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Commercialization of Technology by Japanese
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Statement of

Allan I. Mendelowitz, Director
International Trade, Energy, and Finance Issues
National Security and International Affairs Division

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Mr. Chairman and members of the Committee:

We are pleased to be here today to discuss some of the factors that contribute to the success of Japanese firms in adapting new technologies to commercial applications. The ability to be the first to bring new products to market, to "commercialize" technology, is crucial for industrial competitiveness. And, some analysts fear that American business is simply not matching the ability of Japanese business to commercialize new technology, and that this difference portends serious problems for the U.S. economy.

The growth of the Japanese economy has been one of the most impressive stories of the post-War era. During the 1960s and 1970s, that economy's growth rate was frequently in the double digits. In the 1980s, the Japanese economy grew at an annual rate of 4.1 percent, compared with a 2.8 percent average for the United States.

Along with the overall growth of the economy, Japanese businesses developed into world-class competitors. Once known primarily as manufacturers of low-quality items, Japanese firms in many industries now manufacture products that define quality standards for the world. In some industries, most notably consumer electronics, Japanese firms are the innovators, the first to

introduce new commercial applications of technological developments.

We are not in a position to say whether American business in general is losing this competition. U.S. firms continue to maintain a strong leadership position in certain key industries and associated technologies, such as aircraft and pharmaceuticals. But Japanese firms dominate other important industries, such as consumer electronics, certain types of office equipment, and robotics. And several recent studies by researchers in and out of government have reported significant strides by the Japanese in a number of advanced technologies.

In view of Japan's economic successes it's natural to examine how this was achieved. What did the Japanese government and businesses do that was critical to achieving this success? It is also reasonable to question whether there are aspects of government policy or business strategies, or the structure of Japanese industry, that would improve the ability of U.S. firms to commercialize technology?

Factors affecting the commercialization of technology by Japanese firms have to be viewed at several different levels. First, macroeconomic policy--the monetary and fiscal policies of the government--sets the stage for commerce, and Japan's macroeconomic policies have favored growth and, implicitly, the introduction of

technologies. Second, the goals, policies and management systems of businesses themselves are key elements in economic success, and Japanese businesses are formidable competitors. Competition among Japanese manufacturers, for instance, is an important force that compels them to push for rapid commercialization of technology. Finally, government policies directed at particular aspects of the economy or particular industries affect the ability of firms to commercialize technologies.

While I will discuss the strategies at these three different levels, it is important to bear in mind that these components are not separate, nor do they operate in isolation. The components of success are inherently interrelated, and the likelihood of success is greatly enhanced by doing everything right. For example, the success or failure of a firm's efforts can depend critically on what the government does, such as pursuing favorable macroeconomic conditions, especially lower interest rates. In addition, an examination of Japanese government policy across time shows that the strategies that led to this success have varied in response to changes in the international and domestic economies; there has not been one strategy. Particularly with respect to industrial policy, the Japanese story is one of flexibility.

MACROECONOMIC POLICIES SET THE
STAGE FOR COMMERCIALIZATION

Macroeconomic policy plays a central role in determining the economic health of a nation. For businesses considering commercialization of new technologies, the cost of capital is a critical variable affected by macroeconomic policy. The cost of capital dictates how a business views investment that is expected to yield a profit sometime in the future. This applies to investment in physical assets such as new equipment, as well as investment in research and development.

The advantages that lower capital costs provide to manufacturers are varied, but can be summed up by pointing to one key implication. A firm with a lower cost of capital can afford to be more patient and have a longer planning horizon than a firm facing higher costs. A macroeconomic policy that leads to lower interest rates and lower capital costs can encourage a firm to adopt a long time horizon. And, with a longer planning horizon, a business can more easily undertake investments that have long payback periods, such as investment in research and development to commercialize new technology.

According to a number of studies, Japanese firms have faced a substantially lower cost of capital than have U.S. firms. This is due largely to differences in national savings rates. These

differences reflect both individual savings patterns and government borrowing and are due in part to higher U.S. outlays for social infrastructure and defense. Other determinants of the cost of capital to firms include differences in the tax system facing corporations, and various aspects of firm structure and behavior.

Measuring the cost of capital across countries is not a straightforward exercise, due to the variety of factors involved. But studies have revealed substantial differences in the cost of capital for Japanese as compared to U.S. firms in the 1970s and early 1980s. These differences, while they have likely narrowed in recent years due to partly integrated world capital markets and other factors, are still significant.

JAPANESE INDUSTRIAL STRUCTURE AND BUSINESS BEHAVIOR HAVE FACILITATED COMMERCIALIZATION

Three characteristics of Japanese industry are important to understanding its success. Taken together, they have provided an atmosphere that facilitates innovation.

