Japan's Technological Innovation

By Dr. Wakasugi Ryuhei

Technological innovation activates corporate competition and expands the market by offering new products and better production methods. The long-term growth and structural changes in the Japanese economy stem largely from technological innovation. Understanding specific characteristics of technological innovation, which have heavily influenced the Japanese economy, is important in understanding potential future changes. At the same time, the Japanese experience can provide a useful model for developing countries that are facing high growth, and for Russia and east Europe, both of which have yet to take off.

Innovation and growth

In Japan an extremely close correlation can be seen between economic growth and research and development (R&D) investments over the long term (Chart 1). What mechanism lies behind this? Postwar technological innovation in Japan was actualized through the importation of Western technology spurred by vigorous capital investment, a good example being the move towards chemical and heavy industry in the 1960s.

Japanese industry was not part of the rapid technological advancements that many Western countries enjoyed during the Second World War. Thus, steel, petrochemical and machine industries aggressively tried to import Western technology in the 1950s and 1960s. The bulk of this imported technology was used to set up production plants and contributed to activate production. During the '60s, when the Japanese market experienced its fastest growth, companies competed vigorously for new technology imports and facility expansion. This resulted in lower product prices and a wider market as technological innovation boosted new demand and corporate growth. This in turn spurred high economic growth which provided incentives for further R&D and capital investment, resulting in a favorable connection between technological innovation and economic growth.

The 1970s accelerated domestic R&D investments and dependency on foreign technology declined. This has been illustrated by the growing proportion of corporate R&D expenses compared to sales, and the latter by falling technology import expenses relative to R&D expenses. This meant that Japan's capital investment in technological innovation experienced a

Chart 1
R&D Expenses & Economic Growth

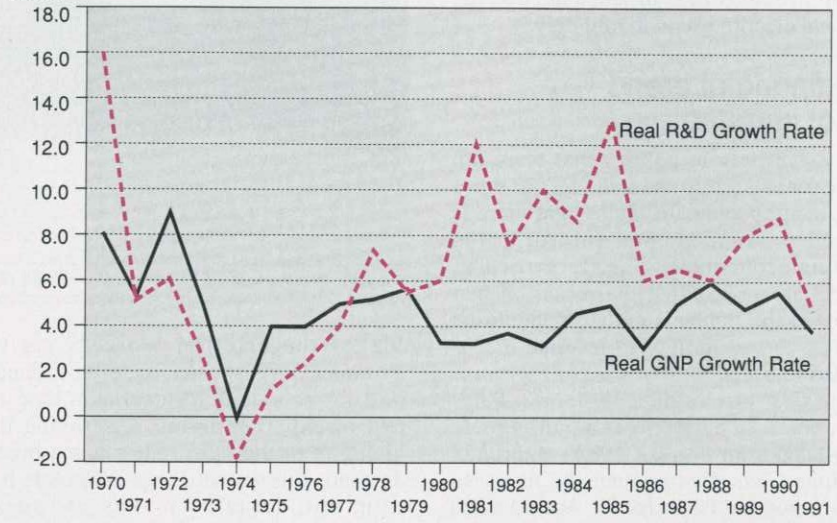
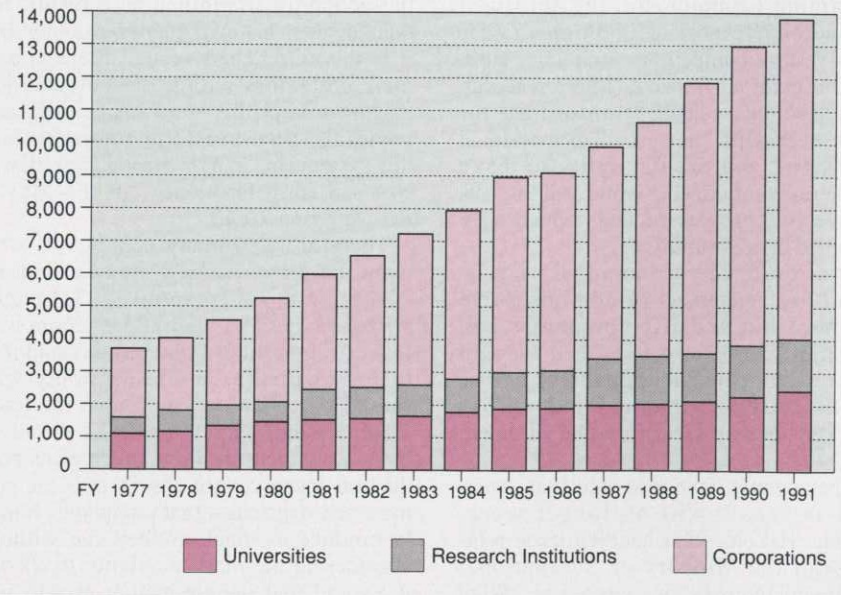


Chart 2
R&D Spending – By Spenders
Source: *Science and Technological Research Investigation Report*



transformation from imported to domestic technologies. In both cases, however, innovation producing new capital formation has always been the result of capital investment. It was fortunate for the Japanese economy that a favorable relationship between technological imports and R&D, innovation, capital investment, and demand growth was established, and the economy continued to expand. This aspect of the Japanese economy can be summarized as follows: A simultaneous realization of both the Demand Pull process (growing demands resulting in new technological innovation) and the Technology Push process (technological accumulation resulting in new technological developments).

Private-sector R&D diversification

The private sector has played a major role in Japan's aggressive R&D investments. Over the past 20 years, corporate R&D investment far surpassed university and research institution expenditures (Chart 2). Private-sector R&D institutions tend to be more sensitive to market needs than universities and public institutions. Just how sensitive has the private sector been? First, we should note that the growth rate of R&D expenses differs from industry to industry. For example, during the 1980s, the R&D to sales ratio rose sharply in the drug, communications, and electronics equipment industries, widening the gap compared to the chemical, steel and auto industries (Chart 3).

Secondly, when examining R&D expenses by product, rather than by industry, we find an interesting development. In drug, communications and electronics machinery products, there has been significant R&D activity by outside corporations, such as steel or chemical, as well as by mainline corporations. This shows how Japanese companies have aggressively invested in the R&D fields where market needs were growing. While this partially stems from diversification strategies, it is also indicative of Japanese corporations' flexible and innovative response to market needs.

Photo: Sumitomo Metal Hasaki Development Center

Sumitomo Metal Research Development laboratories conduct experiments on the cultivation of a new breed of grass.

Profitability-oriented R&D

According to some statistics, R&D spending can be divided into three areas: basic, application and development. On a corporate level, there has been little proportional change in these three areas over the past 10 years. Similarly, at universities and public institutions, the changes have been negligible. Since the proportion of corporate spending on basic R&D is very small in comparison with universities and other public institutions, however, a sharp rise in the overall corporate R&D spending would considerably change the proportions of Japan's total R&D spending. Moreover, the three categories are rather subjective—basic studies by corporations should be different in nature from those at universities. As a result, we should attribute the trend of growing corporate R&D investment as a shift in Japan's overall R&D resource allocation from basic to development projects.

This shift can be explained as follows. The optimal input level, such as human resources, for corporate R&D is the point where marginal revenue from R&D activities meets their costs. At universities and public institutions this resource input level is determined externally by the financial budget. As there is a limit to the total domestic capital and human resources that can be allocated to R&D, these funds tend to go to the profitable private sector rather than the pure research done in basic studies. While the market-sensitive corporate R&D institutions has provided innovation and economic growth, it should also be remembered that it has also caused some unexpected problems.

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Chart 3
R&D/Sales Ratio By Industry