that certainly Euhler's theorem is one of the most elegant things we have ever encountered. If you haven't yet had the pleasure, you youngsters out there, please do indulge yourself. It will require, as Mr. Gibbons would point out, your study of mathematics, which, if you do not indulge yourself in that, you have missed the boat. But I was intrigued by Bridges dilemma, and I do think we can talk here without it just being an old professor indulging himself in his undergraduate curriculum.

The fact is that if you have productivity gains without increased growth in the economy, or increased market share in the economy, you will, of course, increase the pressure for unemployment. That is the dilemma. This, of course, resulted in all kinds. I remember in the early 1960s the terror we had

over automation. And we see this time and time again recurring, that they are threatening to be replaced by a machine and so forth, always reminding me of what my daddy used to tell me that progress was inevitable.

If you didn't keep up with progress, you were left behind, a rather commonplace thing that we all understood as we grew up in hard times in the wonderfully dynamic decade of the 1950s. As George Will pointed out to us yesterday, the 1950s were exciting, but the fact is that it also took me back to the old question we have: Invention versus innovation. We can't stop people from inventing. People will invent. Sometimes even without the interest in the profit, the innovators generally are the ones who are saying, ah, here is my chance to make a better living for myself and my family.

I am going to come back to that in my second ten minutes. I want to focus on what I believe to be the solution to Bridges dilemma. If, in fact, all nations are experiencing productivity gains, and as you pointed out, Ms. Tyson, despite the fact that our productivity is higher than the Japanese, higher than the Germans, higher than practically everybody else, our growth rate is lower, and, of course, to some extent, one is a product of the other. We understand that if we understand mathematics at all. The Chinese have a great increase in productivity because they have no productivity by comparison with us. It is easier to come from zero to someplace than from someplace to someplace further. Still, nevertheless, if we find ourselves in a competition for a stagnant world market, then it, of course, becomes a rather difficult circumstance. So clearly and obviously the solution for not only this country and all the countries of the world and all the workers of the world is growth, and that takes me then, of course, back to our own circumstance, with respect to our own economy, the relatively low rate of growth we have now.

The President has put together an economic plan. Ms. Tyson, I want to address this to you, because I have always believed that the function of the Council of Economic Advisors is to explain the economic programs of an administration to the rest of the world; as is, I believe, the function of all economists to explain what others do. I have searched my mind, I have searched my old academic curriculum, and I have searched the literature and can find nobody that has a model that tells me the two things that this program contends: One, by increasing taxes we can generate prosperity; two, I have to ask where does the magical emergence of lower interest rates come from in this package? It seems to me that the President, even to the extent of his current refinancing of the national debt, has placed all his eggs in the basket of lower interest rates and somehow he sees them coming out of this policy initiative that we are debating in the House, the Senate and Conference Committee, and soon again back on our respective floors, but I can't find it, and I wondered, Ms. Tyson, if you could help me to find how this increase in taxation gets us to prosperity, and how the low-interest rates emerge from this process.

MS. TYSON. Okay. I think the key here is to start with something that Chairman Hamilton brought up in the discussion of his questions, and that is with the issue of savings and investment and its link to long-term growth. I think you have to understand this budget package in terms of an effort to increase investment in the United States over the long run by reducing government dissaving—otherwise known as the government deficit. When the government runs a deficit, it is basically dissaving; that is, it is drawing on the society's savings pool. It is reducing the pool of savings available for investment, so the link here is simply that you need to reduce the deficit; you need

to reduce it in a substantial and credible way over a gradual period of time. It is important, as Mr. Gibbons pointed out, when we thought about how much deficit reduction to try and realize over a four- to five-year period, it is important to recognize, in the short run, deficit reduction by itself cannot slow the economy down unless financial markets respond to the space made for the private sector by the government reducing its claim with lower interest rates. So our package is meant to gradually reduce the government's claim on society's savings, allowing interest rates to come down and stay down.

Those lower interest rates allow the private sector to invest in plant and equipment, invest in research and development, allow consumers to refinance their mortgages, allow students to take out loans to go to college—a variety of interest sensitive activities—so we would hope to see an increase in private nonresidential investment and in all sorts of private sector investment activities. That is the logic. Taxes are one part and only one part of a package designed to get the deficit down. Now, the link to long-term interest rates is that long-term interest rates can be driven by one of a couple of things.

One is an expectation that as the economy recovers, the government will, without deficit reduction, increase its claim on society's resources. If you look at the numbers that we were looking at when we were making the plan, if you look out to 1995, 1996, even assuming economic recovery, the government was going in for more and more funds to finance an ever-increasing deficit. That would drive long-term interest rates up. Long-term interest rates look to the long term and try to say, "what is going to be the demand for credit in the long run." So, by reducing those expectations, the expectations of government deficits getting bigger, you would expect the long-term rates to come down.

The second argument, which is related, is on inflationary expectations. If indeed the economy started to recover and the government's claim on its resources was not through a plan designed to be reduced over time, that should drive up inflationary pressure on the economy, and that could be adding to an inflationary expectation in the long-term rate. Again, what we interpret to have happened here is the market anticipation of a credible deficit reduction plan led the market to expect that in the future that there would not be serious inflationary pressures, and in the future the government would be reducing its claim on society's investible resources. And that is what drove the long-term rate down. That is the logic.

REPRESENTATIVE ARMEY. Let me ask, perhaps, you can get back to me. Is there anybody who has ever written this down? I think you mentioned something about a plan. Would you share that with us? Is there any scholarly papers on this?

MS. TYSON. There are certainly scholarly papers on the relationship between deficit savings, investment and long-term interest rates, yes. There are a number of scholarly papers on that, so I would be happy to.

REPRESENTATIVE ARMEY. If I look at this, it seems to me, the inflation rate becomes a matter of some consequence. The President proposes a plan and has a Btu tax—a very controversial tax—a broad-based energy as a source. Now, if I look at the stagflation of the 1970s, I pin the rap of the 1970s stagflation on two phenomena that occurred early in the 1970s. One was the energy crisis, driving energy prices up—what Hirschman would probably identify as the second most high linkage cost in American economy—in that anything that is done commercially is done with energy, and then, of course, the enormous

increase in labor costs consequent to the negotiated contract binges to the 1960s coming back to haunt us in the 1970s, giving us the third most high linkage cost, labor costs.

With those two inflationary impulses taking hold in the economy, the Fed had no choice but to tighten the money supply and raise the interest rates. Now, it strikes me that you parallel that same circumstance, right now, with the energy tax and with the President's microeconomic initiatives that I see daily in the Labor Committee, which is mandated benefits, increased minimum wage. My line on this Administration is that their economic illiteracy is exemplified by the fact they think that indexing the minimum wage is good public policy and indexing capital gains is bad public policy. But clearly these initiatives hang out over our head.

We anticipate strike replacement possibly being passed and signed into law. All of these things, it seems to me, will give you an inflationary impulse that the Fed must respond to, and your lower interest rates will not be there. They will go up. Then you will be betrayed for having refinanced in the short run the national debt. It seems to me a risk greater even than what the Bulls took in the last three seconds of last night's game by ditching off to that fellow outside the circle.

MS. TYSON. That sounds like something worth seeing.

REPRESENTATIVE ARMEY. Well, it was a very exciting moment.

MS. TYSON. There is a lot in your question, but I think, on the issue of deficit reduction plan, I would say that if you looked at the projections that we looked at—which were CBO projections and were commonly available, and a lot of private studies that also indicated this—they showed that as the economy recovered in 1995, 1996, 1997, deficits went back up.

Now, we know for sure that the consequence of that would have been an upward hit in long-term interest rates from where they were when we took office. You know that that would have been the consequence. Indeed, I would suggest that if you look at the previous point in our economic history where we had a growing economy with escalating deficits, which was in the first part of the 1980s, that is where you saw the dramatic increase in long-term interest rates from what had been their historic position of about 3 percentage points, in real terms, to a decade of 4 percentage point real interest rates, which was really a historical aberration for us.

The primary driver of long-term rates in a growing economy is the deficit, and we designed this policy so that that wouldn't happen. Now, would an energy tax component of this plan undo the anti-inflationary effects of deficit reduction? Even studies such as the DRI study, which looked at the Btu tax in isolation, found that because it was a broad-based tax and because it was introduced gradually, in any year the hit on the inflation rate was at most 0.2 percentage points. So you might go from an inflation rate of 2.8 to 3.0 percent or 3.0 to 3.2 percent, but that is in isolation; that is, assuming that the Btu tax or a broad-based energy tax were the only thing introduced into the economy. If you also introduce into the economy a number of spending cuts so that the government is actually reducing overall, year by year, its claim on society's resources, those models, even the DRI model, shows that the economy goes through this without an increase in the underlying inflationary pressures. So, whenever you look at the analysis of one part of the program, you have to put the whole program into the analysis, in which case the budget plan that we

have proposed would hardly be called a pro-inflation plan. It is an anti-deficit plan, and therefore an anti-inflation plan, and therefore a lower long-term interest rate plan.

MR. GIBBONS. Could I add to that just a comment about the energy taxation proposal? It is designed to be spread over a number of years so that it is a shadow price in the market now, but it gives the market a chance to respond to that, and we know that there is a very strong elasticity to price by substituting other things such as technology for price changes.

Now, I think that is a very important basis of the thing. We also need to understand that energy price and energy taxes in the United States are vastly lower than essentially any of our other industrial competitors. If you look at a chart of what other people pay for gasoline, or other energies in the other industrial nations, it is really a shocker. We also need to understand that the alarming rise of imports of petroleum is something that the Nation really does have to worry about over the long term. We are getting ourselves far more exposed than we ever were in the 1970s, or early 1980s, to import requirements, and that puts another shadow price in the system that is not seen in the marketplace. We need those shadow prices to induce higher efficiency of use, and it seems to me, therefore, that there is a multilateral rationale for looking at the energy sector. I believe we need to keep that in mind when we talk about the revenue potential of a tax in that sector that doesn't bring us anywhere near what our competitors are having to pay for gasoline or other fuels, but at least moves us in that direction.

I was struck the other day by a comment made by one of the CEOs of big motors—most of us have been in Europe for some years—and we know what it is like to pull up to a pump and fill up the gas tank on our car and pay $80. We don't do that here, and because we don't do that sort of thing and the rest of the world does, we are moving in the direction of energy inefficiency that can get us into big-time trouble down the road.

REPRESENTATIVE HAMILTON. Congressman Wyden.

REPRESENTATIVE WYDEN. Thank you, Congressman Hamilton. Let me say, first, if my friend Dick Armey has been comparing the Clinton economic program to the strategy of the Chicago Bulls, my sense is that the President won't object too much.

Let me, if I might, Ms. Tyson, begin on this matter of technology transfer, because I think what we face is more than having a policy. Everybody has a policy and I have known Mr. Gibbons for a lot of years and what was striking is how similar what Mr. Gibbons has said to what Dr. Bromley, your predecessor, has said for many years, and my question is not about having policy, but how we are going to make some of them work, and in the area of technology transfer, what this country is doing is not working. It is not producing, and the stakes are enormous.

The reason it is so important is that we are spending more than $50 billion, a huge taxpayer investment at these laboratories, energy labs, health labs, agriculture labs, defense labs, and the whole theory of the Stevenson-Wydler Act is to transfer the fruits of that research to the private sector. But by anybody's analysis, it isn't getting done. The *New York Times* ran an article recently saying that we are getting demonstrably small results. So it is not as if what I am saying is somehow an aberration.

My question to you both, start with you, Ms. Tyson, is why aren't we getting results now, and what are we going to do to turn it around?

