Testimony of
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Before the
Subcommittee on Oversight of Government Management,
the Federal Workforce, and the District of Columbia
Committee on Governmental Affairs
United States Senate
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Fair or Foul: The Challenge of Negotiating, Monitoring, and Enforcing U.S. Trade Laws

(With Additional Views on the State of the Manufacturing Sector and Policies To Address its Current Challenges)

Mr. Chairman and Members of the Committee, I want to thank you for holding this hearing on a subject of vital and timely importance to U.S. manufacturers. My organization represents over 400 leading manufacturing firms whose products range from basic materials to advanced manufacturing and leading-edge technology and associated services. The Alliance itself is primarily a research and executive education provider, but we do advocate public policies benefiting our member companies. Notwithstanding the support of our member companies, the views I will present today are mine alone and do not necessarily represent the unanimous opinion of our members.

I. The Importance of Manufacturing to the Domestic Economy

The subject of the hearing today is of vital importance to manufacturers for the simple reason that this sector is much more engaged in the global economy than the much larger services sector. When adding together both exports and imports of manufactured goods, the total equals 40 percent of total output in this sector, compared to just 6 percent for the rest of the economy. This proportion has doubled for the manufacturing sector since 1987. Altogether, manufacturing is about six times more engaged in global markets than the rest of the economy.[1] Over two-thirds of all U.S. exports are manufactured goods. U.S. manufacturing exports have more than doubled since 1990, but so have imports. As a result, over 80 percent of the U.S. trade deficit is in manufactured goods and that trade deficit is approaching 5 percent of gross domestic product (GDP) in the United States. In this context, secure, transparent, fair, and enforceable access to foreign markets is vital to the health of this sector.

Today I want to focus on what we think are the sources of strength in U.S. manufacturing, and then on some ways, including negotiating and enforcing trade agreements, the federal government

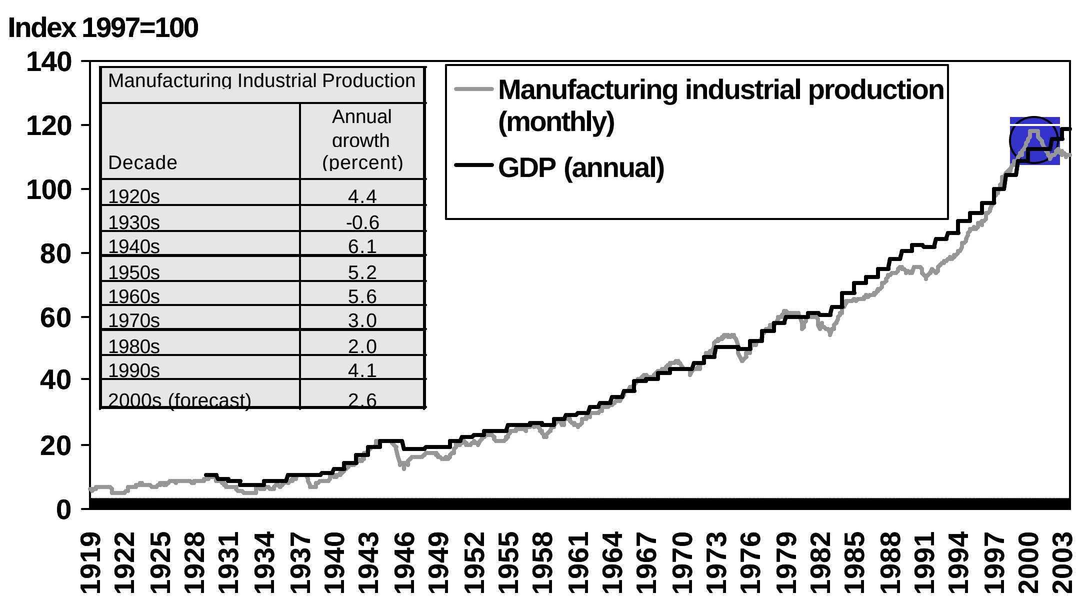
[1] This and other useful data about manufacturing can be found in The Manufacturing Institute, *The Facts About Modern Manufacturing* (Washington, DC: The Manufacturing Institute, 2003).

can play a constructive role in supporting the core strengths of this sector. Before turning to this discussion, I want to say a few words about the importance of manufacturing to the health of the domestic economy.

In many ways which became abundantly clear during the strong economy of the late 1990s, U.S. manufacturing remains the most important engine for growth in the United States—and indeed the global—economy.[2] Despite the prevailing view that this sector is in a state of irreversible decline, the quantity of manufactured output has grown about as fast as the rest of the economy for at least the last 80 years, as Chart 1 shows. In the 1990s, it grew ***faster*** than the rest of the economy. Moreover, this sector drives growth throughout the economy in a number of important ways.[3]

In the first place, producing a manufactured good requires more inputs, investment, transportation, and other services than for other sectors. According to the U.S. Department of Commerce, for every one dollar in sales of manufactured goods, another $1.43 in demand for intermediate products and services is generated. This compares to $1.22 for raw material extraction, 90 cents for transportation and utilities, 70 cents for health and education services, and 50 cents for financial and business services. All told, in the 1992-2000 expansion, manufacturing accounted for 22 percent of growth, even though it represents only 15-17 percent of value added in the economy.

Chart 1
Manufacturing Closely Linked to the Economy: Report of Its Demise Is Premature



Manufacturing Industrial Production	
Decade	Annual growth (percent)
1920s	4.4
1930s	-0.6
1940s	6.1
1950s	5.2
1960s	5.6
1970s	3.0
1980s	2.0
1990s	4.1
2000s (forecast)	2.6

Source: Federal Reserve Board

More importantly, the manufacturing sector is a primary source of innovation and productivity growth in our economy. Manufacturing accounts for over 90 percent of new patent approvals in the United States. Thanks to a strong commitment to research and development (R&D), efficient allocation of capital to new products, and an openness to change, it has been able to turn patents and research into money-making products valued around the world. Chart 2 shows the sources of R&D expenditures in the last decade. Two-thirds of R&D is now provided by private industry, a reversal

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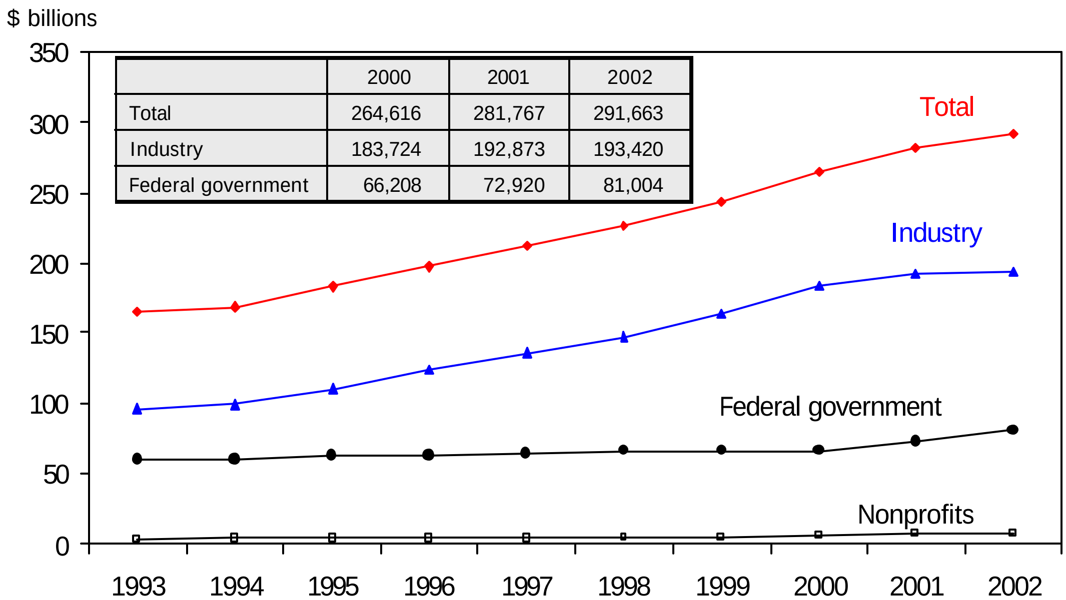
[2] We have developed this view at length in Thomas J. Duesterberg and Ernest H. Preeg, eds., *U.S. Manufacturing: The Engine for Growth in a Global Economy* (Westport, CT: Praeger Publishers, 2003).

[3] A good summary of this argument can be found in Joel Popkin: *Securing America's Future: The Case for a Strong Manufacturing Base* (Washington, DC: NAM Council of Manufacturing Associations, 2003).

from the 1960s when government provided nearly two-thirds of funds for this purpose. Another important development is the growing use of information technology (IT) throughout the economy. Chart 3 shows that investment in IT, including communications, is growing stronger as a share of the economy, especially when measured in real terms to reflect quality improvements.

