"Just as the U.S. citizen feels entitled to 1950-like preeminence in every field," observed Smart, "the Japanese citizen believes that the tilted playing field of the last 40 years is his by national right."

The current U.S.-Japan battle over semiconductor trade reflects the realization that retaliation may be the only way to force Japan to live up to its new global responsibilities.

The Reagan administration drew the line on semiconductors because they are the building blocks of all high technology. Without a strong semiconductor industry, a country loses the ability to develop more powerful computers and the supercomputers that are vital for national defense.

Underlying the trade dispute are fears within the administration that U.S. national security is at stake if American high-technology innovation is thwarted by Japanese protectionist policies at home and aggressive discount pricing in the United States—the heart of the semiconductor dispute.

A 'Diminished Giant'

The situation is painful for Americans, and the country may be suffering from what has been called the "diminished giant syndrome." But many experts believe that it is better for the world than what came before.

"I think the United States has got to recognize that if we can create a community of common political values and economic growth, it will be worth it even if it costs us a relative share of economic and political power," said Nau. "We may have less power today, but we live in a world that is more peaceful, more stable. We live in a better world than the 1930s."

"The rest of the world is coming of age," said William T. Archey, international vice president of the U.S. Chamber of Commerce.

How America responds to these changes is the subject of the competitiveness debate going on in academia, Congress and the executive branch of government; between business and labor as they try to define new sets of work rules to meet heightened competition from other countries, some of which have added technological advances and high degrees of education to lower wages and less opulent standards of living, and among industrialists seeking a niche in this new economic order of the world.

In Congress, much of the debate concerns changes in U.S. laws to stop what is seen as other countries' unfair trade practices. But the larger issues of competitiveness are being framed beneath the jockeying for trade legislation.

"It depends on how much we invest, how much research and development we do, how well we educate ourselves, how we use our capital," said C. Michael Aho, senior fellow of economics at the Council on Foreign Relations. "Those things never used to matter. Now that we are no longer predominant, they do matter."

The once unquestioned dynamism of the United States in the world marketplace is being tested as never before, forcing Americans to confront dramatic changes in standard of living, expectations and values. This is the fourth of sixth articles exploring these changes. Succeeding articles will address "competitiveness" as a political issue and the outlook for the future.

The concerns stretch beyond economic vitality to the international security arena. "As we get less competitive, the burden of maintaining the U.S. policy of national security will get more onerous on the economy," said Cohen, the Berkeley economist.

National Security Concerns

Stephen Krasner, a specialist in international economics and politics at Stanford University, agreed. "You can't think of the United States as the dominant power as it was in the past," he said. "That has to have military implications. It doesn't make sense for the United States to maintain the defense commitment it has in a world in which it is not the hegemonic power in the West."

Does it pay, for instance, for the United States to increase its naval presence in the Persian Gulf, as it did this month, to protect the sea lanes so that Western Europe and Japan can get the oil their economies need? "It would be better if Japan and Europe were protecting interests that are much more vital to them than to the United States," Krasner said.

"Can the world's largest debtor nation remain the world's leading power?" asked Bergsten in his Foreign Affairs article.

"Can a small island nation [Japan] that is now militarily insignificant and far removed from the traditional power centers provide at least some of the needed global leadership? Can the United States continue to lead its alliance systems as it goes increasingly into debt to countries that are supposed to be its followers? Can it push those countries hard in pursuit of its economic imperatives while insisting on their allegiance on issues of global strategy? Can it hold its allies together in managing the security system?"

There is new pressure on the United States to change, to end what some see as a complacency and weakening of the human spirit and to begin to compete fully in the new world environment.

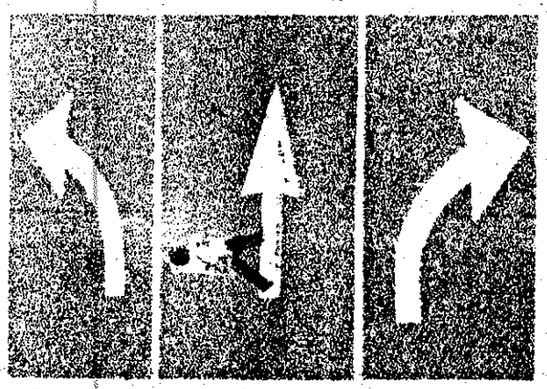
Now, Aho said, "we will see how much vibrancy this economy has."