Ms. TYSON. Well, I think that I will try to answer that question, though I suspect that Mr. Gibbons has more insight into it than I. I have looked at particular technology areas where I think we have been quite successful. For example, in the area of SEMATECH, which was financed primarily through DARPA, we had a very specific objective. We set a timetable for the objective. We had private companies investing their own money in the activity. We had a consortium which included a number of the key players that would have to be involved in the success of the initiative. You need to have a fairly well-defined objective; that is, technology transfer can't really be just a side effect. We are doing something else in the lab. We are creating something else for some other mission. Maybe, there will be some technology output to that, if there is some interested private-sector party. Maybe, they will find out about it and that will be the technology transfer.

It seems to me that you need to have an upfront intended effort, which is what we are trying to do by encouraging the federal labs to really think of this as taking a certain fraction of their budget and devoting it, with intention, to technology transfer efforts with the private sector. Getting the private sector involved in making some of its own investments in the activity matters a lot. In a lot of these areas, consortium efforts are very important because the technology transfer occurs in the networking of related or competitor companies who are working on part of the same technological puzzle, the solution of which would benefit all of them. Those are some of the things that I would want to see in the design, and I think we are beginning to see those things in some of the CRADA programs.

MR. GIBBONS. I would just add a point to that, if I might. It is true that I think Allan Bromley and I have somewhat similar positions on this matter, but we work for very different bosses, and it seems to me, if you look at the Administration now and the Cabinet Secretaries, there is a commitment, a willingness and positive interest in going this way, which I think can help effect the kind of cultural change that will have to occur in these agencies, which, for many, many years, if not decades, have had a very different orientation. It is going to take positive reinforced leadership to have that change occur.

I worked at a national laboratory for a number of years, and in the process of that, helped start a couple of small businesses that were spinouts of the lab. I can tell you that the orientation now toward that process is very different, in a very positive way, compared to what it was in those times, but it is a cultural change. The research environment is one in which you pick interesting topics and you want to work on them and perfect them. Time is not of so much value as it is if you are in an industry trying to make a product work, or a catalytic converter go, and be competitive in the marketplace, so we have a revisitation of C. P. Snowe in which the two cultures, in this case of science and the other of industry, need to rub up against each other so that one appreciates the other's needs and opportunities. This is what, for example, we are trying to do in these CRADAs, the labs in which joint ventures are developed. Both have money on the table, and they begin to not only work with each other, but listen to each other and understand why things are so differently set up in their priorities in the process.

I also believe that we still have a long way to go in this idea that is working so well in Japan, and to a degree in Germany, in which the small- and medium-

sized business people have a much greater opportunity than ours do here at home in accessing modern manufacturing methods, modern technologies that are applicable to their business. It is an order of magnitude different here in the States compared to Japan, and we have a lot of opportunities there, I believe.

REPRESENTATIVE WYDEN. Let me, if I might, follow up on this matter of the cultural gap, because nobody disputes for a second that that is one of the key considerations that traditionally the focus has been on research rather than moving innovations to the private sector. I appreciate your comment that this President is going to make it a priority, because I think that is what this is about, shaking the system up. But to make it a priority, you have to have some measuring standards, and I would like to ask you about two that I think warrant considerable thought.

One is in the downsizing of the laboratory complex, particularly the DOD and energy labs. I would hope that the Administration would give thought to saying that one of the key standards for deciding whether a lab survives or not is whether it has a good track record on technology transfer.

The second standard, it seems to me, is in evaluating a laboratory manager. One of the key new considerations in evaluating that lab manager and all the factors that go into, raises and the like, the track record on technology transfer would be considered a part of that evaluation. Mr. Gibbons, are those two ways in which we could put some flesh on this idea of making this a higher standard?

MR. GIBBONS. I think those are both very important and appropriate measures. Quite precisely, namely the criteria, as it were, for survival, should depend on the demonstrability of the fact that those resources not only continue to fulfill the directly perceived mission needs of that agency, but were accessible user friendly to people who have opportunities and ideas to transform those ideas in other directions in the marketplace. Certainly, the evaluation of lab management is a very key part of that, and I happen to know that Secretary O'Leary, for instance, feels very strongly in this direction about the way we evaluate progress of those laboratories.

REPRESENTATIVE WYDEN. Well, we want to work closely with you on those, make sure that you don't find yourself in the same situation as Dr. Bromley has of coming back years later and having people ask the same questions. Let me, if I might, turn to health care for this round, and Ms. Tyson revisited for a moment, I am very concerned that essentially all of the major proposals are giving short shrift to the issue of technology as it relates to health care, and the danger is that we will get these one-time savings. We won't have dealt with the underlying forces. I can tell you that the central problem was found, to a great extent, by Mr. Gibbons' old friends in the 1980s. For example, it was found that more than 60 percent of the drugs that were developed in the 1980s were essentially me-toos.

In terms of medical devices, the situation is even more bizarre. What you have is a situation when you are producing a me-too device, you essentially go to the head of the regulatory queue, and those that are showing evidence of being clinically superior—ones that could really make a difference in terms of saving lives, or if they didn't do too much clinically additional, but save money relative to what was out there—those things lag behind.

My question to you, Ms. Tyson, is that I have seen virtually nothing in any of these proposals that mention the issue of technology. I think the danger is that the Congress and the Administration will get these one-time savings. Everybody will come back in a year and say what do we do now, because there will not have been an effort to look at this technological question. I have a proposal, as you might have guessed. But I want to hear your thoughts first, and whether the council is looking at this, and in what direction you think we ought to go as part of this health reform on the issue that accounts, according to the Congressional Budget Office, for almost 50 percent of the rate of growth.

MS. TYSON. Well, I think that the main way to think about this is not so much to think about it in terms of policies to directly target it at technology, but rather to think of the health-care reform as an effort to make the market for health-care services in this country—those include technology services and drug services and physician services and hospital services—to make that market subject to more competitive pressures through the managed competition approach. If you put into the system incentives for controlling costs at the level of the hospital or at the level of the provider, you basically organized the consumers into large enough groups that are in a sense negotiating with the providers when they buy their health insurance. The providers are competing with one another to provide the services to get the contract for these large groups of consumers by offering a very cost competitive or a price competitive delivery mechanism.

Once you put significant competitive pressure on the providing network, the network itself will look at technologies differently. The network itself will say, "our demand is different—what we can afford in terms of this medical device or that medical device, or this drug or that drug—we are on a different path." If you think about technology as being affected by the market in which the technology is being sold, if you inject competition into the whole market for health services through managed competition, that should help with the problem that you have identified, which is a very real problem.

REPRESENTATIVE WYDEN. I think, with all due respect, and I know my time is up, this is one where we really disagree. To make a market work, people have to get information about how one technology compares to another, and what we have heard from those big buyers, the people you are talking about—the insurers, the health maintenance organizations, the government agencies—is that they get flooded with information about various technologies and drugs and all this array of technological innovation. Those big buyers don't get information so that they can do comparative analysis on a catheter, or on a fetal monitoring device, or on something of that nature. I would hope that as part of the Administration's health-care proposal, we don't just say, well, gee whiz, managed competition is going to make it possible for providers to go out and compete against each other and say that is going to take care of it, because the underlying problem is that to have managed competition—I have been one of those who supported the President on this—you have to make it possible for those big buyers—insurers, health maintenance organizations and the like—to do comparative analysis of one technology or one device relative to another, and I haven't seen that in any of the proposals.

MS. TYSON. Those kinds of things are actually under discussion. It is very hard. It would be very useful to see your proposal, because it is the case that we are thinking of it in two ways. One is the whole system, which we are thinking about developing here, would put more pressure on these large

organizations to do a better job at analyzing the information that is currently at their disposal. At this point, for the large insurance companies, given the way the insurance market works and given the ability really to pass on escalating costs, their incentive to analyze the information and to make the tough choices hasn't been as great as it might be. But I agree, you can work on the incentives as one part of the problem. You can also try to figure out how we could better provide information to those groups who actually are acting as the agents of the consumers. We are thinking about how best to do that, and any proposal along those lines is appreciated.

REPRESENTATIVE WYDEN. I will send you mine.

REPRESENTATIVE HAMILTON. I want to return to the question of winners and losers and the role of government. Are we at a place now where we just have to acknowledge that in certain areas, at least, the United States cannot be competitive unless we have a stronger active government role and partnership with industry?

MR. GIBBONS. Let me see if I understand your question correctly. You wonder, are there any areas that one could state explicitly, that without government partnership opportunities are likely to pass us by in a globally competitive economy?

REPRESENTATIVE HAMILTON. Well, if I understand your testimony, what you are saying is that the government has to be much more active in technology policy or industrial policy or whatever, and I am just wondering if you, the Administration, has come to the conclusion that we cannot be competitive in the international market unless the government and the private sector develop a much closer relationship than they have in the past. Let me expand on it a little bit.

You talk about instructions to federal laboratories; you have to have an R&D partnership with industry. You talk about the regional technology alliance as promoting commercialization and application of critical technologies. Who decides what is critical or not? You talk about the Department of Commerce helping small- and medium-sized businesses. Who decides what small- and medium-sized businesses you help? You are laying out here, if I understand it, a policy of the government being much more active, doing much more subsidizing. Let me put it bluntly, are we at a point where we simply cannot be competitive internationally unless we have more government participation through subsidies of one kind or another?

MR. GIBBONS. Well, one can certainly make an argument that our loss of major markets to other industrial competitors, such as Japan or other countries, is in part due to the fact that those countries have a much different relationship between government and industry, whether it be between manufacturers and those who will finance large international deals and the like, but in general because of a different kind of a relationship. Germany and Japan come to mind as two clear examples of that. So, comparatively, in a global competitive marketplace, the United States, if we stay in a more adversarial than cooperative relationship, we stand to lose competitiveness. I think there is little question about that, especially in the area of manufactured goods. I think, rather than saying that it is absolutely imperative that the people go out and help our industry, it is better to point out that there are many areas in which the public as a Nation has a good deal of self-interest in working with industry toward commonly identifiable ends.

Let me give you the automobile as an example. We know our industry has been in great trouble. They have made extraordinary investments in capital over the last five to eight years in becoming more competitive with especially the Japanese in the ability to produce a salable car in U.S. markets, in particular. As we look ahead, the industry faces several major issues of its own; namely, how to survive in a time, as they describe their ball game, where one strike and you are out. And their survival is going to depend not only on their own actions in an open marketplace, but also in that marketplace as affected by public policy, such as environmental controls, such as our national concern about getting less dependent down the road on imported petroleum and hopefully more resilient against the kinds of consequences of becoming so totally dependent on imported oil. So, is Detroit's future hanging in the balance on whether or not they can develop the kinds of, let's say, catalytic converters that will enable them to move to two-cycle engines and diesels and still meet clean air standards?

Probably in large measure, a great deal of their future hangs on their ability to develop such catalysts, and therefore be able to go to lean burn engines.

REPRESENTATIVE HAMILTON. And the government would participate in that?

MR. GIBBONS. And the government has already many resources that are directly relevant to these particular kinds of engineering and chemical processes. Many of them are vested inside the National Laboratories, but we have never made the connection. We have never seen the mutual self-interest in greasing the skids between the two.

REPRESENTATIVE HAMILTON. Mr. Gibbons, there are thousands of industries out there and there are thousands of products and there are thousands of technologies, and you are talking about the automobile industry. We all know the importance of that. Is it the role of government to say, okay, the automobile industry needs some help, and we are going to subsidize it, or we are going to protect it, or we are going to do something or other to increase its international competitive position?

Is that the position you are arguing for as you look at regional technology alliances, manufacturing extension centers, advanced technology programs and all the other things you and Ms. Tyson have spelled out? I am really trying to understand here. Look, this is not for me an ideological question. In the end, these things are pragmatic, and what works, and I know ideology gets all tangled up in this, but I am asking these questions because I really wonder. I mean, picking winners and losers, if you ask anybody, do you support a policy where they pick the winners and losers, they say, oh, no, I don't support that. Then you come along and you make all kinds of language that indicates to me that you are picking winners and losers, maybe not Ford Motor Company, but you are picking an industry.