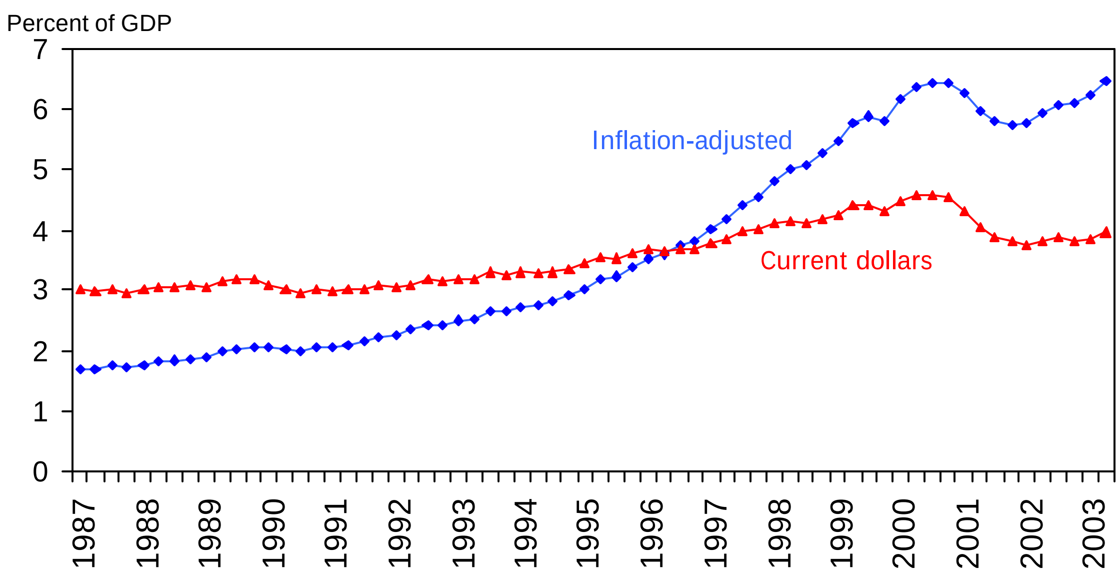
Chart 2
National Expenditures for R&D, 1993-2003



	2000	2001	2002
Total	264,616	281,767	291,663
Industry	183,724	192,873	193,420
Federal government	66,208	72,920	81,004

Source: National Science Foundation/Division of Science Resources Statistics

Chart 3
High Tech Investment is a Growing Share of the Economy



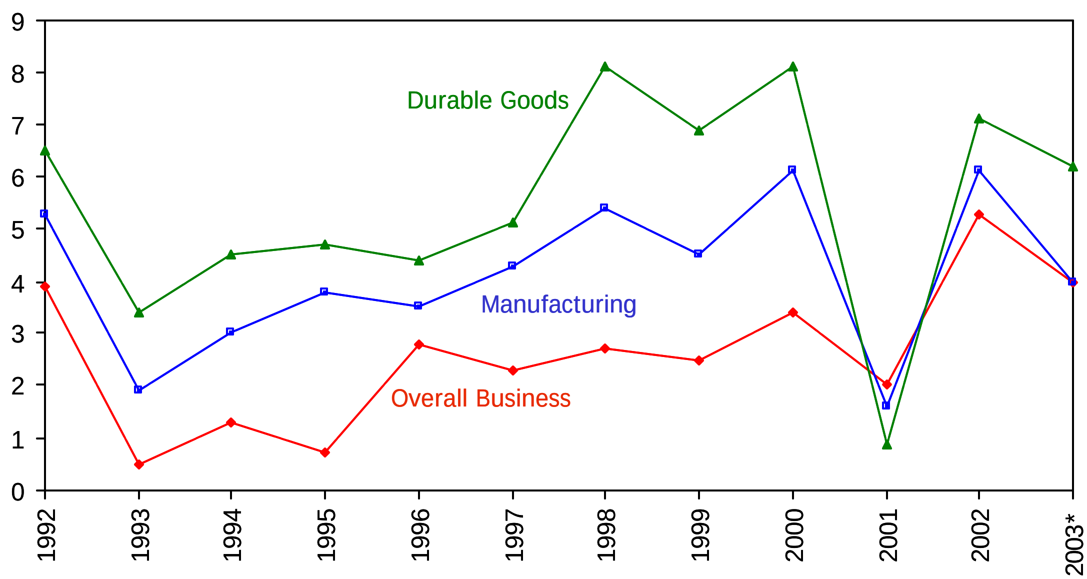
Source: U.S. Department of Commerce, Bureau of Economic Analysis

The use of IT has been shown to be a primary ingredient in enhancing productivity. The development and integration of IT products into the design of products, their production and maintenance, and into the services chain has been pioneered in the manufacturing sector. The commitment to research and innovation, and the widespread adoption of IT equipment and the associated communications networks it engenders, drives improvements in productivity.[4] Data (as shown in Chart 4) for the past ten years confirms that the remarkable renaissance in productivity is led by the manufacturing sector, especially the durable goods sector which is the heart of American manufacturing. In contrast, it is primarily the commodity-type production of consumer goods which has moved abroad.

Moreover, the productivity boom pioneered by the manufacturing sector is now spreading to the services sector. The IT equipment invested and integrated into production processes for goods is now being effectively adopted by associated industries such as wholesale and retail trade and transportation. Manufacturers often drive this process through such management innovations as lean manufacturing, which has in turn driven the development of demand-driven supply chains. Through these processes the customer is linked to producers and their supplies with real-time communications and tracking systems. Flexible manufacturing systems now permit retailers increasingly to customize production for things as diverse as jeans, cell phones, computers, and automobiles. The diversity and choice now enjoyed by consumers is unthinkable without the automated production systems, integrated supply chains, and real-time communications pioneered in the manufacturing sector.

Manufacturers are also increasingly using new technologies and associated management systems to assist customers in various ways that involve "services." Manufacturers are, in effect, becoming "solution providers" by integrating goods production with enterprise planning, supply chain integration, maintenance, and other related services. Better integration of the products and services sectors helps create more value and efficiency throughout the economy.

Chart 4
U.S. Productivity Growth, 1992-2003
(percent growth, year over year)



* First three quarters, 2003
Source: U.S. Department of Labor

[4] For a review of these linkages, see Jeremy Leonard, *The 1990s Productivity Acceleration Is Here to Stay* (Arlington, VA: Manufacturers Alliance/MAPI, 2003), Economic Report 556e, June 23, 2003.

Not only is innovation becoming a driver of growth in the modern American economy, but economists are increasingly emphasizing the substantial spillover effects of a vibrant, research-driven innovation machine.[5] Spillover benefits can come from firms using new products in innovative production techniques pioneered by other firms, from knowledge gained in one sector or product that can be used in others, and from "network spillovers" where "R&D benefits are enhanced in value by the development of a related set of technologies," such as occurred in the telecommunications industry with the advent of the Internet.[6] These spillover effects of course are magnified when the R&D and the firms that develop related new products and production processes are in close geographic proximity. Michael Jensen is well known for elaborating this theme through his work on "clusters," such as Silicon Valley, the biomedical research and development areas around Boston and Washington, and the automotive and machinery cluster in the upper Midwest.[7] Importantly for our purposes today, economic research also tends to corroborate the insight that production benefits from proximity to research, and vice versa.[8] This suggests that maintaining a strong, domestic research base is one key ingredient in sustaining domestic production.

The National Science Foundation (NSF) notes three main reasons culled from economic research showing that high-technology industries are important to any nation.[9] Research-intensive firms lead in innovation, allowing them to capture the benefits of first movers, especially when protected by patents, copyrights, trademarks, or other intellectual property protections. Innovative firms tend to use resources more productively as well. Second, technology-driven firms develop the types of high value added products which ". . . are successful in foreign markets . . ." and support higher levels of pay for employees. Finally, industrial R&D benefits other sectors, such as financial services, transportation, and wholesale and retail trade, by perfecting products and processes which enhance productivity and create new jobs.

Finally, manufacturing jobs on average pay more than the average in the private sector and generate good jobs for both highly educated and technically educated workers. The remarkable dynamism of manufacturing pays dividends to the entire society through productivity gains and the lower prices which are the result of these advances. Chart 5 gives some recent data showing that the higher level of manufacturing wages has continued even in the recent double-dip manufacturing recession, which was the most severe in this sector since the Great Depression.

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[5] See William Baumol, *The Free Market Innovation Machine* (Princeton, NJ: Princeton University Press, 2002).

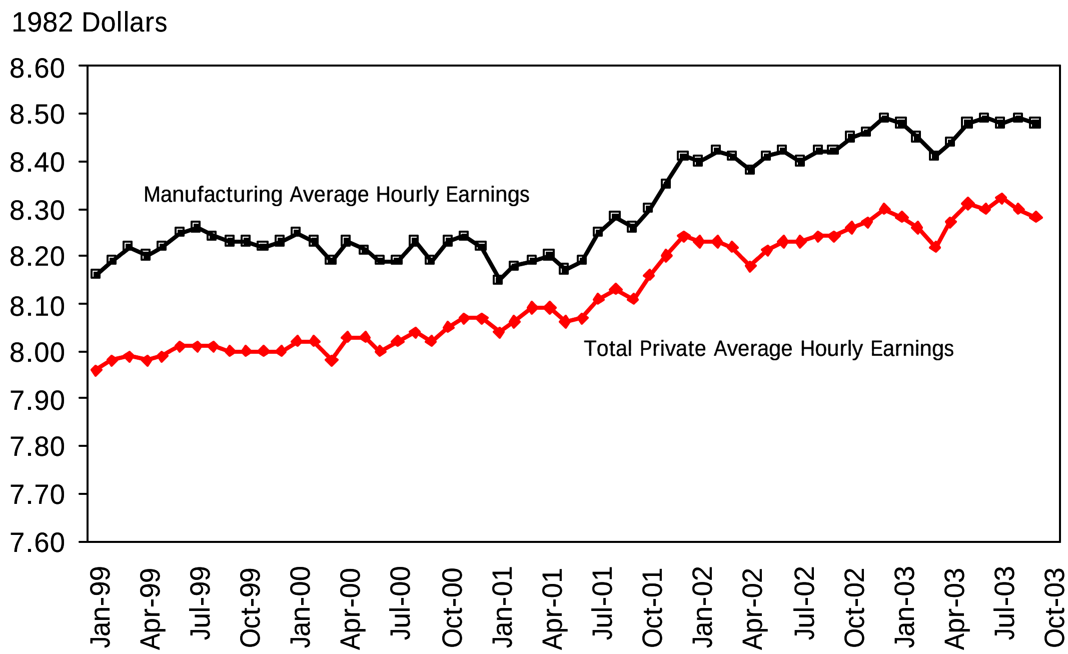
[6] See Popkin, *op. cit.*, pp. 12-14.

[7] Michael Jensen, *The Competitive Advantage of Nations* (New York, NY: The Free Press, 1990).

[8] Popkin, *op. cit.*, pp. 13-14.

[9] National Science Foundation, *Science and Engineering Indicators—2002* (Arlington, VA: National Science Foundation, 2002), Vol. I, p. 6-5.