NEXT: Politics of "competitiveness"

RUDE AWAKENINGS

BY JAMES M. THRESHER—THE WASHINGTON POST

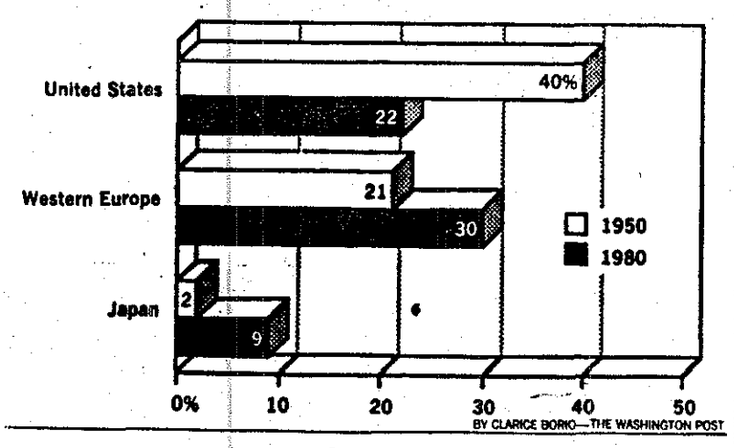
Korean workers prepare Hyundais for export to the United States and Canada. In the United States, the car set a first-year sales record for imports.



Virtually all the experts agree that the era of overwhelming U.S. dominance of the international economy, which began after World War II, is over.

A CHANGING BALANCE: THE U.S. SHARE OF WORLD GNP

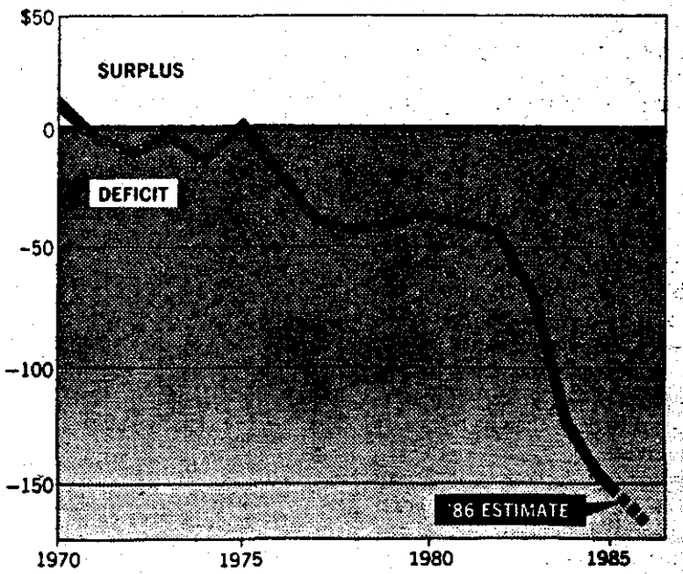
IN PERCENT



BY CLARICE BORIO—THE WASHINGTON POST

U.S. MERCHANDISE TRADE BALANCE

IN BILLIONS OF DOLLARS



SOURCE: U.S. Department of Commerce

BY JO ELLEN MURPHY—THE WASHINGTON POST

themselves as involved in an important global competition. It was an insular stance, common in many U.S. industries, that would later be seen as one of the causes of America's mounting trade deficit.

"Around 1974 RCA aborted its VCR project," said Frank McCann of the company's Consumer Electronics Division, now owned by General Electric. "It seemed clear the consumer just wouldn't buy it. What we didn't appreciate back then was that the Japanese would keep working on the VCR."

Within two years, both Sony and JVC (Japanese Victor Corp.) developed two-hour VCRs. Rising to beat the competition, Matsushita came out with a four-hour machine.

Pattern of U.S. Reluctance

What would come to be called the VCR revolution, accounting for an appreciable share of the U.S.-Japan trade imbalance, had been won by the Japanese. The United States lost, according to many analysts, not because American scientists and engineers had abandoned their heritage of Yankee ingenuity but because American industrial managers were unwilling to invest the resources to apply that ingenuity long enough to make a good idea pay off.