MR. GIBBONS. Very pragmatically the automobile accounts for about 20 percent of our Gross National Product and a large measure of the high class manufacturing jobs in the United States, so one measure is that it is a very important industry because it, in fact, accounts for so much of our employment and our national——

REPRESENTATIVE HAMILTON. Therefore government should help it?

MR. GIBBONS. Therefore, in the area in which public interest is aligned with that industry's survival, yes, and I would say, for example, that assistance and access to capabilities to enable them to fulfill the requirements of public policy

such as the Clean Air Act is a clear collateral interest of public and private concern.

REPRESENTATIVE HAMILTON. Before I ask Ms. Tyson to expand, let me take it one step farther. Let's assume you are right. Let's assume that we are not going to be competitive in a lot of areas in the world today unless the government and the industry develop some kind of a partnership, however you want to describe that partnership. Let's assume that is the status of affairs.

Do you worry about that judgment as to how the choice is made and as to what industry you support or protect or subsidize? Do you worry that that decision under our system will be made on the merits, or because Senator so-and-so or Congressman so-and-so or somebody in the White House like the Council of Economic Advisors' chairman has clout?

MR. GIBBONS. I would hope that it would arise out of a very open——

REPRESENTATIVE HAMILTON. Not what you hope, what you think will happen.

MR. GIBBONS. Well, it is very difficult to predict something, especially if it has to do with the future. It is easier to predict what the atom looks like than to predict what the future holds, but I believe the process by which one approaches this openly and transparently, in which the public and private interests are clearly on the table and the coventuring is clearly there, as it were a quasi market test of the validity of a thing further tested by the impacts on our own people, our investors; namely, the government's investors, the American citizens, to test that openly and transparently and to introduce competition into that choice by the willingness of the parties to each invest are pragmatically the only ways to go here.

REPRESENTATIVE HAMILTON. What I am after is policy. What is the policy of this Administration, with regard to the questions that I am asking?

MR. GIBBONS. Let's see if I can get a policy into a sentence, which is hard for a scientist.

REPRESENTATIVE HAMILTON. Tougher for a politician, Mr. Gibbons.

MR. GIBBONS. The policy would be to provide a seed ground—a policy framework—in which private investment in things that move our economy forward, as measured in the quality of our environment, the competitiveness of our people in competing in a global economy for goods and services is improved by those policies rather than discouraged by them, is enhanced by those policies. A policy in which the resources of the people in the Federal Government, whether it be information in their laboratories or information in their data banks, are more readily accessible by people outside government through an information infrastructure or through other consortia arrangements, a policy in which public goods such as clean air can be more readily incorporated into the private sector actions, which affect that air for better or for worse. An alignment, in other words, each time a test of the alignment of self-interest, of the public side and the private side in any kind of joint venturing, but at least getting past this notion that somehow we live in separate universes only to be matched up in a legal confrontational way or a command and control way. That is not a very satisfactory way of doing business.

MS. TYSON. Okay. I would like to start with the notion that your question seems to imply that the challenge we face is that we need to support the science and technology base in the United States in a different way. We have been supporting it. If you look at the United States compared to other

countries, if you fold in our support for defense and space technology with our support for civilian technology, we at the federal level are very generous.

REPRESENTATIVE HAMILTON. Your argument would be, Ms. Tyson, that you are not asking in your technology policy for a more active role for government but a different role?

MS. TYSON. A different one. Not even for more money. That is, you can see, what is going on here is a shift, a shift from spending our R&D dollars for military purposes to shift a larger fraction of those dollars to civilian purposes. There has been study after study. The Council on Competitiveness, which is headed by George Fisher of Motorola, and the Competitiveness Policy Council, which was put together by the Congress, in their most recent studies they have pointed out, look, the Nation doesn't really need an increase in its aggregate science and technology budget as much as a shift in how the budget is allocated. So I think we want to do different things and shift the spending. We have been an activist government for decades in the area of support for science and technology, and I think if we don't figure out different ways, we may, in fact, unwittingly stop supporting science and technology. We will just cut back the military, cut back the federal support and find ourselves impoverishing our science and technology base.

REPRESENTATIVE HAMILTON. Do you believe it is the role of government to pick out critical technologies and subsidize those technologies?

MS. TYSON. There are two ways to think about doing things in different ways. One is to just have more civilian technology programs of the advanced technology program or the CRADA type, where the proposals for technology support are actually coming from the private sector and are being evaluated by scientists and engineers, and maybe occasionally an economist, on the basis of market merit or merit for a large number of users. That is not the government choosing, that is really the science and engineering community choosing and the government putting in some money behind that choice, but it is not the government choosing. There are some areas where I think you might say the government considers the Nation to have a mission.

I will go to health, even though Congressman Wyden has perhaps raised the issue that we may be investing too much in this, but the U.S. Government has decided over the years to be very generous in supporting basic research and some technology development through NIH and other programs. We have created as a consequence of that the premier medical technology and biotechnology industry in the world. That is one of the outcomes of this effort. We decided to spend here because we thought health was an important national mission. We decided to spend on clean car technology not because of Detroit. The issue is, do we want to help promote the investment into technologies which can lead to a better environmental outcome a decade from now?

REPRESENTATIVE HAMILTON. And if we make that decision affirmatively, then you think government should subsidize that technology?

MS. TYSON. I think if we decide there is a national ... it is like defense.

REPRESENTATIVE HAMILTON. We being who?

MS. TYSON. If the political process decides that the national mission is a better environment or a better health system or a better defense system or space exploration or whatever it is, we as a Nation decide through the political process that those kinds of scientific or technology choices that we might put some support in, so I would think it would logically——

REPRESENTATIVE HAMILTON. Do you worry about the politics of this, that the decision would be made on the basis of politics rather than on merit?

MS. TYSON. I certainly have thought about that issue and what I thought is that the best way to try to handle it, to the extent possible, is to have peer review be the basis for project support. NIH, for example, which has been the allocator of tremendous investment by the American people in their medical and biotechnology, has been left to make those decisions.

You can quibble about decisions. You can argue that they didn't make the right decision in every case. But they have been significantly insulated from the political process, which I think, by and large, you would judge their decisions to be effective.

So I think we can come up with mechanisms to handle the concerns that you have appropriately raised and of all of us who think about this area of politics.

REPRESENTATIVE HAMILTON. Congressman Wyden wanted me to yield. Then I will go to Congressman Armey.

REPRESENTATIVE WYDEN. I appreciate Congressman Hamilton yielding. I will be very brief.

Ms. Tyson, I am not at all saying that we are investing too much in health. I am saying what you are saying in other areas. I am saying that we are not spending it in the right way. What we are spending is too much on things on the marginal clinical value, too many of the same drugs or medical devices that are exactly like what we have.

My proposal, in fact, says we would put a regulatory fast track on devices, drugs, and the like, that are showing evidence of clinical superiority, pull the other ones further down the regulatory queue.

And I would like, as I say, to talk more about it, and the Chair was gracious to yield. We are not talking about investing an insufficient amount in our people. What we are saying is, let's spend it differently and more wisely, like you are saying, in other areas of the economy.

And I thank the Chairman for yielding.

REPRESENTATIVE HAMILTON. Congressman Armey.

REPRESENTATIVE ARMEY. Thank you, Congressman Hamilton. Once again, between you and Congressman Wyden and our panel, you have my mind just achurnin' here, and I can't help it.

Pointing out a regulatory fast track might be another way of saying, to some extent, get the government out of the way of an innovator.

REPRESENTATIVE WYDEN. That is correct.

REPRESENTATIVE ARMEY. So I am sure you will appreciate my translating what you are saying into less government is better. I agree, Mr. Chairman, with your point.

I am an economist by trade, and I am now a practitioner of public policymaking, and in either case the only question that really manages is what works.

And if I can go back, Congressman Wyden, to my beloved Bulls for just a moment, the Bulls had a good empirical record on Paxson's ability to hit a three point shot from exactly that spot. The fact is, the facts of recent experience were with him when they took that gamble. When I look at the President's economic program, I see the danger it is subjected to by his own

macroeconomic initiatives, and I have to say that he doesn't have any empirical record with them in the same way that the Bulls did last night.

For all your best efforts, Ms. Tyson, to explain this to me, the private-sector growth is still an assumption. Deficit reduction is an assertion. Budget cuts are a fiction. The fact is, five years from now the federal budget will be $300 billion greater than it is today. That is a 20 percent increase in the size of the government in five years.

If I were to hope for a 20 percent increase in the size of the private sector that supports that government over these next five years, you would consider me quite bold in my wishfulness. But that is real.

How you increase taxes by $300 billion and increase government by $300 billion and come out with $500 billion, this deficit reduction is still magic to me. I know the interest rates are supposed to assuage my curiosity. But, still, I see no empirical record that shows declining interest rates with economic growth, nor do I see any empirical record that shows any declining interest rates with a declining budget deficit. Neither the growth nor the deficit, in any case, are something that I expect to get.

But let me go, if I may, to your testimony, Ms. Tyson. You have such a fascinating paragraph here. I am just enthralled with it. You point out that the private returns to investment on R&D average 20 to 50 percent. Studies point this out. I am willing to take the numbers as they are.

Then you compare that with 8 percent rate of return on plant and equipment and 10 to 12 percent rate of return on investment in education. Clearly, the private sector would have, in that case, an extraordinarily high incentive to invest in R&D, to compare with investment in plant and equipment; that being, of course, where you innovate the investments that one commits to R&D.

Unhappily, you don't have the data comparison with the social return for either investment on plant and equipment or education.

But, in the case of R&D, which I am going to just generically call invention, discovery, you point out that, in addition to the 20 to 50 percent return on investment to the private concern, the social dividend, if I can use that term—what I would call in the technical language of my own dissertation the economic external economy—is 50 to 100 percent.

Now, my guess is that the social dividend from innovation is less than from invention so that you would not get that kind of comparison if you had the data on return on plant and equipment. And it may be true for education, but we don't have that data, so I don't want to speculate on it. But, certainly, we know that the Nation gets a great external economy as a benefit, and we certainly know with returns being from 20 to 50 percent the incentive is there for the private sector to do that.

My question is, then why would the public sector want to internalize the cost of those great generous external economies that they get from private sector R&D? Why not leave that then to the private sector and let the public enjoy those benefits free of charge, as it were?

Let me just say that these numbers themselves make a great case for no public investment in R&D, rather than more public investment in R&D because we are getting so much for nothing.

MS. TYSON. The theory of positive externalities would support the notion that when there is a positive externality, even though the private sector is doing a lot of this activity, if the private sector did more, there would be a return

which exceeded the private return. It is, basically, a tautology in the presence of positive spillover benefits.

A dollar invested by the public sector to encourage that dollar by the private sector will end up generating 50 cents on top of the 25 cents that the private investor gets.

The reason it is not there for plant and equipment is that we believe that all the returns to plant and equipment, by and large, are internalized; the company that buys the plant and equipment gets the return on the plant and equipment.

But the company that takes on a technology in the area of high performance computing and solves that puzzle, no matter how they try through patent protection and keeping their scientists from moving on to other jobs and all the rest, no matter how hard they try, the information created by that solution will spill out. That may lead the company to say: "I would rather invest in the plant and equipment. I would rather invest in another technology where I think I can internalize."

REPRESENTATIVE ARMEY. I appreciate that point—unless you invoke a jealousy or resentment factor, which I don't think governs the decisionmaking process of investors—any time I can get 20 to 50 percent on an investment, that is a better investment than one where I can get 8 percent or 10 or 12 percent. So the incentive to invest in R&D is going to be self-evident by the number you presented.