Chart 5
Manufacturing and Total Private Average Hourly Earnings
(in 1982 dollars)



Source: U.S. Department of Labor, Bureau of Labor Statistics

The dynamics of a research-driven, innovative, productive, and highly flexible model has allowed American manufacturing to remain globally competitive in increasingly tough international markets. American exporters actually increased their share of world goods trade in the 1990s, especially in the area of products with a high degree of embedded technology. The American advantage based on technology and productivity is enhanced by socio-political factors such as a stable rule of law, a flexible labor force, creative and efficient financial markets, and a general openness to change, factors that are not found to such a degree in major competitors such as Japan, China, Korea, and the European Union. The element of flexibility is especially important in an age of innovation, where life cycles in sectors like electronics, medical products, communications, and consumer durables are very fast. Until the global downturn of 2001, and the peak of the recent strong dollar era in 2001 and 2002, the United States enjoyed a trade surplus in advanced technology products. In 1997, the United States enjoyed a trade surplus of over $32 billion in advanced technology products such as aerospace, IT, biotechnology, medical products, advanced chemicals, electronics, automation equipment, and advanced materials.[10] Chart 6 shows the growth of trade in high-technology products in the 1980s and 1990s compared to competing nations. Clearly the United States performed well in this period. The proportion of "R&D intensive" goods among U.S. exports grew from around 20 percent in 1980 to around 35 percent 20 years later.[11] Clearly, the United States was the outstanding global performer. While many labor-intensive industries were moved offshore, those embodying advanced technologies, difficult production processes, complex systems integration, and substantial capital requirements increasingly were becoming the core strength of the domestic manufacturing sector.

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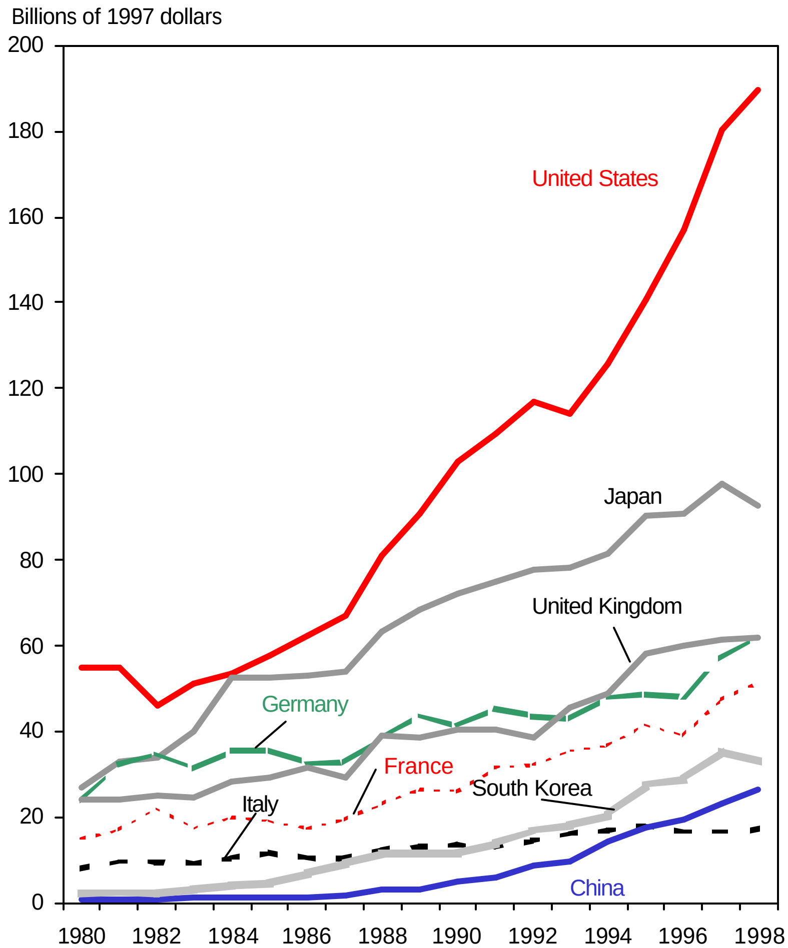
[10] This figure is taken from data collected by the National Science Foundation, definition of "advanced technology products." See National Science Foundation, *Science and Engineering Indicators—2002, op. cit.*, pp. A6-21 to A6-29.

[11] Calculated from U.S. Department of Commerce, Bureau of Economic Analysis data.

Chart 6
High-Tech Exports, 1980-1998



Source: National Science Foundation, *Science and Engineering Indicators—2002*

The trade performance of the advanced technology goods sector has deteriorated since the late 1990s. We project a trade deficit of more than $25 billion this year in this sector. Most of this deficit is, not surprisingly, with Asian nations. In 2002, we lost over 500,000 jobs in high-technology industries and over 300,000 in related service industries such as computer programming.[12] Unfortunately, neither the Department of Commerce nor the National Science Foundation maintains up-to-date, disaggregated statistics on these trends, so we are unable to analyze with any precision the areas where high-technology trade performance has faltered. Given the centrality of this sector to the economy, it would be worthwhile to improve our analytic ability by providing much more timely data. This need also extends to the research and education data discussed in the next section.

II. Challenges to U.S. Manufacturing Competitiveness

The combination of the end of the Internet-related boom, a very strong dollar, the rise of China and India as major competitors, and increased cost pressures on U.S. producers has raised doubts regarding the continued strength of domestic-based manufacturing. While economic cycles cannot be eliminated and the entry of new competitors into the market is inevitable, the issues of cost

[12] American Electronics Association, *Cyberstates, 2003* (press release of November 19, 2003).

pressures and an overvalued currency can be addressed by appropriate policy. Together with the National Association of Manufacturers (NAM), the Alliance released a paper this week on the cost squeeze affecting manufacturers.[13] We found that a combination of cost pressures from excessive litigation, high corporate taxes, high natural gas costs, excessive growth in health care and pension costs and excessive regulatory costs added over 22 percent to core unit labor costs relative to the nine major international competitors to the United States. Table 1, taken from our new study, shows that most of the excessive overhead costs stem from higher corporate taxes and employer-paid benefits and excessive tort and regulatory burdens. These additional costs more than offset the gains made by U.S. manufacturers over the past two decades in unit labor costs relative to our major competitors. (Chart 7 shows that U.S. unit labor costs have declined by about 10 percent over this time relative to competitors, largely thanks to productivity gains.) Such a cost burden is exacerbated by the problem of competing with many East Asian industrial giants (China, Japan, Korea, and Taiwan) which artificially lower the value of their currencies in global markets,[14] and must be addressed for the long-term health of U.S. manufacturing. Before turning to ways to address these problems, I would like to focus on another challenge to the competitiveness and job creation potential of this sector. This concerns the ability to sustain the current advantage of U.S. science, engineering, and technology in global markets which in turn allows us to compete successfully in advanced manufacturing sectors which are the key to the future of the manufacturing sector. Government policy can play an important role in meeting this challenge as well.

Table 1

Effect of Key "Overhead Costs" on Raw Cost Index of Nine Largest U.S. Trading Partners, 2002

(U.S. dollars per hour)

	United States	**Average of nine partners**	**Canada**	**Mexico**	**Japan**	**China**	**Germany**	**United Kingdom**	**South Korea**	**Taiwan**	**France**
Raw cost index	**24.30**	**19.30**	**27.57**	**8.11**	**16.92**	**5.34**	**29.60**	**28.30**	**23.96**	**16.41**	**26.50**
Difference relative to U.S. costs in percent											
Corporate tax rate	–	-5.6%	-3.4%	-6.0%	2.0%	-15.0%	-0.4%	-10.0%	-10.3%	-15.0%	-5.7%
Employee benefits	–	-5.5%	-4.8%	-9.4%	-9.4%	-12.6%	3.6%	-5.1%	9.0%	-11.5%	10.7%
Tort costs	–	-3.2%	-3.1%	N/A	-3.3%	N/A	-0.7%	-3.4%	N/A	N/A	-1.3%
Natural gas costs	–	-0.5%	-6.0%	-2.3%	12.5%	-2.3%	0.6%	2.1%	4.1%	15.3%	-4.2%
Pollution abatement	–	-3.5%	-2.8%	N/A	-2.3%	N/A	-2.4%	-3.0%	N/A	N/A	-1.5%
Manufacturing production costs relative to the United States accounting for differences in overhead costs (dollars per hour)											
Effective cost index	**24.30**	**16.02**	**22.46**	**6.19**	**16.64**	**3.50**	**29.77**	**23.14**	**22.67**	**12.85**	**25.77**

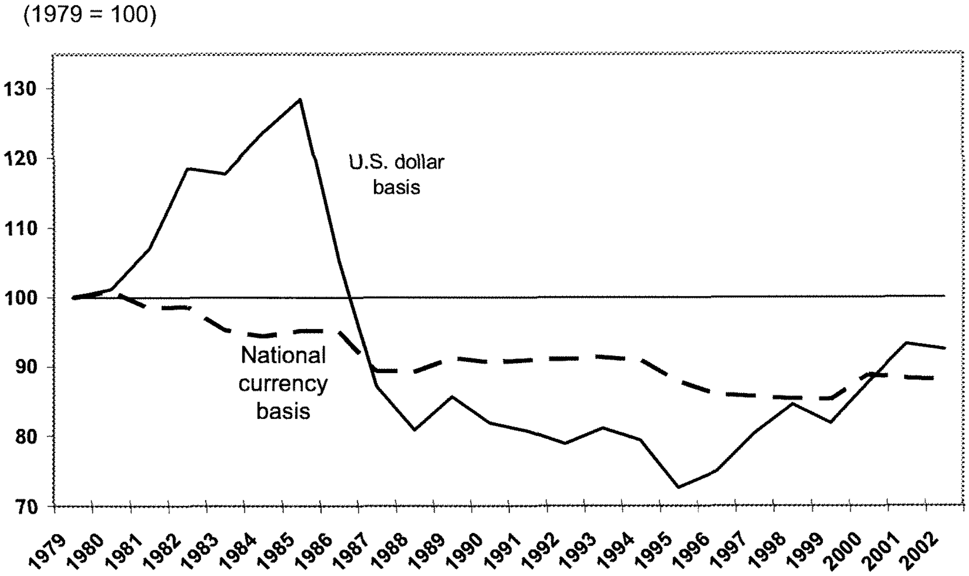
Source: Author's calculations based on data in subsequent tables and charts

Note: Data for tort costs and regulatory compliance costs are limited to the industrialized partners. Conservative assumptions have been made in estimating the missing values, as described in later sections. Thus, the absence of these data likely understates the overall cost advantage of U.S. trading partners.