"It's not as if the United States is caught by surprise by what the Japanese or anybody else is doing," Brooks said. "Our people know what's possible. What we've been surprised by is the rapid commercialization of ideas in Japan."

Brooks said a common U.S. pattern is to avoid investing in new products that aren't fairly sure to return profits quickly and to withhold marketing a new advance in an existing product line as long as its predecessor is selling well. And, until recently, U.S. companies have not planned seriously to compete in international markets.

Japan, by contrast, holds global economic dominance to be a national goal, invests long and heavily in research and development and devotes far more of its best engineering expertise to sophisticated manufacturing methods.

Such factors have given Japan the advantage even though its scientific and technological innovativeness remain well behind that of the United States in all but a few narrow fields.

Although the United States spends more in total dollars on research and development (R&D) than Japan and the next two closest competitors, West Germany and France, combined, according to figures gathered by the National Science Foundation, those competitors have been increasing their spending dramatically in recent years.

In relation to the size of each country's economy, all four countries are now investing about the same in science and engineering research.

In 1986 the United States spent 2.8 percent of its gross national product on R&D, only a modest increase from the 2.6 percent spent in 1970.

Japan, by contrast, has increased its spending faster. In 1970 it invested 1.9 percent in R&D, but climbed steadily to match the United States' 2.8 percent by 1985, the last year for which figures are available. West Germany spent 2.1 percent in 1970 and grew to 2.6 by 1985. France went from 1.9 percent in 1970 to 2.4 percent in 1986.

Many analysts say, however, that the U.S. figures are misleadingly high because this country spends nearly one-third of its R&D money on military research, a far greater proportion than is spent by Japan or West Germany. If military spending is subtracted for the most current figures, the United States spends only 1.9 percent of its GNP on research and development, while Japan spends 2.6 percent and West Germany 2.5 percent.

Some experts note that it is not necessary to be the creator of a marketable idea to make money manufacturing the product. "Americans and especially members of the scientific community have exaggerated the purely economic benefits that flow from leadership at the scientific frontier," Stanford economist Nathan Rosenberg said.

As the costs of high-tech innovation rise, he said, the economic advantage goes to the imitator who can skip the costs of basic research, learn from the innovator's mistakes and come to market quickly with an improved version of the product.

Britain and the jet engine offer an older illustration. Although widely cited as an example of a major industrial power that has slid into global economic impotence and, in some ways, a declining standard of living, Britain continues to be one of the world's leading scientific innovators—second only to the United States as an originator of important fundamental technological advances.

"When a country falls behind in competitiveness, the last thing they fall behind in is innovation," Harvard's Brooks said. "The first thing is manufacturing and marketing."

Although Britain invented the jet engine, U.S. imitators—doing to Britain what Japan now does to the United States—reaped most of the economic benefits.

Britain's pioneer jet airliner, the Comet 1, turned out to be a financial disaster. Only when Boeing and Douglas picked up the idea, added some improvements and manufactured it to higher standards, did jet airliners sweep the world's aviation market.

What has slipped in the United States, Rosenberg contends along with many others, is the ability of industry to capitalize on "next generation" improvements in good ideas, regardless of where the idea originated.

"To a far greater degree than we once believed," Rosenberg said, "a first-rate, domestic scientific research capability is neither sufficient nor even necessary for economic growth." More critical is the sophistication of the nation's manufacturing ability.

Different Cultures at Work

Many observers attribute much of Japan's rise to what amounts to a cultural difference between the way U.S. and Japanese scientists and engineers work.

American engineers often prefer to work in research and development rather than in manufacturing. In the United States, the engineer who invents a product holds higher status and earns more money than the engineer who figures out how to manufacture it to high standards and keep it profitably low in cost.

One painfully obvious result, according to many, is that while the United States still spawns plenty of brilliant ideas, there are too few first-rate engineers to design good products based on the ideas. And when they are designed, those products often contain many times more defects than do Japanese counterparts.