MS. TYSON. I think the simple answer is to encourage the private sector to do more of what we know to be a good thing. The public sector is not doing this instead of the private sector. It is encouraging the private sector to do more.

REPRESENTATIVE ARMEY. An investment is, by and large, done out of earnings.

MS. TYSON. Private sector investment.

REPRESENTATIVE ARMEY. Right. So, in fact, one way in which we might encourage more R&D investment and more investment in capital, equipment and even education, for that matter, might be to just leave the successful invest or keep the earnings from their investment rather than have those earning expropriated by the government, which is exemplified by the fact that the Joint Tax Committee just a few years ago pointed out that the 28.5 percent capital gains tax rate is, according to their numbers, the optimal tax rate on capital gains, that is to say.

Mr. Perlman's cogent point was, if the rate goes up above 28.5 percent, we would say you would start losing money. Of course, the reason you would start losing money is that people would not be making capital investment, capital gains would go off, economic growth would go off, less innovation of any invention, jobs would not be created, and so on down the line.

I should say then that your Administration, if it believes in R&D investment capital investment or even education, could hardly embrace the idea in the Senate that we should raise the capital gains rate to over 31 percent.

I guess what I am asking: Is your Administration going to fight this foolhardy policy? I mean, this to me would be, by these numbers, just the worst possible thing we could do.

MS. TYSON. I have a couple of reasons for you. Number one, I don't think there is any model that exists that tells one the optimum rate of capital gains. But, be that as it may, that is one observation. Since I know you are interested in theoretical and empirical economics, I don't think there is any simple model which will churn out one number versus another. But the answer to the policy thing at this point would be simply to point out that in our plan as it went forward, there was not a proposal to increase the capital gains tax.

REPRESENTATIVE ARMEY. I appreciate that.

MS. TYSON. Where there was a capital gains proposal at all, it was a targeted small business capital gains tax relief proposal, along with some other investment credit tax credit programs for the business sector. This proposal that you are suggesting is, of course, something that is under discussion in the Senate. I really do not want to comment at this point on that.

REPRESENTATIVE ARMEY. I appreciate that.

Now, then, if you say there is no model that can tell us the extent to which capital is optimally taxed at one place or another, how then can you come to the conclusion that the American people are overtaxed? I have not yet found an American person that believes themselves to be undertaxed. And you assert that we are undertaxed. So what is the optimal taxation then?

MS. TYSON. That statement, which you have recalled for me, was made in the context of comparing the United States to other advanced industrial countries along a number of indicators.

We talked about some of them earlier: investment in research and development, and overall investment rates. If you look at the U.S. overall tax burden—state, local and federal—relative to GDP, and if you look at its level over the past decade and a half, the United States is at the bottom of a long list of industrial countries. I think the number in that article referred to the OECD list of countries. I think there were 26 countries. The United States was at the bottom.

I agree with you. I would never say, because I know the literature, that there is any model anyplace that would tell you the appropriate rate.

REPRESENTATIVE ARMEY. But if we can go on, the United States is at the bottom of a long list of industrial nations, in terms of the percentage of the American people's income taken away from them by the government through taxation, right?

MS. TYSON. That is an observation.

REPRESENTATIVE ARMEY. That isn't fair compared to the way the Swedes wreak havoc on their people. Now, isn't it a fact that the United States is also at the top of the list of all those same nations in terms of the productivity of its people and in terms of its per capita income? I mean, I guess we are not concerned about us being behind any nation in the world. We are concerned about our comparative position diminishing relative to other nations as they reclaim their economies and move forward.

MS. TYSON. Right. We could have this as a somewhat academic debate or a policy debate. To have it as a policy debate right now, I would just point out that the tax increases we proposed in our budget plan are there because of a need to construct a credible deficit reduction package over the next five years. That is why they are there.

They are not there because of any OECD study listing. They are there because we believe the primary thing to do for the long-term prosperity of the United States is to get the United States on a sustainable deficit path. The only way to do that, in our view, is to combine revenue increases with spending cuts.

There are still no serious proposals out there that manage to achieve the deficit reduction we proposed, in the time period we proposed, that show a set of spending cuts with no revenue increases. If one can come up with one, then I would invite whoever is the proponent to try and sell that to the American people.

The issue is $500 billion of deficit reduction over five years and how to do that. We have presented one plan which is very progressive as a way to do that. There are no alternatives which have been presented to the American people.

REPRESENTATIVE ARMEY. First of all, there have been alternatives. The entire history of the 1980s was an alternative that worked.

MS. TYSON. Not for deficit reduction. That is when deficits went up.

REPRESENTATIVE ARMEY. When they had the three years of Gramm-Rudman where Congress had to deal with a little bit of restraint, we did have deficit reduction, but that is another court.

Now, I guess this is what bothers me. The fact is, you have a plan, a plan that is baffling at best, and you haven't, in fact, achieved one dollar's worth of deficit reduction. In fact, we are back to passing off that ball last night.

And this is what scares me because, quite frankly, I cannot afford for this presidency to fail. I have five of the most precious people in the world starting their lives. You have them in your lives, too. And we see them in the audience. And nobody can afford to have any administration's economic policy fail when we have a Nation of young people who are trying to put their lives together and move forward.

And I have to tell you, there is no politics in this worry that I carry with me every day. There is a real concern about the lives of real people, and particularly young people, because they will live with the consequences of these policies. We will not. I will have my pension. The President will have his pension. You will have your pension. And we will be okay.

So I have to tell you that this policy initiative to me is an extraordinary gamble that is supported by very, very little empirical foundation. As I told the President, it is the wrong model. The empirical data is errant, and it scares me to death more for the Nation than for the President.

And it seems to me that in your own testimony, you give us some very good indications that this process will not work. And, as the Chairman said, it is a matter of what works that matters. Not a matter of whose politics we insert. No matter what works for the young people.

MR. GIBBONS. I think we all share your well-expressed concern. It seems to me, whether or not it works, it depends on whether we can go to work with what has been proposed to be done, and I think we will have a full measure of that in the weeks ahead with the closing down of some military bases and the enactment of a budget for fiscal year 1994, and all that goes with it.

MS. TYSON. Can I say one other thing?

I think it is important in thinking about what we are bequeathing to our children to focus on the debt and focus on the deficit as we have done, but also to recognize that these children who have to pay this debt, who have to deal with the excesses of the last decade, have to also be invested in. That is, we cannot in some sense say that there is such a debt, which, in order for us to handle this problem, we are simply going to retrench so dramatically that we retrench in education, retrench in training and retrench in civilian technology support. We don't give them a health-care system they can depend upon.

We will make these children less capable because they have fewer skills, worse technologies, worse health, worse prospects. We will make them less capable of paying the debt that they are going to have to pay. So we have to be very careful when we do this, to do it in a way that is gradual enough to give people who are currently entering the job market real opportunities, to give children who are currently entering schools and colleges real educational opportunities so that they can acquire the skills and wherewithal to help us pay back what we have borrowed from the future.

REPRESENTATIVE ARMEY. Well, it seems to me, Congressman Hamilton, that is really what this great debate is about, this great public policy debate: Will the opportunities for those children be created in the private sector or will they be created by the public sector? And, in that regard, I fall back on my Armey's axiom number one: The market is rational. The government is dumb.

It scares the death out of me to see more government afoot in America. I am sorry, but I just don't see a great empirical track record. They haven't been sinking these three pointers with public initiative.

REPRESENTATIVE HAMILTON. Congressman Wyden.

REPRESENTATIVE WYDEN. Thank you, Congressman Hamilton.

First, let me say, because this hearing is focusing specifically on technology, I want to make sure that the Committee, and also people listening on C-SPAN, don't lose the central point of what you are saying—and it is one that I commend you very much for saying—and that is that what you both want to make sure we do in the technology area is to not go out and say, we will just go spend more of the taxpayers' scarce resources.

But, in fact, what you have told Congressman Hamilton and me on the health care issue is that the challenge is to spend it more wisely and to spend it differently, and I commend you for that, because my sense is that a lot of what we need to do in the technology area doesn't cost more money.

Motorola, for example, told me a horror story about theirs. They are trying to do technology transfer. They spent a year trying to negotiate a tech transfer agreement because the government didn't have any real standards.

Mr. Gibbons told me a few minutes ago that he was interested in having some real standards for the laboratory managers as a method of evaluating them. That is not going to cost more taxpayer money. It is not going to cost more taxpayer money to say that one of the criteria in evaluating whether a lab survives is whether they do tech transfer.

So I thank Ms. Tyson and Mr. Gibbons. In the course of this whole back-and-forth, I want to make sure that the message does get out that you all are not saying, hey, we are going to throw a lot more taxpayer money at these important issues, but our first challenge is going to be to spend it more wisely.

Now, the area I wanted to move into on this round that we have, which hasn't really been touched on, deals with telecommunications.

There is, as you know, a massive restructuring and shake-out going forward in the telecommunications industry. My sense is five years from now the telecommunications sector is going to be dramatically different. It will be like the difference between horse and buggy and space travel. It will still be called transportation if you talk about a horse and buggy and space travel, but in five years telecommunications is going to be experiencing the same sort of dramatic changes.

I think it would be helpful to know what the Administration intends to use as the key principles that are going to govern this huge forthcoming sea change in telecommunications, and how those principles might address this matter of productivity. I am much more interested in the principles that the Administration is going to use, rather than just your ideas about whether one regional phone company or another survives. I would be much more interested in understanding what theory the Administration is going to use as it tries to shape this telecommunications revolution and how it can help the economy. Ms. Tyson?

Ms. TYSON. Well, I think there are three principles I can think of—maybe Mr. Gibbons can come up with some more. The first is the recognition that the process of moving towards an advanced telecommunication systems will be primarily a market-driven process, and primarily the very expensive investment in infrastructure will be financed by the private sector.

When we talk about fiber optic networks or information superhighways, this is going to be a major challenge and opportunity for the private sector. It is a market-driven opportunity.

With that in mind, it seems to me, a critical thing that the government can do is to work to make sure that its regulatory policies encourage competition rather than discourage competition. There are a number of competing potential providers of these services, and I think we need to focus our attention on how best to adjust our regulatory procedures and guidelines so that we encourage as much competition as possible. That is the second principle.

A third principle arises when the government can play a role in addition to making sure its regulatory system is efficient. And I would say that boils down to two parts. One is to think about generic technologies. And we have a successful program here. Again, we have some successful technology support programs. The high performance computing initiative is widely considered to be one of them. The notion is that there are some generic technologies that really can benefit: Whoever ends up being the competitive winner in the marketplace will benefit from this technology support.

And then, second, large users of sophisticated information systems are developing private networks, and they are doing very well. There is the issue of whether or not there are certain public-sector activities, particularly education activities or education and research related activities, which might be better able to key into some of these networks. And that is why we have proposed spending some money on projects that would be demonstration projects, showing how a library system or a public education system might better link into these highways, and then that would show some market opportunities to the private sector to come in and provide that service.

So those are the principles. It is primarily market-driven. We have to worry about our regulatory approach, and then we have to do things at the margin to encourage the development of this network.

MR. GIBBONS. I could add very little to that. I think it was a pretty complete statement.

One of the roles of the public sector in assuring competition and the most productive open running field for the private-sector decisions is to assure not only competitiveness but along with that inter-operability of systems so that you truly do have a competitive and accessible infrastructure.

And I think the notion of the demand-site pull is an important thing. Namely, there are a number of public-sector potential uses of this technology, in addition to the private-sector uses, and the most appropriate role for government is to try and help understand what those uses are, in terms of the increase of the efficiency, productivity, user friendliness of public-sector activities, which include the delivery of government services, Social Security checks, IRS, other things, law enforcement, schools, health care, libraries and the like. These are all areas that, with public support, can deliver major public benefits.

