# 12 Research and Development and Economic Growth in Japan

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## *I. INTRODUCTORY*

There is no question that science and technology play one of the most important roles in the economic growth of advanced countries. However, when one attempts to discover the relation between the effort devoted to research and development and the economic growth of a nation, it is not easy to find a simple correlation between them.

In the case of Japan, in fact, there exist several studies on the relation between expenditure in research and development and the growth of national income or gross national product. The correlations are generally very good; for example it was shown that during the period 1953 to 1960 G.N.P. ($y$) could be related to investment in research ($x$) by an equation of $y = 6{\cdot}55 + 44{\cdot}3x$ with a correlation of $r = 0{\cdot}980$, and a much higher correlation was found when research investment was related with G.N.P. with a lag of two to four years [1].

Once, however, one turns to international comparisons the facts become more complicated. In contrast to the continuous high rate of economic growth since World War II, the total expenditure of research and development in Japan has always been at a relatively low level compared with similarly industrialised European countries And again, an international comparison of indicators of technological innovation made by O.E.C.D. shows that the ranking of Japan is low among O.E.C.D. countries [2]. Thus a simple macroscopic comparison indicated no positive relationship between research and development and economic growth in Japan.

This apparent paradox has not been generally understood even by the Japanese themselves, because though the high rate of economic growth of Japan may be attributed to several other causes, no one can deny that the rapid growth has been based on successful introduction and development of advanced technologies in industry.

A clue to the interpretation of these facts may be found in the recent understanding of technological innovation as an integrated process in the industrial system, combining such stages as technical development, investment, production and sales. The effect of

B. R. Williams (ed.), *Science and Technology in Economic Growth*
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research and development effort on the economic growth of a nation should be evaluated in such context.

In the following paper the author has attempted to set out his views, though based on qualitative observations, regarding the pattern of research and development and its contribution to the growth of the economy as illustrated by the process of technological innovation in Japanese industry [3].

## *II. THE TRANSFORMATION OF INDUSTRIAL STRUCTURE*

The rapid growth of 9 to 10 per cent per year in the Japanese economy since the war has not been a mere matter of expansion but has resulted from a substantial change in industrial structure. There has clearly been a general shift from primary to secondary industry. The most remarkable change, however, has taken place inside the sector of manufacturing industry itself.

After the war the objective of Japanese industry was to strengthen its competitive capacity in international trade and to transform the industrial structure to a more advanced type, with emphasis, that is to say, on 'heavy and chemical industries'. After complete defeat and complete loss of her pre-war colonies, everyone, the government and industry alike, was convinced that this would be the only way to reconstruct the Japanese economy.

The success of the transformation can be seen in the figures showing the relative proportion of heavy and chemical industries – the percentage, that is, of products of machinery (including electric), metals, and chemical industries, within the total of all industries. In 1950, the figure was about 50 per cent and reached 64 per cent in 1960, which is about equivalent to that of the industrialised countries in Europe and the United States. It also can be seen that the structure of exports has followed the same pattern as that of industrial production with a lag of a few years; the relative share of the heavy and chemical industries in exports was 38 per cent in 1955, 43 per cent in 1960 and reached 62 per cent in 1965.

This shows that the transformation of industrial structure started first in production for the domestic market and then extended to export. It should also be noticed that the demand in the international market has followed a similar trend of decline in raw materials, food and natural fibres and increase in advanced industrial goods such as machinery, vehicles, and chemicals, and that this has contributed to the increase in the competitiveness of Japanese industry in the international markets.

Since heavy and chemical industries are all technology-intensive, the growth of the economy and the transformation of industrial