[13] Jeremy Leonard, *How Structural Costs Imposed on U.S. Manufacturers Harm Workers and Threaten Competitiveness* (Washington, DC: National Association of Manufacturers and Manufacturers Alliance/MAPI, 2003).

[14] See Ernest H. Preeg, "Exchange Rate Manipulation to Gain an Unfair Competitive Advantage: The Case Against Japan and China," in C. Fred Bergsten and John Williamson, eds., *Dollar Overvaluation and the World Economy* (Washington, DC: The Institute for International Economics, 2003).

Chart 7
U.S. Manufacturing Unit Labor Costs Relative to 12* Competitors, 1979-2002



*Korean data begin with 1985 and have been omitted from this chart.
Source: U.S. Department of Labor, Bureau of Labor Statistics

According to the independent World Economic Forum, the United States is still the world leader in technology, based both on its commitment to research and its ability to bring innovative products to market. Table 2 gives the most recent rankings of this Swiss-based organization and shows that this lead is the key factor in keeping the United States near the top in global competitiveness rankings. Importantly, this group ranks the United States first in its Technology Index, due especially to its strong innovation performance. The NSF concurs that ". . . the United States continues to lead, or be among the leaders, in all major technology areas . . .," and rates ". . . the United States as the world's leading producer of high-technology products . . . ."[15] One measure cited by the NSF as a sign of the resurgence of U.S. technology was the increase in the share of U.S. patents granted to U.S. nationals. Since peaking in 1989, the share of patents granted to foreign nationals in the United States has fallen from 48 percent to 44 percent. Additionally, "U.S. inventors led all other foreign inventors [in patenting their products] not only in countries bordering the United States but also in markets such as Germany, Japan, France, Italy, Brazil, Russia, Malaysia, and Thailand."[16] The United States is especially active and leads the world in some bright new areas for growth such as DNA-related patents and patents related to development of the Internet. Nonetheless, despite this position of leadership, there are some signs that the dominant position held by the United States is beginning to slip.

[15] National Science Foundation, *op. cit.*, p. 38.

[16] *Ibid.*, pp. 6-21 to 6-24.

Table 2
Business Competitiveness Rankings, 2003

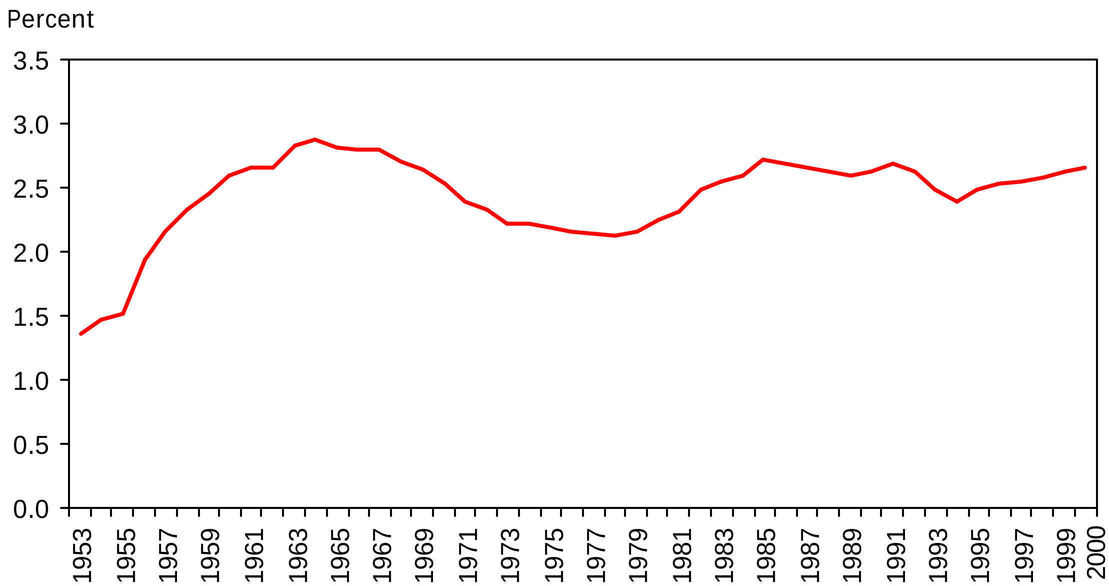
Country	Business Competitiveness Ranking 2003	Technology Index Rank	Business Competitiveness Ranking 2002*
Finland	1	2	2
United States	2	1	1
Sweden	3	4	6
Denmark	4	8	8
Germany	5	3	4
United Kingdom	6		3
Switzerland	7		5
Singapore	8		9
Netherlands	9		7
France	10		15
Australia	11		14
Canada	12		10
Japan	13		11
Iceland	14		17
Belgium	15		13
Taiwan	16		16
Austria	17		12
New Zealand	18		22
Hong Kong SAR	19		19
Israel	20		18

*Applying 2003 formula
Source: World Economic Forum

We have already mentioned the recent trade deficit in advanced technology products. While this is due in large part to the strong dollar, severe cost pressures on domestic producers and increased competition, some data indicates that our science and technology lead is not as secure as it was a few years ago, and that our commitment to funding the required research and education is not quite as solid as needed to maintain our competitive edge.

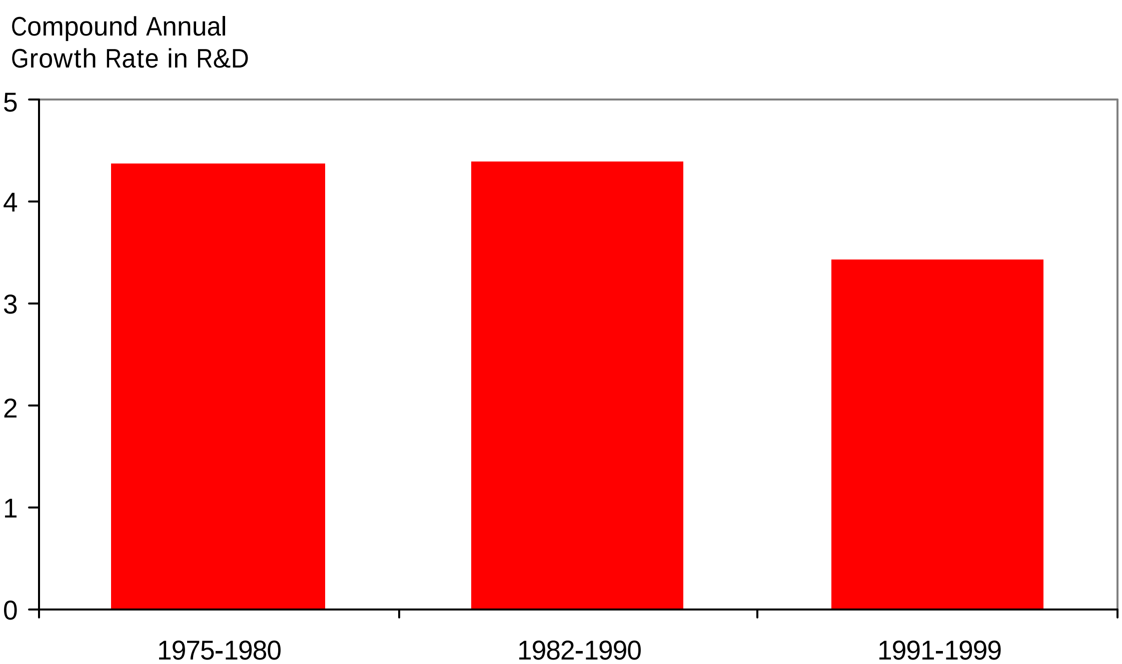
In the first place, national funding for R&D and basic science from all sources, especially that related to manufacturing such as the physical sciences and engineering, has been flat to slightly declining as a proportion of national output. Chart 8 reviews the historical pattern of R&D expenditures as a proportion of GDP. While the United States still leads all industrial nations except Japan in this measure of support for R&D, there seems to be a waning in the willingness or ability to maintain vigorous growth. Chart 9, for instance, chronicles a modest slowdown in the growth rate of R&D during the long boom of the 1990s, which was of course dominated by the technology-intensive fields such as communications and information technology, when compared to the two previous periods of expansion. Most of this decline is attributable to lower federal support in the 1990s.

Chart 8
Historical Pattern of R&D as a Percentage of GDP, 1953-2000



Source: National Science Foundation, *Science and Engineering Indicators—2002*

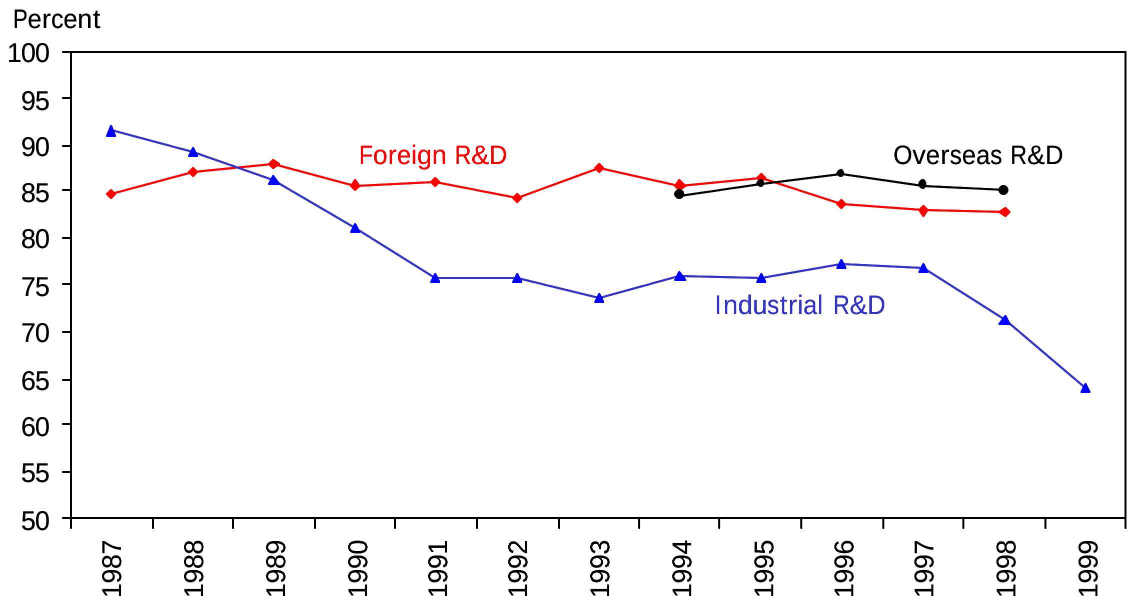
Chart 9
Compound Annual Growth Rate in R&D During Economic Expansion Periods, 1992 Dollars