And the role of government, it seems to me, is to help by case studies, by investments, by other mechanisms, to explore just what one can do there and then let the market develop it from that.

REPRESENTATIVE WYDEN. I think that is a thoughtful assessment, and I think I want to ask about one other item, with the time being short.

I would just hope that in the telecommunications area, you also portrayed on that matter as it relates to those principles. I know in our part of the world—U.S. West, for example—a state-of-the-art regional phone company has been trying to get into all these emerging democracies. One of my colleagues said that it is pretty hard to set up a democracy when you can't get a dial tone. Somebody is going to sell these telecommunications systems, and unfortunately there have been a lot of barriers that have kept us from getting there.

The last question I wanted to ask on this round deals with this matter of how we allocate again scarce resources: The point you made, Ms. Tyson, about not spending more money but spending it differently.

At this point when you talk about the Federal Government and science and technology, it seems that we have most of the eggs really in two baskets. One is in the space station and the other is in the area of the supercollider.

I think, in an ideal world, you would love to have these projects. I don't see how anybody could possibly oppose these projects if you had the resources to do it. But I and others are pretty skeptical about whether or not we can have these at a time when we are trying to drive down the deficit and open up these expanded, technology-driven programs that could help so many more small businesses.

My question to you, Ms. Tyson, is, has there been any analysis to show the comparative benefits, for example, of the space station and the supercollider, relative to how those dollars might be used, say, for the kinds of programs that could help the entrepreneurial sector, the small businesses and the kind of businesses that predominate my district, and I guess my colleagues' as well?

Again, I am mostly interested in comparative analysis. No one disputes that these projects have benefits. They do. But I am curious about what the comparative analysis of what those projects produce relative to other projects might indicate, particularly ones involving small business.

Ms. TYSON. Well, I do not myself know of a comparative analysis along those lines. Maybe, Mr. Gibbons does.

I would say that we have made proposals in both of those areas, which are, of course, significant scalebacks from what was originally budgeted in and projected out. Both projects, I think, have very strong statement justifications which you alluded to. I am sure you know this, so I don't really have to go through them.

It seems to me in a very tight budgetary situation that we confront, we have to make adjustments. And, in this case, I think we have tried to come up with a balanced adjustment, saying that the projects are important enough to our scientific employment, international cooperation, and futures to maintain, but we must maintain them on a different trajectory because of our budgetary concerns. That is really where we have come down.

As far as whether or not there could be a comparative analysis, I am not sure there could be one because of the nature of these technology programs. I was thinking about how one would do what you asked. And you said, well, could we say that they are more worthwhile than entrepreneurial programs in my district or in anybody's district?

We don't know what programs they are. We believe that the supercollider would lead to scientific information which could be the basis of all sorts of private-sector activities.

The same is true with the space station. In the development of subcontractors and contractors who are working on this project, and scientists and engineers who are working on this project and who are supported by this project, again, you have this notion of spillover. You cannot say with any degree of certainty what the outcomes for the private sector of these projects will be, though you know that they are supporting science and research throughout the private sector. So it is very hard to do the kind of analysis that you would suggest.

REPRESENTATIVE WYDEN. Mr. Gibbons, your thoughts on this?

MR. GIBBONS. Recently, there was a monograph put out by the Carnegie Corporation on science, technology and national goals, which I had the pleasure of participating in. And it spoke to the very dilemma you speak of; namely, the relationship in the overarching way between our science and technology, our research and development enterprise and those goals that could be articulated as representing national goals of safety, well-being, environment security, and the like.

And it is easier to talk about this than it is to quantify it or put it into very explicit terms, but it seems to me that it is the kind of dialogue that does need to be continued. The President has asked the Office of Science and Technology Policy to take a look at the federal R&D budget which is a little over $75 billion a year, and ask how well does that relate to what one might describe as our overarching national goals.

The first look at it is a little unnerving in that you see the R&D budget is totally dominated still by the defense community. I think the second largest has to do with nuclear weapons. The third is probably the space station. And then maybe health comes down around fourth when you get pretty far down the curve. And you ask, how well does this reflect our national goals? And I think a very interesting public dialogue can and should ensue over that.

When you inherit large projects such as space station or supercollider that have been under way for a number of years, it is very traumatic to try and turn

these things around instantaneously. We are trying to deal, in other words, with things now that have a decade of momentum behind them.

Some of them are excellent science, such as the supercollider, but a very expensive project that tends to draw resources from other places, and unfortunately that is a project that was couched as a national venture rather than part of an international consortium, which I believe it should have been in which the costs were shared by our global participants. So what we have done in the supercollider is to try and stretch that schedule out, in part to give time to draw it into an international venture.

In the case of the space station, it is truly an international undertaking. Our several partners are investing billions of dollars in this process.

To give you one of several examples of why it is a situation where you simply can't safely turn around and walk away from, so the President in this case, as you know, undertook a study with independent expert observers to try to see what we could do in holding on to the best that was there, and at the same time downscale the project so that the investment wasn't so heavy, and yet at the same time not have the economic-regional economic impacts of a change of course to multiply the already difficult readjustments that are going on from defense conversion.

So, when you inherit things that have been going on for a decade or more, you simply can't turn them around that fast, but we are very much concerned about the relationship between that overarching set of goals that we might articulate as a people and how well that is matched by our R&D enterprise. And, I think, as a consequence of that, we will see some changing priorities appearing in our 1995 budget and even more in the 1996 budget.

I anticipate that substantial changes will come out of this if, in fact, the public agenda reflects this kind of thinking about matching up our R&D enterprise to something that has a larger measure of national interest.

REPRESENTATIVE WYDEN. I appreciate your comment, and my time is up.

I would tell you that I think that kind of analysis is going to have to be done, or you are not going to be able to make the case for these projects. Because I know in my district people are doing that comparative analysis. The people who come to my town hall meetings are saying that what they need are trained, educated workers at their small business. That is what they need more than anything.

There is a comparative analysis right there being done in a small business, say in Gresham, Oregon, in my district, and those citizens are clearly making the call. They are saying, use those very same dollars, again reallocating spending not more spending, for making sure that skilled educated workers who know how to handle a computer network or a database and can show up at the work site, rather than on something that, Mr. Gibbons —and you are always so diplomatic—may have great regional implications, but may not produce the kind of productivity that we want for the long term.

I appreciate it. Thank you, Congressman Hamilton.

REPRESENTATIVE HAMILTON. We have had a very good hearing, and all of us have a lot more questions for you, but you will be glad to learn that we also have commitments to make, and so we are going to have to conclude the hearing.

I want to express my appreciation to you and ask, Ms. Tyson, to comment on only one other item if you would.

You may not have had the opportunity to read this month's *Atlantic Monthly*, but there is an interesting article there. It is called, "It's Not the Economy, Stupid." And it is written by Charles Morris, whom I do not know. Let me just quote a few sentences to you, and then I want to get your impression of him.

He said:

> I will argue that, he—President Clinton—won on a false issue and that the main criterion on which our presidential elections have come to be decided, managing the economy, is a sham. The assumption that the President manages the economy is the core of prevailing political wisdom.

I am just reading various quotes here.

> The fact is, presidential elections have become referenda on the business cycle. Modern political campaigns, however, are fought on the premise that Presidents can manage the economy, that they can take detailed actions that have precise results such as raising productivity, reducing unemployment or increasing investment. In that sense, how much control do Presidents really have over the economy? The answer is very, very little.

How do you feel about that?

MS. TYSON. Well, I did pick up the *Atlantic Monthly* yesterday in the airport when I was driving a small child back to go to California. I did not get a chance to read it, but I did see that it was an important article to read.

REPRESENTATIVE HAMILTON. The question is really how much do presidents manage the economy?

MS. TYSON. I think presidents can change directions.

I will just go back to the theme that has come up again and again. We are trying to change directions in technology policy and also in the deficit situation. In the post-World War II era, in the aftermath of World War II, we set up a very important science and technology base in the United States, based on a set of geopolitical missions associated with the Cold War. We put in place a series of institutions and policies which have served us very well as a Nation, in terms of our geopolitical objectives and in terms of supporting science and technology.

We are at a turning point in our history. The Cold War is over. We are going to scale back our military commitments one way or the other. We are going to, therefore, scale back our funding for research and development through that channel. We can chose to just scale the whole thing back. We can say the Government of the United States will no longer support science and technology to the extent that it has in the past 40 years, or we can say let's do it a different way.

This is a critical moment. A President can have a real effect because we are at a moment of change.

The issue of deficits, again, just look at the numbers. Do you ask, if you look at the postwar period, when did debt start to rise? When did the deficit start to explode? It is in the early 1980s. You can see that clearly in any chart, however you want to put it together.

I think we are at a critical juncture. We cannot have another decade where the debt is growing at the same rate. We cannot have another decade where we do not get the deficit under some serious reduction relative to the size of the economy.

So we are at a moment when a President can really make a difference. This is a difference in terms of changing the course for the Nation in the two fundamental ways that we have discussed today. That does not mean that something a President does today will have an effect on the economy tomorrow or in the next 24 hours, or 48 hours, or three months, or six months.

REPRESENTATIVE HAMILTON. Or four years.

MS. TYSON. I would say in a period of four years, yes, you can get the deficit in a different trajectory. You can get a health-care system on a reform path which would be fundamentally new for the country, and you can get technology policy shifting again from its military orientation to a civilian orientation.

REPRESENTATIVE HAMILTON. Well, we can come back to a number of these things. We are grateful to you for the opportunity to have a chance to question you.

I think Congressman Armey wanted to make a statement.

REPRESENTATIVE ARMEY. Thank you, Congressman Hamilton.

I think an equally intriguing question would be, as we see it, to what extent can the President make public policy? But that is another question.

I want to personally thank both our witnesses, Ms. Tyson and Mr. Gibbons. This has been, for me, a very rewarding, encouraging morning.

And I want to also thank you, Congressman Hamilton. It has been my experience over these two-and-a-half years that I have been privileged to be on this Committee, that every time you chair a session of the Joint Economic Committee, it rises to its real potential as a committee, and I want to thank you personally for that. You chair sessions in such a way as to make the Committee perform as it was assumed it should when I tried so hard to get on it. You have made my day. Thank you.

Thank you all.

REPRESENTATIVE HAMILTON. Thank you and our thanks to the witnesses. We stand adjourned.

[Whereupon, at 12:37 p.m., the Committee adjourned, subject to the call of the Chair.]

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SUBMISSIONS FOR THE RECORD

PREPARED STATEMENT OF REPRESENTATIVE RAMSTAD

Mr. Chairman, I am pleased to have Drs. Tyson and Gibbons with us this morning to discuss one of the most important issues facing our economy — the development and marketing of technology.

I must say I am extremely concerned that today's tax and regulatory environment makes it increasingly difficult for the technolgy-driven companies in this country to continue to innovate and compete.

And President Clinton's tax proposal — the largest tax increase in history — will only exacerbate the current situation. You simply cannot expect to stimulate innovation and economic growth by taking hundreds of billions of dollars worth of capital out of the productive private sector to finance further government expansion.

I read with great interest the Administration's publication, "Technology for America's Economic Growth, A New Direction to Build Economic Strength," prior to a Small Business Committee hearing last month with Dr. Gibbons.

While I certainly applaud President Clinton and Drs. Tyson and Gibbons for their recognition of the importance of technology to the economy, I have fundamental reservations about the government-directed, government-funded industrial policies outlined in this proposal.

Private capital — not taxpayer money — is the appropriate financing mechanism for research, development and marketing of new technologies. And individuals and businesses — not bureaucrats and politicians — are best equipped to make sound and efficient investment decisions.

That's why the "technology policy" I support differs dramatically from the Clinton Administration's proposal to put the government in charge of innovation and why I feel the proposal does not address the fundamental problems facing our high-technology companies.