First, much of Japanese industry is characterized by fierce horizontal competition. Almost all industries in which Japan has achieved particular international success contain at least several domestic rivals. Automobiles, consumer electronics,

semiconductors, fax machines, and machine tools are just several examples. Rivalry forces firms toward automation, higher technology, and new products, and for many industries, leadership position shifts frequently among competitors. One observer noted that Japanese firms accustomed to this environment often find competing with foreign rivals a relief.

Second, one aspect of Japanese business that has been critical to their ability to innovate is the structure and management of many Japanese firms. For example, Japanese firms were first to adopt on a broad scale the total quality management model propounded by American experts such as W. Edwards Deming and Joseph Juran.

In this approach, satisfying the customer's needs and wants is the key to gaining success in the market. One of the ways that this happens is through the reduction in cycle time required for the introduction of new products. The best-managed Japanese firms, including many of those that have succeeded in American markets, have emphasized a relentless pace for the introduction of new products. This results in part from superior coordination of design and manufacturing, such that information is shared quickly across various activities of the firm.

These relatively short cycle times provide increasing opportunities for introducing the latest technologies into the marketplace. For example, a comparison of U.S. and Japanese

automakers found that the Japanese brought new products from the conceptual stage to market introduction in about two-thirds the time of American producers. And actual product cycles can differ by a greater amount. It is not unusual to find cars in the United States and Europe with a 10 year model life, whereas many Japanese models change every 4 to 5 years.

There are, of course, examples of American firms that have commercialized new technologies quickly and successfully. Motorola was the first to market a compact cellular phone, and is now the world leader in that market. And its pagers, supplied to Nippon Telephone and Telegraph, were introduced in 1982 and now claim a major share of that market. Similarly, Xerox, which experienced substantial loss in market share during the 1970s and early 1980s, has reversed that trend through increasing attention to quality, reducing the number of suppliers that it deals with, and equipping their products with the features customers want.

Finally, ownership ties among Japanese businesses can facilitate commercialization through reducing risk and fostering the exchange of information. These ties can be both vertical and conglomerate in nature. And even among firms not part of these formal structures, or keiretsu, there are often strong, continuing buyer-seller relationships.

These vertical relationships are not necessarily permanent. But their relatively long term nature, particularly by U.S. standards, have an important implication for commercialization of technology. They can facilitate joint development of new products, including the transfer of technology, between parts suppliers and the manufacturers of final products. Because the firms have a long term relationship, it is in each firm's self interest to cooperate and invest in product development, increasing the speed of commercialization.

Auto parts sourcing provides an interesting example. Japanese auto makers have each developed a network of a few hundred suppliers of components, generally avoiding becoming vertically integrated producers of auto parts themselves. Unlike U.S. parts suppliers, these firms play a major role in product development. This provides an incentive to invest in specialized facilities and develop a close working relationship with the auto producer. If their performance and rate of quality improvement doesn't measure up, the automaker might step in with loans or technical assistance, or as a last resort replace the supplier. This combination of commitment and competition has contributed substantially to the success of the Japanese auto industry in commercializing technologies.

THE JAPANESE GOVERNMENT'S INDUSTRIAL POLICY
HAS BEEN VARIED AND FLEXIBLE

As Japan's macroeconomic policies have aided commercialization through a relatively low and stable cost of capital, Japan's government has carried out a variety of policies directed at specific industries or technologies. Through the 1960s, Japan's postwar economic strategy focused on rebuilding basic industries and catching up with other industrialized countries. The government's role during that period has been described as fairly heavy-handed, directing scarce capital and resources into selected sectors, imposing limits on foreign entry, and providing export assistance to selected industries. The targeted industrial policy actions enhanced the effects of macroeconomic policies that provided artificially low interest rates and exchange rates that favored exports.

The Japanese steel and shipbuilding industries, for example, evolved largely in conjunction with specific plans for expansion and very favorable loan programs. These two industries, I might add, are among those that subsequently received government assistance in scaling back operations as world demand conditions changed.

It is also interesting to note that Japanese industry was not always compliant in this era of strong direction. Consolidation

was an early--and recurrent--theme in the government's plan for the automobile industry, which the industry consistently rejected. And Japan's targeting of specific industries has not always been correlated with immediate success. For example, in the case of civilian aircraft, government assistance has been substantial; yet the industry has not thus far evolved into a world class competitor.

Since about 1970, industrial policy in Japan has reflected the conviction that Japan's international competitiveness is linked to success in high technology industries. Support of industries such as computers, electrical machinery, precision instruments and robotics was carried out during the seventies and eighties using a variety of tools.