"The relatively lower status and lower pay that have characterized careers in [U.S.] manufacturing represent an impediment to attracting first-rate people. Engineering departments in colleges and universities have largely ignored the field until very recently," a panel of the National Academy of Engineering concluded in a 1985 report. "In sharp contrasts, in both Europe and Japan the status of technical education and of careers in manufacturing is higher."

By having better brains in manufacturing, the Japanese and the Europeans are able to develop superior manufacturing methods and technology.

A related difference that yields poorer quality American products, according to a study of computer manufacturers done jointly by two experts in technology management, one an American and the other a Japanese, is that Japanese engineers move easily back and forth between R&D and manufacturing.

American R&D engineers, according to the study, not only come up with a new product idea, they produce the final specifications and simply turn them over to a separate manufacturing division. Japanese R&D engineers design only to a rough prototype stage, leaving the final specifications to manufacturing engineers.

Often a key R&D engineer will then move with the product to the manufacturing division, a step rare in the United States but part of the normal career ladder in many Japanese firms.

Under the Japanese system, experts in manufacturing technology

are free to complete the design in accordance with their knowledge of sophisticated manufacturing methods. They may modify the product design to ensure more reliable quality after manufacture. They may even invent new methods to make the product. As a result, the Japanese product can be made more easily, more cheaply and with much lower risk of defects.

The study was done by D. Eleanor Westney of the Massachusetts Institute of Technology's Sloan School of Management and Kiyonori Sakakibara of Hitotsubashi University in Tokyo.

Other key differences between the Japanese and American styles of managing engineering talent, according to Westney and Sakakibara, include:

- Japanese firms invest far more time and money in advanced training for their engineers than do American firms, partly because they have little fear that highly talented individuals will be hired away by rival firms. It is traditional for Japanese engineers to stay with an employer for life. One result is that hundreds are sent abroad to study for months or years—most often at American universities, which many Japanese regard as the best in high-technology fields. At MIT, for example, there are more than 100 Japanese engineers taking classes at any given time. Japan's much vaunted "fifth generation" computer project, in which the country hopes to leapfrog American computer technology, is based largely on innovations borrowed from U.S. computer scientists at MIT.
- While many Japanese engineers are soaking up the most advanced R&D skills and knowledge in U.S. universities, far fewer American engineers go to Japan, even to learn what Japan does best, advanced manufacturing technology.
- Although engineers everywhere often engage in "bootleg research," using company resources to pursue personal projects on the side, American firms try to discourage such activities because the engineers may then leave to exploit their ideas in new, spinoff entrepreneurial firms. Japanese companies encourage such sideline research, confident that the engineers will stay and turn the new ideas into valuable products for the company.

Another important difference, cited by many analysts and illustrated by the history of the VCR, is the greater willingness of Japanese firms to spend money over longer periods of time to bring a new product idea to fruition. U.S. firms are often run by professional business managers, untrained in engineering, who make decisions to maximize short-term profits.

In Japan, which has no business schools, high-technology firms are more likely to be run by engineers who showed management skills and who have advanced up the corporate ladder. They plan much further ahead and are willing to forgo short-term profits for a long-term advantage.

"American investors need earnings trends quarter to quarter. The Japanese are much more patient," said G. Stephen Burrill, head of a high-technology consulting group at Arthur Young, an accounting firm.

Next Battle: Biotechnology

Electronics has been one of Japan's oldest arenas of high-tech competition. One of the newest is biotechnology, another field pioneered chiefly in the United States and which promises a multibillion-dollar market supplying medicine with more effective drugs and diagnostic tools and supplying agriculture with various products to enhance crop yields. Japan's approach to biotechnology illustrates what many scientists see as another of that nation's advantages—Japan's method of creating government-supported consortiums of private corporations.

U.S. biologists invented gene splicing, also called recombinant DNA technology, and developed most of the methods of applying the technology. Although a swarm of new American entrepreneurial biotech firms has emerged, the Japanese are pushing hard to capture much of the market. Many leaders of U.S. biotech firms believe it will be hard, though not impossible, to stay ahead of Japan.

The once unquestioned dynamism of the United States in the world marketplace is being tested as never before, forcing Americans to confront dramatic changes in standard of living, expectations and values. This is the second of six articles exploring these changes and their causes.