Government doesn't innovate and doesn't create jobs — small businesses do. We all know that small businesses provide 85 percent of all new jobs in this country, but according to the SBA, small businesses also provide about 2.4 times as many innovations per employee as large firms.

Instead of increasing the government's control of high-tech industries in our economy, we must reduce governmental obstacles — taxes and regulations — to private-sector initiative.

Lowering taxes to reduce the cost of capital is an essential component of promoting a strong technological base.

I refer you to a column, which I ask permission to enter into the hearing record, published in the *Wall Street Journal* in April. It was written by an entrepreneur, T.J. Rodgers, who built Cypress Semiconductor from a one-computer company to a corporation that has, in its 10-year history, generated over a billion dollars in cumulative revenue, made more than $160 million in profits — on which it paid $60 million in taxes — created 1,500 jobs and paid cumulative salaries of nearly $500 million, on which employees paid taxes of $150 million.

Rodgers' column, entitled "What Silicon Valley Needs from Clinton," rejects the President's call for subsidizing high-tech companies. Instead, he urges the President to improve the financial infrastructure by increasing the supply of capital by reducing federal spending and decreasing the capital gains tax — not by creating government-funded research programs.

Murray Weidenbaum of the Center for the Study of American Business urged similar action on "technology policy" in the *Harvard Business Review* a year ago. He wrote, "The availability of capital to develop technology is another crucial element. During the 1970s and the early 1980s, venture capital fueled entire new industries, such as

semiconductors and biotechnology. Over the past five years, venture funding has steadily declined." We all know the capital gains tax rate was reduced in 1978 and raised again in 1986. There should be no question about the correlation between the availability of capital and the taxes imposed on capital gains.

The other main issue facing high-tech companies is excessive government regulations. A perfect example of overregulation involves several of the so-called Medical Alley companies — over 500 medical-related companies — located in my district of the Twin Cities area of Minnesota.

One of these companies, Medtronic, developed the first wearable external cardiac pacemaker in 1957 and manufactured the first reliable implantable pacing system in 1960. Since the Medtronic has been the world's leading producer of pacing technology. Earl Bakken, the founder of Medtronic, has often said he could not start Medtronic in today's regulatory environment.

Other biomedical companies in my district have told me chilling stories about the bureaucratic hoops they are made to jump through to get approval from the FDA for their products. I hear regularly about instances where the FDA was supposed to review proposals within 90 days, but after 300 days, companies are still waiting for an answer. Government regulations that make it difficult for companies to predict when they might take a product to market literally make it impossible to attract investors and sustain the innovative, job-creating enterprises that should serve as the foundation of our Nation's economy in the next century.

When government agencies adopt such an adversarial stance, companies are literally regulated out of business — and the American public suffers. Loss of innovation through overregulation will have a direct impact on the health of our economy and our citizens.

Mr. Chairman, I am very much looking forward to today's testimony. I know Dr. Gibbons is genuinely interested in stimulating technological development, and I welcome this opportunity to dialogue with him and find out exactly what the Clinton Administration will do to maintain a vital and growing technological sector of our economy.

What Silicon Valley Needs From Clinton

THE WALL STREET JOURNAL MONDAY, APRIL 12, 1993

By T.J. Rodgers

My company, Cypress Semiconductor, makes data-communications chips used in electronic superhighways, memory chips for supercomputers, and microprocessor modules for massively parallel computers, a kind of supercomputer. It might appear that we would benefit greatly if billions of taxpayer dollars were showered on various technology projects favored by the Clinton administration. But such subsidies will hurt our industry. Why? Because it is impossible to separate the Clinton technology program from the administration's broader "tax-and-spend" economic plan. And "tax-and-spend" programs can't help businesses, including mine.

The administration would have us believe that the business leaders of Silicon Valley stand unanimously behind it. But many of us disagree with the proposition that the right way to enhance America's technology leadership is to increase taxes to finance government mega-programs—even if the mega-programs support technologies being developed by those companies.

There is a second dangerous misconception in the president's economic program—it preaches the politics of envy. Yes, the White House tells the American people, we plan to increase spending by hundreds of billions. But we plan to spend that on "you." Even better, "they"—the bad guys—pay for it. To describe the "bad guys," politicians offer caricatures—images of Michael Milken and Ivan Boesky defrauding investors. Who wouldn't want to tax such "excesses of the 1980s"?

A Success Story

So please allow me to introduce myself—I am an excess of the 1980s. Through Cypress, I became a paper millionaire in the 1980s—eight times over, in fact.

How did I profit? I started a company in Silicon Valley. I obtained stock in that company when it had one employee (me) and one used computer. Over its 10-year history, Cypress has generated more than $1 billion in cumulative revenue, made more than $160 million in profits on which we paid $60 million in taxes, created 1,500 jobs and paid cumulative salaries of nearly $500 million, on which our employees paid taxes of $150 million. All our employees own Cypress stock.

I am a person of simple tastes; therefore, I still have most of the wealth associated with my Cypress shares. What have I done with that wealth? I invested it. In fact, I invested it in precisely the kinds of companies on which the administration wants to shower taxpayer subsidies—the world's most advanced competitors in fields such as semiconductors, biotechnology, software, networking, environmental sciences and health care.

Nearby is a list of some 100 companies in which I hold investments through my participation in three venture-capital funds. Eighteen of those companies are innovators and leaders in high-speed data communications. Other companies are innovators in the field of high-performance computing.

Every incremental dollar that Washington takes from me comes directly out of my investments in these companies. Under a higher tax regime, I cannot sell my house or car. But I am going to invest less. After all, the cash to pay my higher taxes has to come from somewhere. Essentially, the administration is arguing that by taking my money in the form of higher taxes and "investing" it in subsidies, it can make better investments than the venture-capital firms with which I invest—firms that are already the envy of Japan and Europe. That logic defies common sense.

The Clinton plan also raises taxes on Cypress as a corporation. Suppose, as a result of the plan, that Cypress's corporate taxes increase by $1 million next year. As chief executive, my only choice is to take that money directly out of R&D—our lifeblood. A tax increase of $1 million means that Cypress will employ 10 fewer Ph.D. technologists than it would otherwise.

The third misconception in the Clinton plan brings us directly to high technology and high-performance computing. It is the proposition that the best way for good ideas to become marketplace realities is for government to subsidize them.

What *does* work, then? The free market. Today, in industry after industry—semiconductor chips, computers, biotechnology—U.S. companies lead the world or are demonstrating remarkable comebacks. American performance has relied on the invisible hand while Japan and Europe have relied on government targeting and subsidies. To see the drama in this, think back to just five years ago, when America was in a panic about the Japanese government's high-definition television program, or HDTV. Today, everyone agrees that it was a multibillion-dollar flop and that America has won—thanks to the messy, uncoordinated innovations of many private companies. We also lived in fear of the Japanese Fifth Generation Computer Project. "Tron" was going to walk, talk and eat our lunch. It too failed.

Or think about Europe. Amazingly, we still have "experts" who want us to emulate its alphabet soup of technology consortiums such as Jessi. Europe's equivalent of the U.S. chip consortium Sematech. Jessi showered billions on the European semiconductor industry. It also "rationalized" the industry by allocating market segments to various companies. Siemens became the DRAM (dynamic random access chip) company for Europe—and has since gone out of the business. Philips became the SRAM (strategic random access chip) company for Europe—and has since gone out of that business. Today, there is no major European chip industry or computer industry to speak of—thanks to the role of programs like Jessi. In the U.S., Sematech itself sometimes slowed the progress of the semiconductor industry.

The new administration's programs represent the same kind of misguided industrial policy. For example, the administration proposes big spending increases on a range of projects to speed creation of the "data superhighway."

The trouble here is that multiple, competing data highways are already being built by private companies across the U.S. Entrepreneurs are racing to develop new networking systems, new software interfaces, new value-added services. MCI, AT&T and Sprint already have three independent, coast-to-coast, fiber-based long-haul networks. The real issue is extending those networks into the home. The role for government in this is to untangle bureaucracy and regulations that prevent companies from hooking up the "last mile" of fiber to the home. For example:

- The regional Bell operating companies would gladly hook fiber optics from the long-haul network to the home. But they are prevented from doing so by regulations that make the huge capital investments uneconomical.
- Cable operators are already hooked into 60% of American homes. They too could make the connection with existing long-haul data superhighways, but they are prevented by regulations that declare them a "natural monopoly" and restrict them to the TV and movie business.
- The long-haul superhighway could be hooked to the home through wireless circuits. But the frequencies required are currently being held up by the Federal Communications Commission.

The most constructive thing the Clinton administration can do involves improving infrastructure—not roads and bridges, or even data superhighways, but financial infrastructure. The scarce supply of reasonably priced capital deprives companies of the chance to build manufacturing muscle and create jobs.

The first step is to make more dramatic spending cuts than the ones the Democrats plan. Boeing recently announced plans to dismiss 20% of its workers. My company recently took the painful step of dismissing 20% of our workers to become more efficient. By contrast, administration plans to eliminate 100,000 federal jobs over the next four years—only 5% of a total work force of two million—do not look particularly significant.

What Is Needed

To impose true spending discipline, Congress must pass a balanced-budget amendment and approve the line-item veto. Washington should also restructure the capital-gains tax to encourage long-term investment. The Clinton administration has proposed a modest reduction in the capital-gains tax that is targeted to tiny companies. The proposal is good political symbolism, but it does not address the problems of entrepreneurs. It focuses on start-up companies, while many difficulties begin at the next stage, when a company needs that second or third $10 million to build a plant and acquire real manufacturing muscle. This stage is when young companies must turn to the public capital markets—or to cash-rich foreign operations eager to acquire valuable American technology at bargain-basement prices. The best way to reduce the serious barriers to progress is to enact a sweeping restructuring of the capital-gains tax.

To discourage unproductive speculation, and fend off charges of creating a "tax break for the rich," we should at the same time increase taxes on assets held less than six months. We should eliminate capital-gains taxes on assets held for more than three years, assets that help build America. Assets held between six months and three years should be taxed at the current income-tax rate.

America has plenty of work to do on the economic problems we have created for ourselves—problems that trace their roots to fiscal recklessness. Ultimately, though, the economic battles of the 1990s will be won in America's factories, labs and offices—not in the halls of Congress or the corridors of the Commerce Department. America's entrepreneurs have the guts, brains and drive to beat the best the world has to offer. All we need from Washington is the confidence to let us fight.

Mr. Rodgers is president and CEO of Cypress Semiconductor Corp., based in San Jose.

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PREPARED STATEMENT OF THE HONORABLE LAURA D'ANDREA TYSON
CHAIR, PRESIDENT'S COUNCIL OF ECONOMIC ADVISERS

Technology Policy

I would like to thank you, Mr. Chairman, and members of the Committee, for inviting me to appear before this Committee to talk about technology policy and the economic competitiveness of the United States.

There is a popular perception that the United States competitive position is and has been weakening for some time, and that we have allowed our economic leadership to erode. As we shall see, this perception is partly supported by economic trends of the last two decades.

However, let me start with the good news first. Today our standard of living is the highest in the world; higher than such formidable competitors as Japan and Germany. We are also the most productive economy in the world. According to calculations by BLS, GDP per worker, the broadest measure of productivity, is nearly 26 percent higher in the United States than in Japan and over 10 percent higher than in Germany.

Although our economy remains the richest in the world, economic growth has been decelerating for quite some time. Decade by decade, GDP per capita growth rates have falling from the 1950's to the present. Just as worrisome, GDP per capita has grown more slowly in the United States than in the other major industrial countries for nearly two decades.

The same trends hold true for productivity growth. The United States has suffered an overall slowdown in productivity growth since the 1970's, and it has had the lowest productivity growth among major industrial countries since at least 1960. Overall our productivity growth has been below one percent for the last 20 years.