Two examples are worth outlining briefly. The first is robotics. Robots were introduced in Japan in 1967. The industry developed, at first, with little or no government assistance. In the late 1970s, the government officially recognized the industrial robot as a means of boosting productivity, and improving product quality. As a means of expanding the demand for robots, and thus reducing the risk to firms engaged in bringing this technology to the marketplace, the government established in 1980 the Japan Robot Leasing Company. The Japan Robot Leasing Company has been the recipient of low interest loans that have enabled it to lease robots to small and medium sized firms, turning a capital cost for

those firms into an operating cost. In addition, the industry received a special depreciation allowance and MITI support for research and development. In 1991, due to a combination of management and economic factors as well as the government support, Japanese producers dominate the world market for robotics.

A second example is the government's role in the semiconductor industry. In the infancy of Japan's semiconductor industry, the government's primary role was to provide trade protection. During the 1970s, the importance of the semiconductor industry became clear to Japanese government and industry, and the government's role in the industry grew. Beginning around 1973, MITI provided substantial research and development support for individual firms and for consortia. The Very Large Scale Integration Project was begun in 1976, with the goal of developing large scale integrated circuits. Several firm participated, with the help of success-conditional government loans. The success of this effort played an important role in Japan's move to a leadership position in the world semiconductor market.

The Japanese government's broad role in influencing Japanese industrial and technological development continues to evolve. The role of MITI, the government agency traditionally at the center of Japan's industrial policy, has shifted from forcing the direction of commercialization to supporting more fundamental R&D with broader applicability. MITI's activities, such as support of

research and development consortia and government labs, and publication of scientific and technological agendas for the future, may serve primarily to signal the country's technological and commercial future, and thus reduce the risk to particular firms of undertaking certain research and development efforts.

As Japan has moved to the frontier in many areas of applied science, there is much interest in its future role in pushing out that frontier through engaging in basic research. While the proportion of GNP spent on research and development is similar for Japan and the United States, only a fraction of Japan's spending is in basic research. And while there are several areas where Japan's basic research is considered world class, most of the country's research and development is undertaken by industry, which focuses understandably on research with foreseeable commercial applications. The Japanese government has announced its intention to substantially improve its basic research capabilities and output.

IMPLICATIONS

Japanese success in commercializing new technology has occurred in a historical context, with a number of factors working together. At different times, the public and private strategies that led to that success have varied in importance. The involvement of the government in the structure of industry is less important today

than it was 30 years ago, for instance. The strategies, goals, and management systems of businesses are much more important contributors today than they had been earlier.

Nevertheless, there are three areas which are worth examining closely to see what implications they may hold for U.S. policy. First, it is clear that the macroeconomic policies of a government set the context within which other government and private strategies can succeed or fail. In Japan, the macroeconomic policies have contributed to a lower cost of capital than in the United States, enabling Japanese businesses to have a more patient planning horizon.

Second, while we pay much attention to the role of government in the Japanese success story, it would be a mistake to overlook the importance of Japanese business. Those businesses not only had the advantages that were created by lower capital costs; they also have been strong competitors. Japanese firms have been leaders in implementing management systems that are driven by the need to satisfy customers. This has meant significantly shorter product development cycles than are generally seen in U.S. firms, enhancing the likelihood that they would be first to commercialize new technologies important to consumers. The nature of business relationships in Japan, most visible in the keiretsu, also contribute to faster introduction of new technologies. Stable, long term supplier-customer relationships among firms enable them

to move more quickly and in a more coordinated manner to bring emerging technologies to market than might be possible with business relationships not built on the shared interests of a long term relationship.

Finally, government programs have been important, but the government's role has not been static. Compared with the policies that were in place thirty years ago, Japanese industrial policy today is not as forceful. It remains important, however, as a signaller of the direction of future technological development in Japan, and as a sponsor of longer range, riskier research and development projects not as attractive to industry.

If we are to draw any lesson from this brief overview it is that there is no single key to success. Success starts with well managed firms focusing on meeting the needs of their customers. While government alone cannot bring about industrial success, its policies can reinforce or hamper the efforts of the private sector. Macroeconomic policies that lower the cost of capital can reinforce the efforts of a well managed company, just as macroeconomic policies that make the cost of capital too high can frustrate the efforts of even the best managed firms. A similar analysis can be made for a whole host of government activities, including tax policy, government supported research and development spending, defense procurement, and education.

It is clear that while the United States does not have an industrial policy, the federal government does have an array of programs and policies that affect the competitiveness of U.S. industry, including the rate at which new technology is commercialized. Some of the government's actions promote competitiveness and others retard it. There is no consistency to the government's influence on the competitiveness of U.S. industry. This lack of consistency was of less significance when U.S. industry was the unchallenged world leader. However, U.S. industry now faces formidable foreign competitors. Our response must recognize the extent to which actions of the public and private sectors are interrelated and how important it is that we strive to do everything right.