Source: National Science Foundation, *Science and Engineering Indicators—2002*

The manufacturing share of R&D, while still above 60 percent of the total, has also declined in the past few decades as a proportion of total industrial R&D, as Chart 10 shows. This may be due in part to the rise of spending on related areas such as research on software and IT systems related to manufacturing, and the growth of research spending by the services sector. The steady decline in cash flow of the manufacturing sector may also explain some of the lack of dynamism in manufacturing R&D. Since 1990, the cash flow of U.S. manufacturers has fallen from 37.2 percent of total corporate cash flow to 25.3 percent in 2001, reflecting the cost pressures and global competition affecting this sector.[17]

Chart 10
Manufacturing Shares in Foreign, Overseas, and Total Domestic Industrial R&D, 1987-1999



Source: National Science Foundation, *Science and Engineering Indicators—2002*

Federal government expenditures for basic science and R&D, especially those areas directly related to manufacturing, have also failed to keep pace with the overall growth of the economy. Some growth in the past two years in R&D outlays only allowed the real level of support to return to 1987 levels. The most spectacular example of this long and steady erosion of support is for space research. While no one would want to recreate the circumstances of the 1960s, namely the threat from the Soviet Union, that motivated much of the spending for the Apollo program, the benefits to high tech manufacturing from the space and national defense programs of the times were large and extended into the 1990s at the very least. In 1965, federal R&D (including plant and equipment) for the National Aeronautics and Space Administration (NASA) was three-quarters of one percent of total GDP. Combined with Department of Defense (DOD) expenditures, R&D in 1965 supported by these two agencies was equal to fully 1.7 percent of GDP. By 2002, NASA research was down to .09 percent of GDP and the combined NASA/national defense expenditures totaled only .42 percent of GDP, less than one-quarter the rate of 1965.[18] Federal spending in basic sciences related to manufacturing have also trended downward over the past three decades. In 1976, fully 43 percent of all federal expenditures for research, largely conducted by universities and federal labs, was devoted to engineering and the physical sciences. In 2002, that proportion had fallen to 26.8 percent. At the same time, research in the life sciences grew from 43 percent to 48 percent of the total. Overall, federal support for basic research has increased as a proportion of all federal science spending in recent years. In 2002, about .43 percent of GDP was devoted to all scientific research supported by the federal government.

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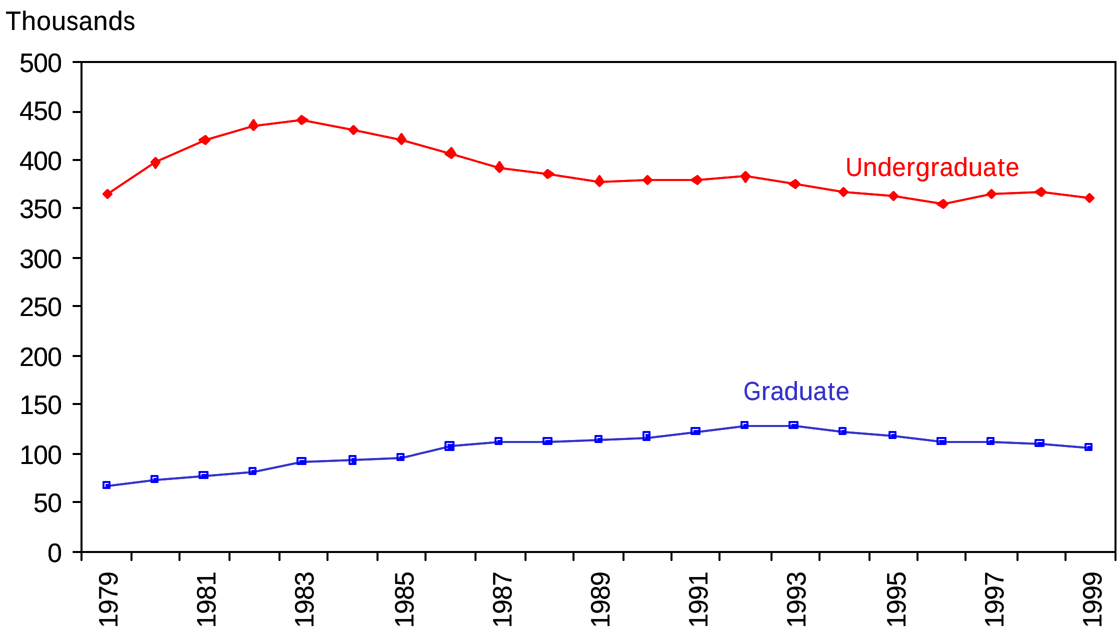
[17] Data are from the U.S. Department of Commerce, Bureau of Economic Analysis.

[18] National Science Foundation, *op. cit*.

The training of scientists and engineers too has fallen from its levels three decades ago. In the 1960s and 1970s, there was a palpable sense of excitement, adventure, and a clear national purpose associated with scientific and engineering projects such as the Apollo program, development of large commercial aircraft, the early development of robotics and automation equipment, and the nascent industry of computing. This inspired students to enroll in related educational fields, and students were assisted by generous federal programs such as the fellowships awarded by the NSF and under the National Defense Education Act. Chart 11 depicts the slow decline in engineering enrollment in the United States since peaking in the early 1980s. Chart 12 shows slippage in graduate enrollment in advanced U.S. science and engineering programs over the past two decades. Undergraduate degrees awarded in engineering have fallen by almost 20 percent since 1987, those in the physical sciences by about 5 percent, and those in the critical-related area of mathematics by over 20 percent in the same timeframe. On a brighter note, degrees in the biological sciences, a potential source of technological strength and new products in the 21st century, have grown by nearly 70 percent since 1986, as Chart 13 shows.

The overall decline in the education of mathematicians, physical scientists, and engineers is cause for concern because demand for these skills is outpacing the economy-wide growth in demand for all workers, according to the U.S. Department of Labor. The latest projections (again, these are somewhat dated) are for overall employment to grow by 0.3 percent per year in the first decade of the new millennium, while that for computer- and math-related occupations grows 2.6 percent, architecture and engineering jobs by 0.4 percent, and those in the life, physical, and social sciences by 0.9 percent.[19]

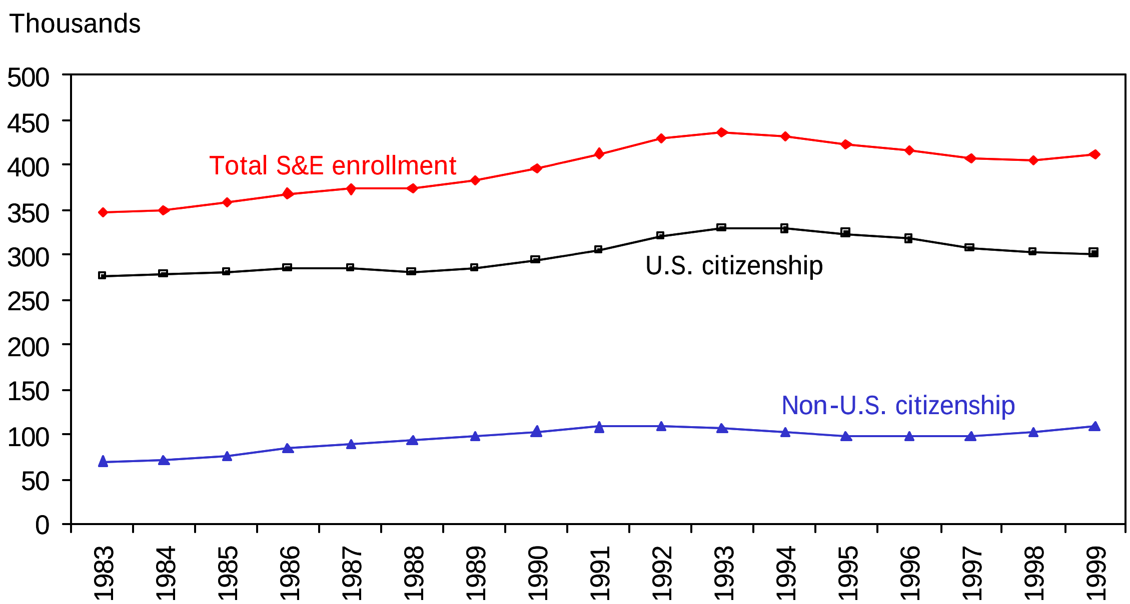
Chart 11
U.S. Engineering Enrollment, by Level, 1979-1999
(Full- and part-time students)