Over time, the growth in real wages is dependent on the growth in productivity. As a result of slow productivity growth, real hourly compensation has increased by a mere 0.7 percent a year since 1973. If instead real hourly compensation had increased at 2 percent a year, an average worker would make almost $5.00 an hour more today.

So what can we do to reverse these trends? The first step is to define our goal clearly: national competitiveness is the ability of a nation to produce goods and services that meet the test of international competition while providing sustained increases in the standard of living of its citizens.

In the latter half of the 1980's the combination of a lower dollar and industrial restructuring made U.S. products more competitive in world markets. Our exports have more than doubled since 1985, and, once again, we have become the world's largest exporter.

Unfortunately, our improving trade performance has not translated into a higher standard of living for the average American family. Average real median family income fell in 1991, and was virtually unchanged from its 1978 level. For 13 years, real family incomes have stagnated, despite a large increase in the number of the two-earner households.

In the long run the generation of new knowledge and its translation into new and improved products and processes are the most important forces contributing to national growth. It is estimated that, in the 1980's, research and development contributed about 0.4 percentage point per year to the real GDP growth rate of 2.6 percent per year.

Technological change contributes to national competitiveness in two ways. First, new technologies drive productivity increases, which, in turn, allow companies to remain competitive even as they increase the wages of American workers.

Second, new technologies generate new products that compete on their quality and innovative features, not just on price. Companies that compete on innovation are often able to capture large shares of lucrative markets.

As a result of technological change, we can compete on the basis of higher productivity and superior products, rather than on the basis of low prices driven by low wages. The latter is a recipe for declining standards of living and national competitiveness.

It is not surprising that jobs in high-tech industries pay better than the rest of the economy. In 1989 average annual compensation in high-technology industries was 22 percent higher than in all of manufacturing. If we focus purely on production workers, that is excluding most white collar scientists and engineers, average compensation in high-technology firms was 15 percent higher than in manufacturing as a whole.

Although scholars have only an imperfect understanding of the process of technical change, there is widespread agreement that spending on research and development encourages innovation. There is also widespread agreement that private market forces alone will result in too little funding for R&D, because not all of the benefits from R&D will accrue to the company that finances the research. The benefits spillover to other producers and consumers.

As a result of spillovers the social returns to R&D far exceeds the private returns. Private returns have been estimated to be very high averaging 20 and 50 percent, compared with 8 percent, the rate of return on plant and equipment, and 10-12 percent, the private return on investment in education. According to a recent survey, the social rate of return to R&D averages between 50 and 100 percent, which is 35 to 65 percentage points above the private rate of return.

Past government policy has focused on the support of basic science and mission oriented research. Although this approach has served us well in the past, it is time we adjust our policies to our new international environment. Our goal must be not only to continue to be the world leader in innovation, but also to translate those innovations into successful products that are sold in the market.

Throughout the Cold War, the bulk of federal spending on R&D flowed to military research. At that time the applicability of military technology to civilian uses meant that our military preeminence translated into technological superiority. With time, however, the magnitude of these spillovers has diminished because technological advance is being driven by commercial applications rather than military ones in areas such as biotechnology, semiconductors, robotics, artificial intelligence, and high definition television.

Over the last two decades the United States has had one of the slowest rates of growth in civilian R&D of all industrialized countries. Indeed, relative to our GDP we spend far less than Germany (2.7 percent) and Japan (3.0 percent) on non-defense R&D (US:1.9 percent).

We must, therefore, dedicate a larger share of federal R&D to commercial applications rather than military uses. Today, only 41 percent of our Federal R&D dollars fund civilian research. By 1998 we hope that federal support for civilian or dual use R&D accounts for at least 50 percent of the total federal R&D budget.

- Specifically, the Administration proposes expanding the Advanced Technology Program in the Commerce Department from $68 million in FY93 to $750 million in FY97. This program has been an example of successful government-business partnership because the program is driven by market considerations. Project proposals are submitted by private companies and chosen by scientific experts on their technological and commercial merits. The private sector picks the potential winners, and the government contributes a portion of the funds in order to share the risks and speed technological development and diffusion.
- In addition, the administration plans to increase the focus on dual-use technologies through the Advanced Research Projects Agency (ARPA), formerly called DARPA, which will have primary responsibility for most of the technology programs in the defense conversion package that congress passed last year.
- Congress has passed, and the president has signed into law an amendment to the National Cooperative Research Act of 1984, called the National Cooperative Production Amendment of 1993, that limits anti-trust penalties for firms that

undertake production joint ventures, thus encouraging industry consortia to advance critical technologies.

- The Federal labs at the Department of Energy, NASA and other agencies have been instructed to devote a larger share of their budgets to R&D partnerships with industry, through cooperative R&D agreements (CRADAs). Like the ATP, the CRADA programs ensure that these projects are partially funded and designed by companies so that the resulting technology is used to develop marketable products and processes.
- The Administration is committed to improving our national information infrastructure, which is composed of high speed telecommunications and computer networks. The purpose is not to displace the rapid and successful private sector efforts in this area. Rather the government's role is to support private sector efforts by formulating forward looking telecommunications and information policies that promote investment and competition. Specific measures include:
  - Reforming government telecommunications policy to keep pace with the rapid developments in telecommunications and computer technologies.
  - Increased support for the High Performance Computing and Communications Program to develop more powerful supercomputers, faster computer networks, and more sophisticated software.
  - An Information Infrastructure Technology and Applications Program to develop advanced computing and networking technologies for manufacturing, health care, life long learning, and libraries.
  - Networking pilot programs funded through National Telecommunication and Information Administration (NTIA) at the Commerce Department.
- Finally, a new multi-agency program has been established at EPA to fund the development and diffusion of environmental technologies. For FY94 the administration is requesting $36 million for this program. The market for environmental technology stands at around $200 billion and is projected to grow to $300 billion by the end of the decade.

As I noted earlier, not only do we need to innovate but we must also have the ability to commercialize our new developments. To that end, the Administration has several proposals:

- The creation of manufacturing extension centers, much like the agricultural extension programs, to help small and medium sized company's evaluate and adopt advanced manufacturing technologies. The Administration is committed to working with state and local governments and universities to create a national network of over 100 extension centers. In FY93 nearly 90 million was provided to support these types of programs as part of the defense conversion package.
- Regional Technology Alliances to promote commercialization and application of critical technologies by bringing in firms and research institutions in a particular region to exchange information, share and develop technology, and develop new markets and products.
- Expansion of the Small Business Innovation Research Program (SBIR) and the Small Business Technology Transfer Program (STTR). The STTR is provides grants to small businesses so that they can work with University and National Labs to move technology from the laboratory to the market place (FY94 funding $24 billion).

In order for firms to successfully innovate, specific technology programs must be supported by a general economic environment that is conducive to investment in both physical capital and human capital.

- Making the Research and Experimentation tax credit permanent will permit businesses to pursue R&D without fear of a sudden change in the tax law. In the past the credit has been extended periodically when it expired, raising the real possibility that it would not be extended, and in fact it expired during July 1992, and has not yet been reinstated. This uncertainty needlessly adds to the cost of a firm's

R&D project, which, in turn, could lead to fewer R&D investments by U.S. industry.

- Reforming procurement practices of the federal government to purchase new products based on leading technologies.
- The administration is committed to developing world-class education and training programs. Our long-term competitiveness depends on the skills of our workers to innovate, to use new technology, and to bring newer and better goods and services to the market place. For that reason, this administration has stressed the importance of improving our education system. A critical component of our technology policy is to achieve world leadership in basic science, mathematics and engineering.
  - A key component of the Administration's economic package is to make training accessible, especially for workers displaced by the rapid changes in our economic environment, ranging from the reorientation of our defense industries to pressures arising from international trade.
  - Expand the use of high-technology tools such as computers and distance learning in education and training.

As these programs demonstrate this administration is committed to working with industry to make sure that our nation is able to compete in the global economy of the next century. The government has an important role in providing our industry with the tools it needs: well trained and well educated people, as well as physical infrastructure. In addition, we are pledged to cooperate with our private sector to undertake the R&D that will generate the innovation that will propel our economy forward.

Thank you very much. I would be happy to answer any questions you may have.

PREPARED STATEMENT OF THE HONORABLE JOHN H. GIBBONS, DIRECTOR OFFICE OF SCIENCE AND TECHNOLOGY POLICY

Mr. Chairman, Members of the Committee, thank you for this opportunity to describe the President's technology initiatives and their potential impact on the economy. The technology initiatives, introduced February 22 in Technology for America's Economic Growth: A New Direction to Build Economic Strength, focus American technology on 3 central goals:

- Long-term economic growth that creates jobs and protects the environment;
- Making government more efficient and more responsive;
- World leadership in basic science, mathematics, and engineering.

We are moving in a new direction that recognizes the critical role technology must play in stimulating and sustaining the long-term economic growth that creates high-quality jobs and protects our environment. The traditional federal role in technology development has been limited to support of basic science and mission-oriented research in, primarily, the Defense Department and NASA. This strategy was appropriate for a previous generation, but not for today's profound challenges. We cannot rely on the serendipitous application of defense technology to the private sector. We must aim directly at our goals and focus our efforts on the new opportunities before us, recognizing that government can play a key role in enabling private firms to develop and profit from innovations.

I would first like to discuss the initiatives specific to the civilian economy. I will then describe our work on defense conversion–the effort to reinvest defense assets (people, technology, facilities) in the civilian economy to stimulate growth and economic strength. Finally, I will summarize initiatives designed to spur technological innovation and create a business climate hospitable to the opportunities presented by science and technology.

Technology Initiatives For The Civilian Sector

The technology initiatives encompass many efforts to directly aid companies developing new technologies. This represents a critical change of course for the United States. Compared to Japan and our other competitors, government support for civilian technology development has been minimal in the United States. Our focus has been on basic research and the development of technologies related to defense and space exploration, which have only indirectly led to new technologies for the civilian sector.

That is no longer sufficient. In many high-tech fields, foreign companies have either matched or surpassed the best American companies. In many cases, most notably in Japan, they have done so by working closely with each other and with their government to accelerate the development and application of new technologies.

The Administration intends to dramatically increase funding for development of civilian technologies over the next five years. Much of this new funding will go to small businesses, particularly start-up companies, which play a key role in developing and commercializing technologies.

The programs designed to strengthen industry-government cooperation and to provide more federal support for commercial R&D include:

1. Instructions to Federal laboratories run by the Department of Energy, NASA, and other agencies to devote a growing percentage of their budget to R&D partnerships with industry. These partnerships will be designed and partially funded by industry in order to ensure they lead to technology that will be utilized to develop new products and processes.
2. Dramatic expansion of the Advanced Technology Program. Established by Congress in 1988 and first funded in 1990, the ATP shares the costs with industry of R&D projects that are defined and led by industry and are selected through merit-based competition. ATP is funded at $68 million this year. In his vision statement of February 17, President Clinton set a goal of raising that amount tenfold by 1997. This increasing support for the Commerce

Department's industrial partnerships is an essential feature of the thrust to a more civilian-oriented Federal technology policy.

3. A new multi-agency program established at EPA to fund development and diffusion of new environmental technologies. The worldwide market for environmental technology is projected to grow from $200 billion today to at least $300 billion by the year 2000. We want to help American businesses capture as much of this market as possible. For FY94, the Administration is requesting almost $36 million for this program. Two-thirds of this funding would be for contracts with other agencies to develop and promote the use of new environmental technologies. Some of this money would be spent at Federal laboratories, but most of it would probably be awarded as competitive grants and contracts to industrial and university researchers working on leading-edge technologies.
4. Expansion of the Small Business Innovation Research (SBIR) Program. The SBIR program has been a real success, helping hundreds of small companies throughout the country take good ideas and turn them into new technologies and new products.