As in many other fields, a key feature of Japan's drive is its unusual degree of cooperation among related industries and universities and the Japanese government's strong encouragement and financial support for a coherent national program in this area.

While antitrust laws prevent U.S. biotech firms from collaborating and while tradition leads many to pursue their goals apart from federal labs, Japan's Ministry of International Trade and Industry (MITI) has created a consortium of 14 major corporations to collaborate on biotech. Global domination in biotechnology is an official national goal under one of Japan's 10-year "Next Generation Projects."

Howard A. Schneiderman, vice president for R&D at Monsanto, a major biotech firm, sees his company as having to compete not just with other firms but with all of Japan.

"Monsanto, du Pont and Eli Lilly cannot cooperate in biotechnology," Schneiderman said. "We must be competitive, at arm's length. Yet Monsanto must be able to compete scientifically and commercially in biotechnology with MITI's consortium of 14 great companies in biotechnology and must compete with Japan's national commitment to biotechnology."

Monsanto's answer, and that of many other firms, is to seek collaboration with U.S. science-oriented universities.

"No MITI consortium in Japan, no industrial combine in the U.S. or elsewhere can duplicate or compete with the basic research capabilities of America's great research universities," Schneiderman said.

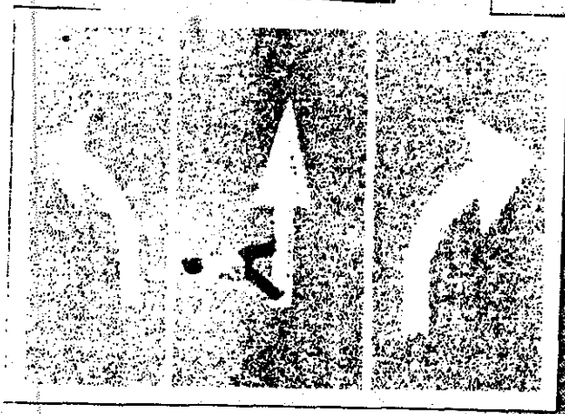
While such corporate-university collaborations are developing, there is controversy as to whether industry's need for proprietary secrecy conflicts with the traditional openness of university research.

Most university-based research in biotechnology is funded by federal grants and some industry leaders, such as Ronald E. Cape, chairman of Cetus Corp., a California biotech firm, worry that spending in this area has not grown significantly in several years. Because Japan's spending on basic biotech research is continuing to grow, Cape forecasts that Japan will take the world lead in biotechnology in the 1990s.

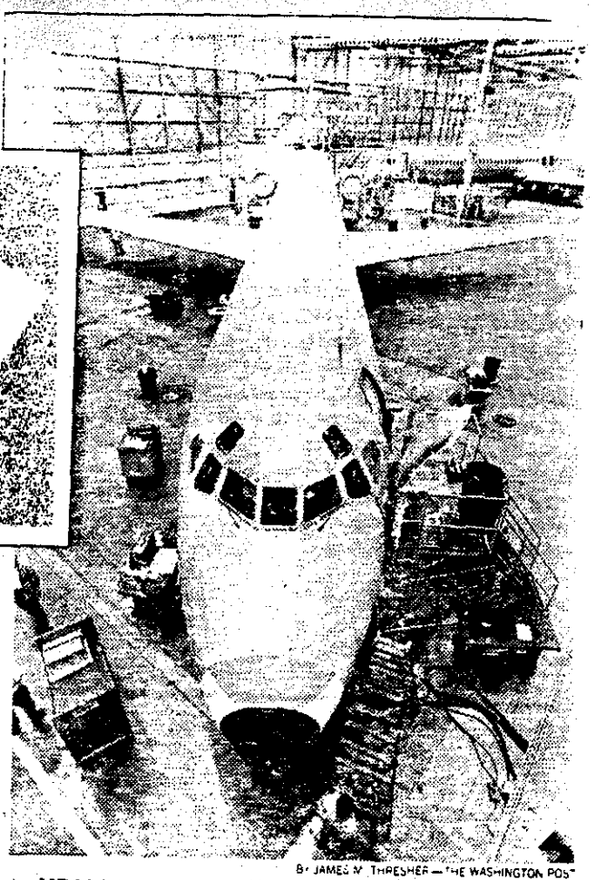
"In 10 years, if what I'm saying is correct," Cape says, "I bet we'll have hearings in Congress and a lot of American industrialists will bitch and moan about how the Japanese have done unfair things in trade. But that is not the case with biotechnology. The Japanese are doing the right thing."