Source: National Science Foundation, *Science and Engineering Indicators—2002*

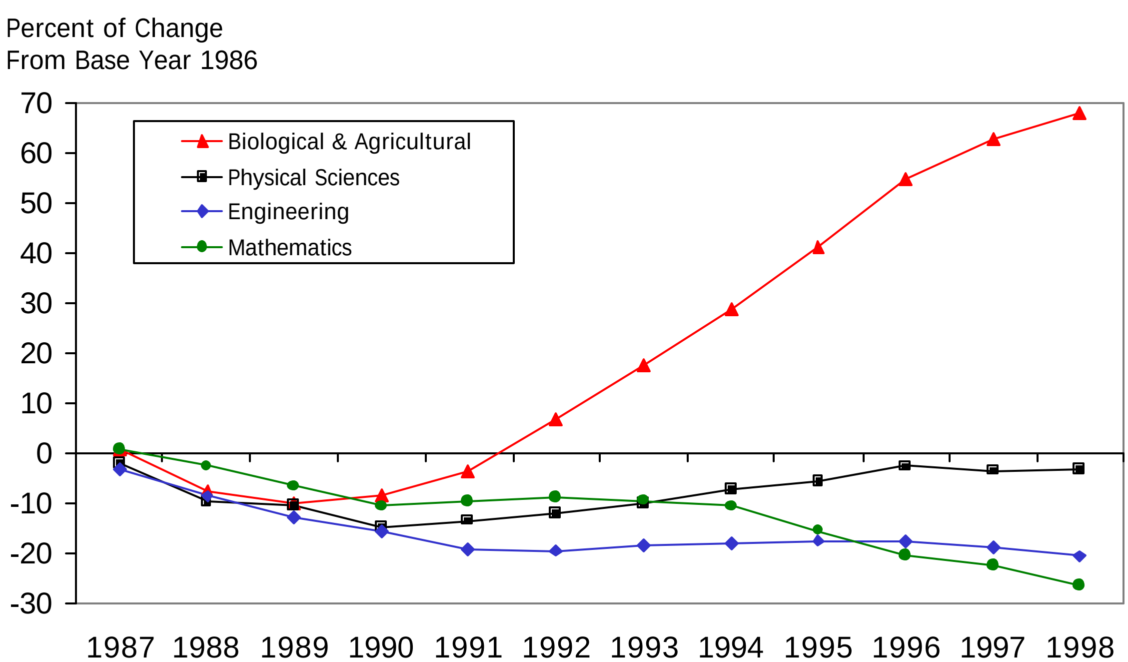
[19] U.S. Department of Labor, Bureau of Labor Statistics, November 2001.

Chart 12
Graduate Enrollment in Science and Engineering by Citizenship, 1983-1999



Source: National Science Foundation, *Science and Engineering Indicators—2002*

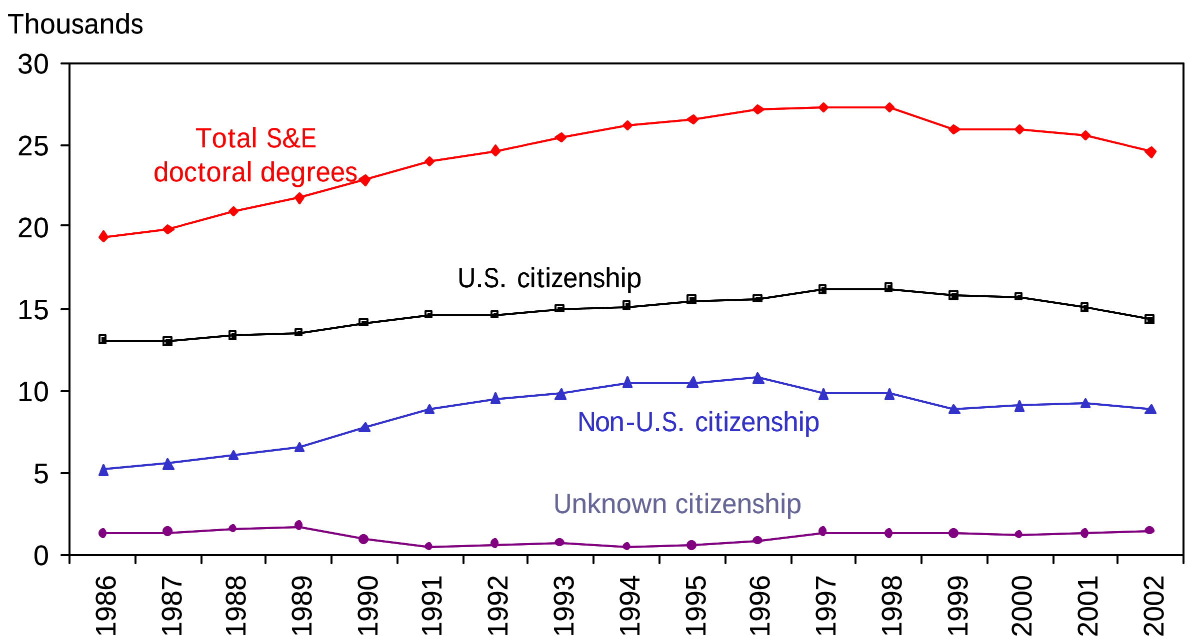
Chart 13
Growth in Undergraduate Science and Engineering Degrees, Indexed to 1986



Source: National Science Foundation, WebCASPAR database, www.nsf.gov

The United States higher education system has a lead on its competitors by almost any measure of quality. One result is that foreign students flock to the shores of the land of opportunity, especially to receive training in the sciences and engineering. Foreign students are especially prominent in the advanced study of these fields. Chart 14 shows that almost all the growth in the awarding of Ph.D.s in science and engineering results from an increase in those earned by non-U.S. citizens.

Chart 14
Earned Science and Engineering Doctoral Degrees by Citizenship, 1986-2002



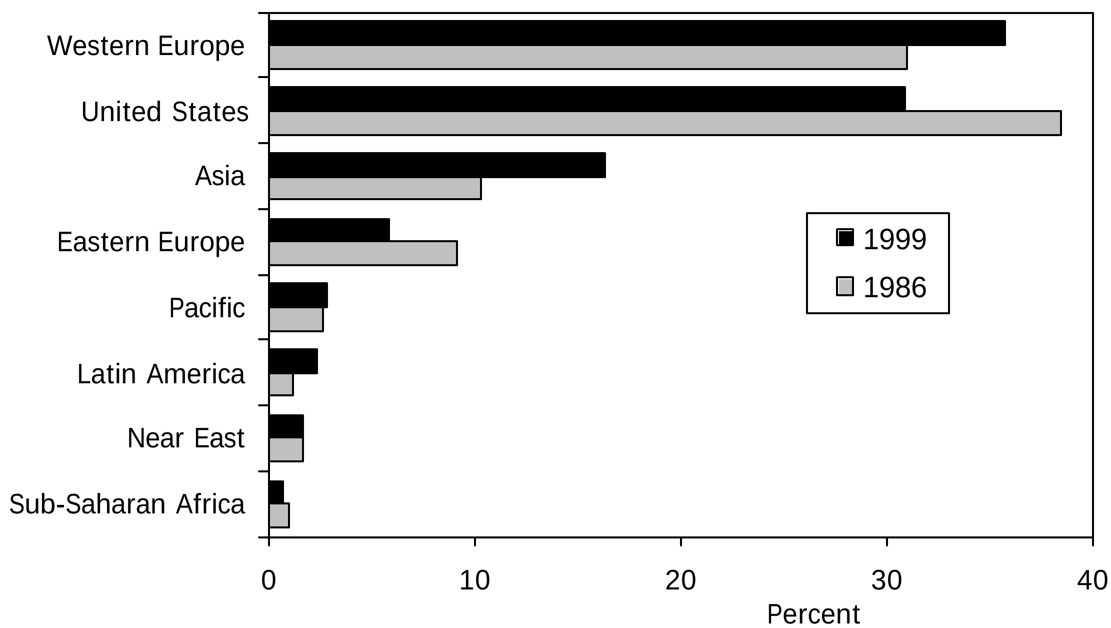
Source: National Science Foundation, WebCASPAR database, www.nsf.gov

While many of the U.S.-trained foreign students remain in this country and add immeasurably to the research and entrepreneurial dynamism of the domestic economy, many return home and transfer their knowledge to local industries. China, for instance, has sent over 600,000 of its youth to study in the United States in the past 25 years, and only 160,000 have returned to the motherland. In recent years, the pace of return to China has picked up speed as opportunities in China are flowering and the Chinese government gives new incentives to those who come back. Over 90 percent of the 18,000 students who returned to China in 2002 hold a masters or doctoral degree from abroad.[20] Taiwan, South Korea, India, Mexico, Thailand, Malaysia, and Japan also send large numbers of students to the United States and are reaping the benefits through growth of the high-technology industries whose most important ingredient is the brainpower of trained researchers.

One measurable result of the slight fall in interest and enrollment in science and engineering on the part of U.S. students, and of the flattening of financial resources devoted to these fields, is that the traditional lead of American researchers in science publications is being slowly whittled down. While the prestige awards like Nobel prizes continue to be dominated by U.S. scientists, the mass of research which underpins broad scientific excellence and technological leadership is being globalized. Chart 15 chronicles the decline in "market share" by the United States of gross output of scientific research in the 1990s. Asian and West European researchers increased their market share during this period of strong economic growth. Chart 16 gives a measure of quality and importance of research, the number of times research is cited in other scientific papers. Even though the United States is still well in the lead in this measure, the lead is eroding.

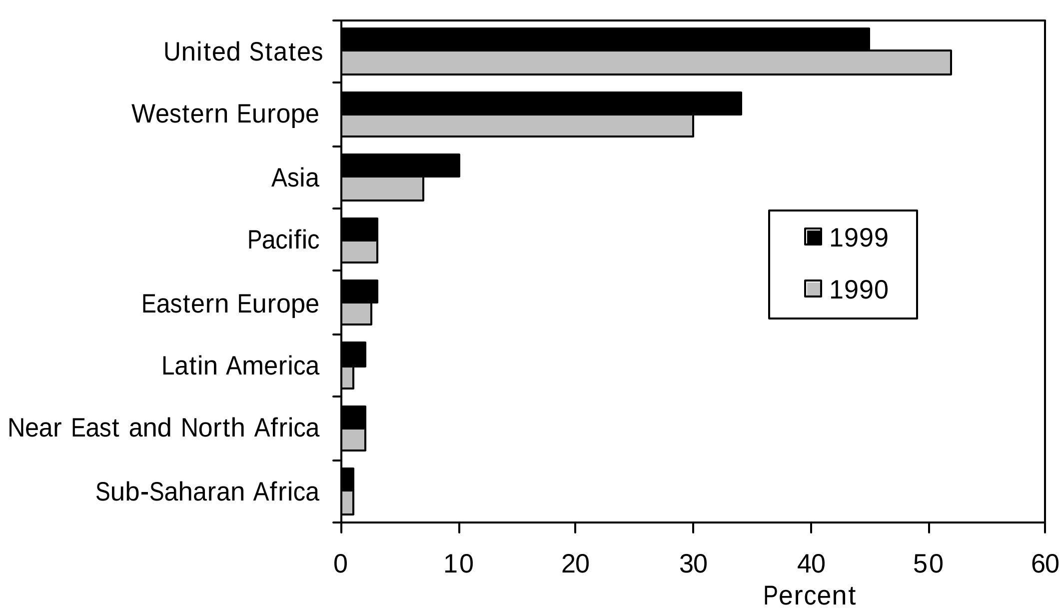
[20] See "On Their Way Back," *The Economist*, November 6, 2003, pp. 59-60.