The Technology Initiative includes a number of different programs to accelerate the commercialization and use of new technologies, including:

1. Regional Technology Alliances, to promote the commercialization and application of critical technologies by bringing together firms and research institutions in a particular region to exchange information, share and develop technology, and develop new products and markets.
2. Manufacturing Extension Centers, which work in much the same way as the agricultural extension programs. Existing state and federal manufacturing extension centers managed through the Department of Commerce help small- and medium-sized businesses evaluate and adopt new, advanced manufacturing methods and technology. To date the Commerce Department has been able to fund only seven Manufacturing Technology Centers, which can reach only a small fraction of the firms that could benefit from their testing facilities and technology programs. However, over $100 million in FY93 funding was provided to support these types of programs as part of the defense conversion program established by Congress last year. The Administration is committed to building upon these programs and plans to work with state and local governments and universities to create a national network of over 100 extension centers.

Technology Initiatives For Defense Conversion

Defense conversion, broadly defined, is an integral part of President Clinton's vision for using science and technology as engines of economic growth. The President's technology initiatives call for a bold advance from the tradition that limited Federal support to mission-oriented research in defense and a few nondefense areas, mainly health and space. With the end of the Cold War, the biggest challenge for our country is no longer the threat of global military conflict, but the economic challenge to restore U.S. competitiveness and raise living standards for all Americans. We no longer need to justify government investments in technology solely on the grounds of military necessity. At least as important are government/industry partnerships to improve industrial performance and to serve critical human needs–health, education, environmental quality.

The technology initiatives reflect a two-fold–short- and long-term–approach to defense conversion. Much as we welcome the end of the Cold War, some of our people and communities are having a very tough time with the transition to a post-Cold War world. Workers and communities that have lost their economic lifeblood deserve first class help in the form of retraining, reemployment, and community economic redevelopment programs. The Clinton Administration's defense conversion package includes over $600 million in transition assistance, much of it directed to ex-service men and

women for education and career change opportunities. Help is also available to workers laid off from defense plants, and to communities affected by military base closings and cutbacks in the defense industry. But without healthy growth in the local and national economies, there is a limit to what even the best retraining and community redevelopment planning can do. In the long run, the best conversion strategy is the broadest–investment in programs that can promote technology advance, support the growth of high-performance, knowledge-intensive industries, and ultimately create high-wage jobs.

R&D programs that support dual use technologies have an important place in President Clinton's vision. He has announced his intention to shift from the present ratio in Federal R&D spending, which is 41 percent civilian and 59 percent military, to more than 50 percent civilian and dual use by 1998.

The Advanced Research Projects Agency (ARPA) has been given the responsibility for most of the technology programs in the defense conversion package Congress passed last year, which the Clinton Administration is now aggressively implementing. The package includes over $900 million in FY93 for investments in dual use technology. The Technology Reinvestment Project (TRP), jointly operated by ARPA and four other agencies, accounts for most of this–nearly $500 million in FY93. The TRP consists of programs to improve manufacturing engineering education; support industry-led-partnerships to develop technologies with the potential to become commercial products and processes within five years; fund regional technology alliances that encourage companies to share information and technology, and thus develop new products and markets; and support manufacturing extension programs run by States and universities to help small firms make better use of technology. All the programs require matching funds and merit-based selection. The most unusual feature of TRP is that the agencies are acting as a unit. They are accepting proposals for all the component programs at the same time, will evaluate the proposals together, and will parcel out management of each of the resulting agreements to the agency with the best capability and most experience in that field. This effort embodies a second goal of the President's technology plan–increasing government efficiency and responsiveness.

Fiscal And Regulatory Policies

While Federal technology programs are important, they cannot succeed unless coupled with government policies that encourage American businesses to develop and apply new technologies. Unfortunately, many of our current fiscal and regulatory policies stymie rather than encourage investment in new technologies and new products. The Administration intends to change that by:

1. Making the Research and Experimentation (R&E) Tax Credit permanent. In the past, the effectiveness of this credit has been undermined because it has been extended one year at a time. This means that companies cannot accurately project the real costs of a given R&D project. Research and development, by its nature, requires long-term investment, and businesses will be reluctant to make such commitments without a permanent R&E tax credit.
2. Reforming procurement policies. In many areas, Federal procurement regulations make it difficult for agencies to buy the most modern equipment and supplies. Because specifications are often written with existing products in mind, agencies cannot purchase a newer, superior product. An even larger problem is the reluctance of many companies to deal with the government, or the alternate tendency to segregate their civilian and defense operations, because of the heavy burden imposed by government recordkeeping, audit, and review regulations. These practices have cost the government dearly and our goal is to create incentives for companies to integrate their civilian and defense operations. As part of the National Performance Review, the Administration is looking at ways to be a better customer and thus encourage American industry to develop and market new technologies.
3. Encouraging patient capital. There are recurring concerns about the lack of patient capital for investment in new technologies. The Administration is

exploring a number of other ways to provide low-cost capital to enable both large and small companies to invest in new technologies. The private-sector Council on Competitiveness recently proposed a sweeping set of reforms to encourage long-term corporate investment. These proposals and others are presently being carefully considered by a multi-agency group working under the aegis of the National Economic Council.

Education And Training

Business leaders will tell you their companies' most important resource is their people. Productivity and profits depend upon having well-educated, well-trained employees. For that reason, the Administration is committed to helping all Americans have access to world-class educational and worker training programs.

Technology has a key role to play in this area. Computer software, computer networks, and distance learning are just a few of the tools that are being used to improve education and training. Unfortunately, many companies have not been able to take advantage of these technologies. The Clinton Administration believes the Federal government needs to do more with the development and application of cost effective technologies. For that reason, we intend to:

1. Expand access to the Internet computer network to connect more universities, community colleges, and high schools to each other and to a broad range of information resources. This will enable teachers at one college to teach courses at schools and colleges throughout the country. In addition, companies that connect to the Internet will be able to take advantage of education and training programs offered over the Internet as well. They will also be able to locate and use training software for their in-house training programs.
2. Create an interagency task force to (i) establish software and communications standards for education and training, (ii) coordinate the development of critical software elements, (iii) support innovative software packages and (iv) collect information resources in a standardized format and make them available to schools and teaching centers through the nation using communications networks.
3. Transfer some of the education and training technology developed by the military to the civilian sector so that it can be used in our schools, factories, and offices. Last year, the Navy Training Systems Center and the Army Simulation, Training, and Instrumentation Command together spent about $1 billion on training systems. The same technology they have developed to train engine mechanics could be used to train factory workers as well.

Information Infrastructure

The President has repeatedly emphasized the need to improve this country's infrastructure. Today, that means not only roads and bridges and airports, but also high-speed telecommunications networks and computer systems that form a "National Information Infrastructure." This National Information Infrastructure will soon provide almost all Americans with access to unprecedented amounts of information, when they want it, where they want it.

This infrastructure will enable dramatic improvements in education, health care, education, entertainment, and other sectors of the economy. For instance, using advanced networking technology, a doctor who needs a second opinion could transmit a patient's entire medical record--x-rays and ultrasound scans included--to a colleague thousands of miles away, in less time than it takes to send a fax today. A school child in a small town could come home and through a personal computer, reach into an electronic Library of Congress--thousands of books, records, videos, and photographs, all stored electronically.

Without this information infrastructure, American business will find it hard to compete in the 21st Century. Other countries are moving ahead aggressively to deploy high-speed telecommunications networks. Our companies need to have faster, better

access to information, which will enable them to make higher-quality products and provide superior service.

The information infrastructure will be built and run primarily by the private sector. But the government has a key role to play in: (1) working with industry to develop and demonstrate the technology needed for the information infrastructure and (2) formulating forward-looking telecommunications and information policies that promote competition and investment while ensuring the information infrastructure benefits all Americans. The Administration will use a number of mechanisms to implement the information infrastructure, including:

1. The High-Performance Computing and Communications Program established by the High-Performance Computing Act of 1991. Research and development funded by this program is creating (1) more powerful supercomputers, (2) faster computer networks, and (3) more sophisticated software, needed to help build the National Information Infrastructure. The Congress appropriated almost $795 million in funding for FY93 and the Administration is requesting a total of $1 billion for FY94.
2. An Information Infrastructure Technology and Applications Program to assist industry in the development of the hardware and software needed to fully apply advanced computing and networking technology in manufacturing, in health care, in life-long learning, and in libraries. This multi-agency program will involve the National Science Foundation, NASA, the National Institutes of Health, the National Institute of Standards and Technology, and other agencies. The Administration requested $96 million for FY94 for this effort.
3. Networking pilot projects through the National Telecommunications and Information Administration (NTIA) of the Department of Commerce. NTIA's Public Telecommunications Facilities Program will provide matching grants to states, school districts, libraries, and other non-profit entities so that they can purchase the computers and networking connections needed for distance education and for hooking into computer networks like the Internet. These pilot projects will demonstrate the benefits of networking to the educational and library communities. The Administration has requested $54 million for FY94.
4. Dissemination of Federal information. Every year, the Federal government spends billions of dollars collecting and processing information (e.g. economic data, environmental data, and technical information). Unfortunately, while much of this information is very valuable, many potential users either do not know that it exists or do not know how to access it. The Clinton Administration is committed to using new computer and networking technology to make this information more available to the taxpayers who paid for it. This will require upgrading computer systems at dozens of Federal agencies and development of consistent Federal information policies designed to ensure that Federal information is made available at a fair price to as many users as possible.
5. Reforming Telecommunications Policy. Government telecommunication policy has struggled to keep pace with new developments in telecommunications and computer technology. As a result, government regulations have tended to inhibit competition and delay deployment of new technology. Without a consistent, stable regulatory environment, the private sector will be hesitant to invest the hundreds of billions of dollars needed to build the high-speed national telecommunications network that this country needs to compete successfully in the 21st Century. To create a consistent Federal telecommunications policy, the Clinton Administration will create a high-level inter-agency White House task force which will work with Congress and the private sector to find consensus on issues like the Modified Final Judgment, spectrum reallocation, the cable television regulation, and the evolution of the Internet.

Nurturing The Seed Bed Of Technology

This testimony emphasizes the President's proposals to create a business climate more hospitable to technological innovation. I have also alluded to another goal the President has established for Federal science and technology programs: making government more efficient and more responsive. Before concluding my remarks, I would like, just briefly, to review the President's commitment to world leadership in basic science, mathematics, and engineering–the fields in which technology grows.

Our basic science program provides an ongoing sense of adventure and exploration while improving the knowledge base. It also lays the foundation for new technologies. The federal government has invested heavily in basic research since the Second World War, and this support has paid enormous dividends. Our research universities are the best in the world; our national laboratories and the research facilities they house attract scientists and engineers from around the globe. In almost every field, U.S. researchers lead their foreign colleagues in scientific citations, in Nobel Prizes, and in most other measures of scientific excellence.

None of the innovations in technology proposed in our initiative will be funded at the expense of basic science. Our budget proposal ensures that support for basic science remains strong and that stable funding is provided for projects that require continuity. We will not allow short term fluctuations in funding levels to destroy critical research teams that have taken years to assemble.

But stable funding requires setting clear priorities. In recent years, rather than canceling less important projects when research budgets have been tight, Federal agencies have tended to spread the pain, resulting in disruptive cuts and associated schedule delays in hundreds of programs. Improved management of basic science can ensure sustained support for high-priority programs

Conclusion

As you can see, the Administration has a comprehensive, pro-active technology policy that will provide huge benefits to American business. And by doing so, it will provide huge benefits to all Americans--in terms of new, high-paying jobs, a cleaner environment, and a higher quality of life for all of us and our children. I look forward to working with this Committee to ensure that our technology programs meet the needs of American business.

Thank you again for this opportunity to testify. I would be happy to answer any questions.

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