NEXT: The role of education

RUDE AWAKENINGS



The United States may have lost the VCR revolution because industrial managers were unwilling to invest resources long enough to make a good idea pay off.

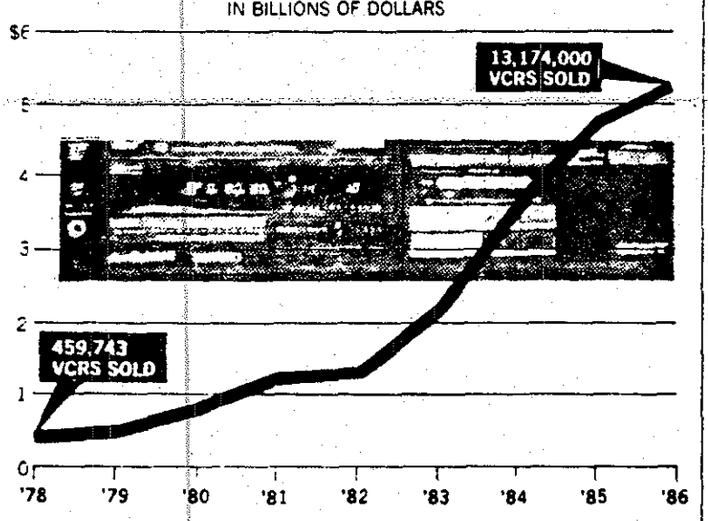


BY JAMES M. THRESHER—THE WASHINGTON POST

An MD80 jet nears completion at a McDonnell Douglas plant in Long Beach, Calif. Britain invented the jet engine, but U.S. imitators, including McDonnell Douglas, improved on the idea and reaped most of the economic benefits—doing to Britain what Japan now does to the United States.

MISSED OPPORTUNITY

VCR SALES FROM MANUFACTURERS TO U.S. DEALERS
IN BILLIONS OF DOLLARS

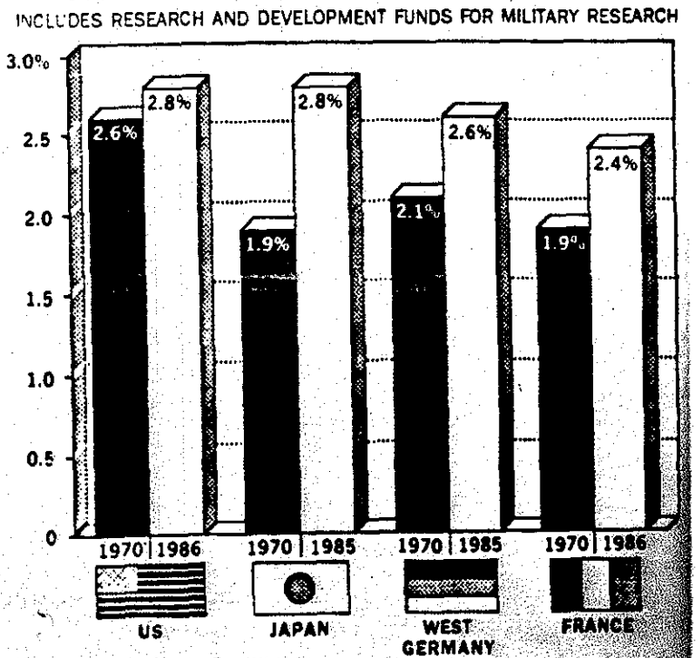


SOURCE Electronic Industries Association

BY JO ELLEN MURPHY—THE WASHINGTON POST

PERCENTAGE OF GNP SPENT ON RESEARCH AND DEVELOPMENT

INCLUDES RESEARCH AND DEVELOPMENT FUNDS FOR MILITARY RESEARCH



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