Chart 15
Scientific Publications: Regional Share of World Output



Source: National Science Foundation, *Science and Engineering Indicators—2002*

Chart 16
Scientific Research Cited by Scientific and Technical Papers, by Region



Source: National Science Foundation, *Science and Engineering Indicators—2002*

Although the United States has increased its market share of patent activity since 1989, it is worth noting that foreign corporations are increasing their patenting activities, especially companies from South Korea and Taiwan. Chinese firms are sure to start showing more activity in coming years. For the period 1977-1996, six of the top ten corporations for U.S. patent awards were American firms, while in 1999 that number had fallen to three. In 1999, six Japanese and one Korean (Samsung) firm were among the top ten for patent awards.[21]

It is important to retain perspective on this brief review of scientific research and education over the past few years. It does show flat to slightly lower commitments to these areas in the United States and comparatively stronger growth among major economic competitors in Asia and (in part) in Western Europe. The United States still maintains the preeminent position, but its leadership is being challenged. Combined with the cost advantages enjoyed by competitors in Asia, the growing sophistication of Asian scientists and engineers, often learned in the United States, helps to explain the small erosion of competitiveness in world markets for products with a high degree of embedded technology.

III. Ways to Address the Challenges Facing Manufacturers

It is important for federal policymakers to address the issues currently facing U.S. manufacturing because this sector is a driver of growth, innovation, and productivity throughout the economy. As such, it is a primary source of improvement in domestic standards of living and international competitiveness. A strong manufacturing base, especially in advanced technologies, of course is also of immense importance to maintaining our national security.

There are a variety of ways in which federal policy can play a constructive role in establishing the conditions needed for the continued vitality and global competitiveness of this sector in the United States. I first focus on some general policies which would help meet the cost pressures facing domestic manufacturers. Then I turn to policies which support the core strength of U.S. manufacturing, namely the highly innovative, research-oriented, technology-intensive, fast-changing, and flexible manufacturing model which is most likely to enjoy success in global markets.[22]

Currently, a variety of cost differentials with major trade competitors cumulatively add at least 22.4 percent to domestic costs of manufacturing. The major challenges which can be addressed by federal (and, in some cases, state) policy include:

- ***Tax policy.—***U.S. corporate income tax rates are the second highest in the industrialized world, after Japan, and competitors such as Germany and Russia are lowering corporate tax burdens. Corporate income taxes should be lowered or eliminated. Additionally, depreciation rates are often out of step with the real economic life of capital goods used in manufacturing or in the provision of IT services; and U.S. tax structures also discourage investment through the double taxation of dividends and other measures. Capital-intensive manufacturers are especially disadvantaged by the high burden of taxation on capital. Finally, making the R&D tax credit permanent would add certainty to the research and innovation so crucial to U.S. manufacturing.

- ***Health care policy.***—Provision of health care is the fastest rising cost facing manufacturers. Reforms are needed to provide incentives for more efficient use of services and to give health care consumers a better awareness of the trade-offs between cost and quality of overall care.

- ***Legal reform.***—The costs of various kinds of liability and torts faced by U.S. manufacturers are at least double those of major international competitors. Serious reform of the tort,

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[21] National Science Foundation, *op. cit.*, p. 6-22.

[22] For more detailed discussion of policy responses, see Duesterberg and Preeg, *U.S. Manufacturing: The Engine for Growth in a Global Economy, op. cit.*, Chapter 9; and Leonard, *How Structural Costs Imposed on Manufacturing Harm Workers and Threaten Competitiveness*, *op. cit.*, pp. 24-25.

product liability, and class action regimes is needed. Addressing the asbestos crisis should have top priority.

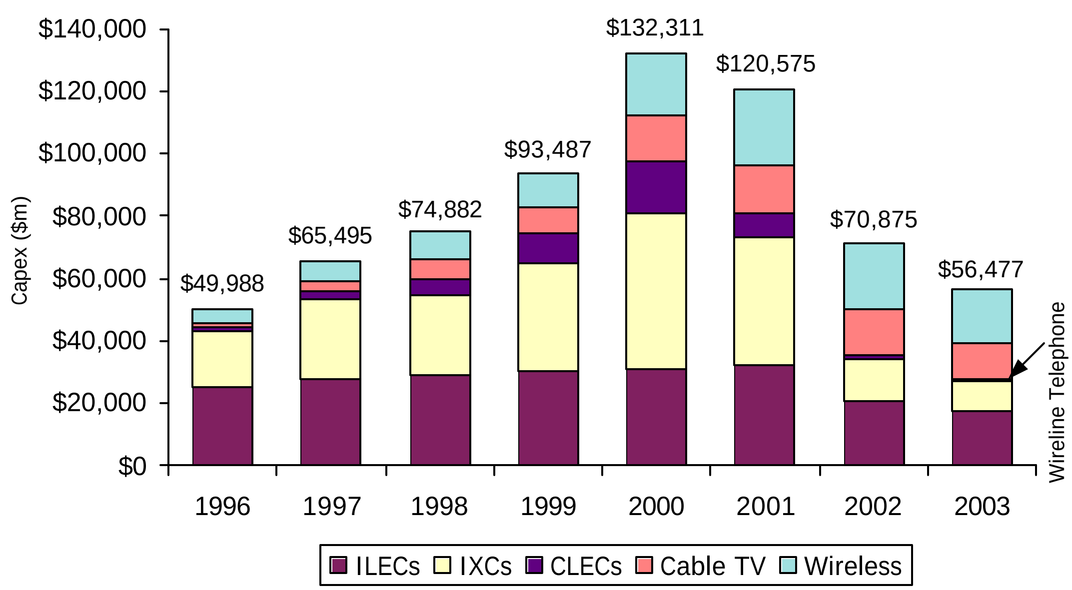
- ***Regulatory reform.***—Environmental, health and safety, and other regulatory mandates tend to add costs to American manufacturers. Attention to the trade-offs between the necessary goals of such regulation and the costs needs to be heightened and cost-benefit analysis needs to be employed more widely.

- ***Energy costs.*****—**The secular rise in energy costs, especially for natural gas, has undermined the competitiveness of energy-intensive industries like primary metals, paper and glass, and chemicals, while adding to the costs of almost every manufacturing sector. Broader development of domestic and North American resources to reduce cost pressures is urgently needed.

I would like to dwell briefly on one area of regulatory policy which greatly affects an important, high-technology sector. Telecommunications policy is often viewed as a zero-sum game of competing claims between various classes of service providers, or as a purely intramural fight which has few real-world consequences. Unfortunately, we can no longer be so complacent. The rise of telecommunications capital investment was of course crucial to the spread of the Internet in the 1990s, and continued investment is required to perfect the IT infrastructure so crucial to enhanced productivity in the modern economy. Growth in capital investment by the telecommunications and IT industries between 1996 and 2000 added nearly one full percentage point to U.S. GDP growth and contributed greatly to enhanced productivity by lowering consumer prices and expanding the communications net by many orders of magnitude.[23] Since 2000, however, the investment bubble has burst, as capital expenditures for communications equipment plummeted by 57.3 percent, as Chart 17 illustrates.

Chart 17

U.S. Telecom Service Providers Capital Expenditures, 1996-2003



Source: T. Rowe Price & Company Reports

[23] See Thomas J. Duesterberg and Jeremy Leonard, *The Telecommunications Sector and Economic Recovery* (Arlington, VA: Manufacturers Alliance/MAPI, 2001), Economic Report 526, September 2001.

This precipitous fall is important to U.S. manufacturers because a good deal of the capital equipment is produced domestically, and without continued strength we will experience a loss of critical mass needed to support R&D and continued technological leadership. Over 86.6 thousand jobs, or 34 percent of the workforce in this industry, were lost in the manufacture of communications equipment after 2001, on top of over 200,000 jobs lost in the telecom services area.[24] Importantly, due to lack of investment, the United States is falling behind leading competitors in the provision of the high-speed data connections which are so crucial to the continued competitiveness of the U.S. economy. Table 3 shows the rate of broadband access among leading OECD countries as of June of this year. The United States trails such competitors as Korea, Japan, and several European nations.

Table 3
Broadband Access in OECD Countries per 100 Inhabitants, June 2003

	DSL	Cable Modem	Other Platforms	Total
Australia	1.48	1.11	0.07	2.65
Austria	2.76	4.22	0	6.98
Belgium	6.25	3.82	0.27	10.34
Canada	6.09	7.18	0	13.27
Denmark	7.29	3.17	0.65	11.11
Finland	5.39	1.21	0.01	6.61
France	3.56	0.57	0	4.13
Germany	4.68	0.06	0.10	4.84
Iceland	10.66	0	0.56	11.22
Italy	2.50	0	0.34	2.84
Japan	6.49	1.75	0.36	8.60
Korea	14.36	8.45	0.37	23.17
Luxembourg	2.02	0.24	0.06	2.32
Mexico	0.12	0.15	0.001	0.28
Netherlands	3.82	5.38	0.001	9.20
New Zealand	1.87	0.06	0.14	2.07
Norway	4.08	1.17	0.14	5.39
Spain	3.24	1.00	0	4.24
Sweden	5.44	1.96	1.76	9.16
Switzerland	4.70	4.43	0	9.13
United Kingdom	1.78	1.82	0.02	3.63
United States	2.68	4.84	0.74	8.25
OECD (Average)	3.37	2.40	0.29	6.06
EU (Average)	3.31	1.10	0.14	4.55

Source: Organization for Economic Cooperation and Development, www.oecd.org/sti/telecom

According to a recent study by three Nobel prize-winning economists and a leading expert on prices, the current maze of regulation employed at the federal and state levels seriously discourages investment and innovation in telecommunications. The four economists conclude:[25]

> It is our view that current telecommunications regulations threaten to reduce the pace of technological gains by reducing the incentives of local exchange carriers ("ILECs") and competitive local exchange carriers ("CLECs") to invest in new services and to upgrade their networks. . . . When, as today, new telecommunications

[24] U.S. Department of Labor, Bureau of Labor Statistics, and Dun and Bradstreet.

[25] "Report of Kenneth Arrow, Gary Becker, Dennis Carlton, and Robert Solow On Behalf of Verizon" (Chicago, IL: Lexecon, November 18, 2003), p. 3.

> technologies are emerging rapidly, firms must decide whether to make large and risky investments in these new technologies. These are precisely the circumstances in which there is an increased likelihood that inappropriate regulation will adversely affect productivity growth and consumer welfare.

To underscore their arguments regarding the impact of lower investment due to inappropriate regulation, these award-winning economists state: "The resulting harm to the U.S. economy could be large and could extend beyond the telecommunications sector."[26] Some of the changes needed to address this problem include providing full tradable private property rights to wireless spectrum holders, ending the counterproductive requirements to share facilities at less-than-economic rents for service providers, and avoiding new regulation of cable, Internet, and wireless telephony and data services.[27]

We also need to be very vigilant about how we regulate (and pay for) another high-technology sector: medical products. As we noted earlier (see Chart 13), biotechnology and life sciences is the one area where U.S. R&D and production of advanced degrees has increased, and one where the United States enjoys a competitive advantage in the production of related products. The research lead in this sector is currently enhanced by a more favorable regulatory environment in the United States. Japan, Europe, Canada, Australia, and other leading industrial countries discourage investment in biotechnology and health care products through heavy-handed regulation of bio-engineered foods and through their command-and-control health care payment systems. If we are to maintain our lead, we will need to avoid replicating such harmful policies and work assiduously to fend off the efforts of Europe and others to use the World Trade Organization (WTO) to thwart research and the use of biotechnology products.

In a more general sense, protection of intellectual property such as pharmaceuticals, medical devices, microprocessors, and telecom equipment through the WTO and through our growing array of bilateral and regional trade agreements should be a general and ongoing priority of the U.S. trade authorities. This is especially true since the future of U.S. manufacturing is increasingly tied to its ability to provide innovative products embodying new and proprietary technology. The many examples of theft of protected products such as pharmaceuticals, movies, and even designs for new cars are well known. New assaults are waged with growing frequency as countries such as Brazil, India, South Africa, and China attempt to undermine existing protections or ignore them in order to support new domestic industries. China, to take a recent example, is trying to develop domestic DVD and wireless phone technologies to compete with—or undermine—dominant U.S. and European standards.[28] Computer software is another ongoing target of IP pirates, especially in Asia. Entrepreneurial thieves in Malaysia are already selling the next version of Windows, slated for release by Microsoft in 2005! "Malaysia's brazen software pirates are hawking the next version of Microsoft Corp.'s Windows operating system years before it is scheduled to be on sale," read a recent dispatch from Reuters.[29]

Trade policy, in a broader application, is important to lowering existing barriers to the sale of manufactured goods in foreign markets. While average tariff levels for goods imported into the United States are only 4.3 percent, Brazil imposes average tariffs of 13.9 percent, India 32.4 percent, China 16.9 percent, Egypt 20.2 percent, Russia 13.4 percent, Nigeria 24 percent, South Korea 7.8 percent, Poland 10.9 percent, Thailand 14.6 percent, Saudi Arabia 12.6 percent, and Pakistan 46.9 percent. The Alliance has long supported free and open trade and aggressive policies to achieve this goal by opening foreign markets and lowering these too-high tariffs. It is equally important to pay attention to faithful enforcement of agreements. Secretary of Commerce Donald Evans has

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[26] *Ibid.*, p. 23.

[27] See Duesterberg and Preeg, *U.S. Manufacturing: The Engine for Growth in a Global Economy, op. cit.*, pp. 210-213.

[28] See "China Armed with EVD in 'Attack' on Dominant DVD," *The Washington Times*, November 17, 2003, p. A1.

[29] "Asian Pirates Sell Microsoft's Next Windows System," Reuters, December 1, 2003, 7:49 AM EST.

announced plans, for instance, for special monitoring of China's compliance with its new WTO obligations, a much-needed initiative.

In the wake of the hopefully temporary collapse of the WTO round, constructive progress can and should be made through regional and bilateral deals such as the Administration currently is pursuing in the Americas, and with countries like Thailand and Australia. The Alliance also supports an initiative announced by U.S. Trade Representative Robert Zoellick to achieve free trade in the manufacturing sector.[30] Given the long-standing difficulties of our negotiators to make progress with Japan, Korea, and Europe on agricultural trade, given the overwhelming predominance of goods in U.S. trade, and given support for this initiative by key allies in Britain, now is an auspicious time to move this idea to the forefront of the multilateral agenda.

Exchange rate policy has also come to the fore in influencing U.S. international competitiveness in manufactures and as a major cause of the sharp increase in the U.S. trade deficit in recent years. The Alliance supports the Administration policy of market-based exchange rates. Unfortunately, a number of East Asian trading partners, most importantly China and Japan, have been intervening heavily in financial markets to buy dollars in order to maintain their currencies substantially below market-based levels. This, of course, provides them with an unfair competitive advantage in trade. Such "currency manipulation" is in violation of IMF and WTO commitments,[31] and the Administration should take appropriate action to stop it.

Finally, I believe policymakers should reflect on the relationship between our national investment in science and technology and in education, and the future health of the manufacturing sector. A few years ago I frequently heard from manufacturing executives of a shortage of both skilled workers and of a lack of interest on the part of academic and advanced researchers in areas of interest to manufacturing. In fact, despite major private sector investment in technical education and scientific research, students frequently are not attracted to the disciplines like engineering which are so crucial to the success of manufacturing, especially in an age of innovation and rapid changes in technology. This is in sharp contrast to the 1950s and 1960s, and perhaps even to the 1990s, when the race for space, the competition to build the biggest and best commercial aircraft, computer, or robot, and, later, the lure of IT entrepreneurialism in Silicon Valley attracted the best and the brightest.

In the 1950s and 1960s, if not beyond those years, NASA and other agency programs played a major role in supporting needed research. The centrality and visibility of federal support also added to the allure of making a contribution to large national goals such as being the first to land on the moon or building the fastest supercomputer. Today, federal financial support for similar activities is only a fraction of what it was 40 years ago. Perhaps more importantly, national leaders are not articulating national goals which inspire our young people to enter the science and engineering fields which once were imbued with glamour and excitement.

In today's fiscal environment, it is unrealistic to expect major infusions of funds to basic research and to R&D that would return us to the levels of the 1960s. Moreover, it is questionable if major funding increases would work as effectively as before in a world of rapid technical change where industry is much more adept at deploying resources to the best possible uses. One could legitimately ask, however, whether existing federal support is as effective as it should be in supporting the types of science and engineering education and research that provide a foundation for advanced manufacturing, technological innovation, and national defense. Clearly we are not producing the personnel and the R&D needed to maintain the same technological lead we enjoyed in the 1980s and 1990s.

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[30] Ernest H. Preeg, *Free Here to Free Trade in U.S. Manufactures: How and Why* (Arlington, VA: Manufacturers Alliance/ MAPI, 2003).

[31] See Ernest H. Preeg, "Chinese Currency Manipulation and the U.S. Trade Deficit," testimony before the U.S.-China Economic and Security Review Commission, September 25, 2003.

One could also legitimately ask whether the sort of inspired leadership we saw in the 1960s to challenge our students and researchers could not be replicated to at least some extent today. National leaders rarely speak of or make appearances with technology leaders. Many technologies pioneered in the United States—microprocessors, advanced materials, biotechnology, and nanotechnology—are vitally important to our manufacturing future and could be aided by the attention and endorsement of national leaders, and by judicious support using existing funds. Can we not also imagine more inspirational programs—deep space exploration, a return to the moon, new materials and propulsion technologies to allow manned flight to Mars and beyond, enhanced sensor technologies to root out national security threats, pushing the limits of nanotechnology, ending hunger and environmental degradation through new biotechnology, finally conquering cancer through genetic technology—where national leadership and investment would be constructive in attracting the best and brightest? If we could do this in a sustained way, it would work wonders too for the future competitiveness of the manufacturing sector which would lead in performing research and developing the new products required to meet national goals and sustain our global competitiveness, just as it did 40 years ago.

Let me be clear that I am not advocating a huge increase in federal resources to regain the glory days of the 1960s. Rather, I believe we should be using our resources much more wisely in ways that advance the national interest and aid in sustaining U.S. competitiveness, especially in the advanced technology areas which tend to produce good jobs. The lion's share of research is going to continue, and should continue, to be provided by the private sector, which is much more adept at getting resources to the best possible uses. But policymakers can help in the following ways:

- improving elementary and secondary education in math and science training;
- supporting advanced training in engineering and the physical sciences;
- establishing clear and inspirational national goals for our space and national health research programs which both meet national needs and attract students to the academic disciplines needed to carry out these programs;
- supporting the basic research needed to buttress development of new areas such as biotechnology, nanotechnology, and advanced information technology that cannot be carried out efficiently in the private sector;
- supporting the necessary programs to ensure development of the technologies needed to meet national security threats;
- streamlining and accelerating the drug and medical device approval process at the Food and Drug Administration;
- making the R&D tax credit a permanent part of the IRS code to promote research and innovation; and
- modernizing the U.S. Patent and Trademark Office so that it can more rapidly and efficiently assess the flood of new applications for intellectual property protection.

More judicious and thoughtful policy and financial support in these areas will pay larger dividends in the future, not the least of which is assisting the vitally important manufacturing sector in its core mission of technological innovation.