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A Long-term Comparison of Productivity in the Manufacturing Industries of the United States and Japan

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This writer, jointly with Dr. Tangjun Yuan of Hitotsubashi University, has conducted a comparative study of labor productivity in the manufacturing industries of the United States and Japan for the pre-World War II period. Following are some recent studies relating to international long-term comparisons of productivity as well as the results of the present study.

Methodology of International Long-term Comparisons

In comparing the wealth or productivity by industry of one nation with that of another, the different price levels in the two countries must be taken into account. Even if the yen-dollar exchange rate is 120 yen to the dollar, if the price of a particular commodity in Japan is twice the price of the same commodity in the United States under this exchange rate, then it will be necessary to apply a conversation rate of 240 yen to the dollar (purchasing power parity) to compare the productivity of the two countries. This is the concept of Purchasing Power Parity (PPP) used in international comparisons.

There are two methods of obtaining Purchasing Power Parity: One is the approach from the side of the purchaser, in which the prices to the purchaser of goods and services of equal quality are obtained for final goods for consumption and investments. An example of this approach is the United Nations' International Comparison Program (ICP). The other is the approach from the production side, in which unit values of goods are collected from production statistics. An example of this approach is the ICOP of the University of Groningen in the Netherlands.

Estimations based on unit values, such as those of The International Comparisons of Output and Productivity (ICOP), have the problem of not adequately taking into account the difference in qualities. On the other hand, the ICP and other approaches from the purchaser's side fail to gather adequate data on price differentials on intermediate inputs, which are essential for a comparison of productivity at industry level.

The databases of Penn World Table of the University of Pennsylvania in the United States and Angus Maddison of the University of Groningen compare per capita gross domestic products (GDPs), using PPP in a certain year (e.g., 1995, 2000) obtained from the ICP. From these benchmarks, they make international long-term comparisons of productivity by extrapolation, using the data on per capita GDP growth rates, which are estimated by national governments or private researchers.

The EU KLEMS Project by the European Union, in which this writer is participating, also uses benchmarks based on the 1997 PPPs obtained from ICOP or ICP and extrapolates using the time-series data on each country's output in order to make an international comparison of productivity by industry since 1970.

These methods, which use a single benchmark, have the following problems. 1) Markedly different growth rates can be obtained depending on the base year (weighting of production amounts) of the real production data series used for extrapolation (Gerschenkron effect); 2) For countries with high degrees of dependence on trade, trends in the relative level of living standards will vary, due not only to differentials in economic growth rates but also to changes in terms of trade (terms of trade effect) and 3) The reliability of economic growth rate estimates is low when the comparison includes a period of confusion, such as a world war.

Recently, many researchers, including Stephen Broadbery of Warwick University, have estimated PPPs of different points in time, including the years before World War II, aiming at international comparisons based on multiple benchmarks.

1935 Productivity in the Manufacturing Industries of Japan and the United States

With these considerations in mind, we have compared the productivity of the manufacturing industry in Japan with that in the United States for the year 1935. Using Japanese industrial statistics and Industrial Statistics of the United States, we have obtained the PPP between the United States and Japan by industry by comparing the ex-factory unit prices of equivalent products according to classification under the most-detailed product categories. We were able to compare unit prices of goods for 31.7 percent of the total amount of output in Japan.

Yukizawa (1977) and Pilat (1994) compared the productivity of Japan and the United States during World War II. Yukisawa did not estimate the PPP, but used the conventional method of comparing the amount of output per unit of labor input for each item. As Pilat chose 1939, the year when the Japanese economy was moving toward a controlled economy under the National Mobilization Act enacted due to the war with China, this choice is considered inappropriate as a benchmark for a productivity comparison.

As shown in the U.S.-Japan comparison for 1935 (Table), Japan's per capita total output converted into the U.S. dollar using the exchange rate of the time was 24 percent of that of the United States for all manufacturing industries. However, given the long working hours and the low ratio of value added in Japan, the difference in labor productivity is thought to have been greater than this figure suggests. The fact that the unit product price in Japan was a mere 53 percent of that in the United States was responsible for the fact that the productivity gap was no greater than the above figure.

Table
A Comparison of Manufacturing-Industry Productivity
Between Japan and the United States: 1935

| | Amount of total annual output per worker (U.S.\$, figures for Japan are those converted into the U.S. \$ using the exchange rate of 3.42yen /U.S.\$, effective at the time.) | | Ratio of value added | | Annual average hours worked | | Gross value added per hour worked (\$) | | Japan's absolute price level (U.S.=1) | Japan's labor productivity (U.S.=1) |
|------------------------------|---|--------------|----------------------|-------------|-----------------------------|--------------|--|-------------|---------------------------------------|-------------------------------------|
| | Japan | U.S. | Japan | U.S. | Japan | U.S. | Japan | U.S. | | |
| | a | b | c | d | e | f | g=a*c/e | h=b*d/f | | |
| Textiles | 974 | 3,356 | 0.12 | 0.42 | 3,209 | 1,774 | 0.04 | 0.80 | 0.36 | 0.12 |
| Metals | 2,528 | 5,294 | 0.23 | 0.42 | 3,081 | 1,813 | 0.19 | 1.22 | 0.69 | 0.23 |
| Machinery | 1,164 | 5,445 | 0.51 | 0.44 | 3,158 | 1,809 | 0.19 | 1.34 | 0.59 | 0.24 |
| Ceramics, clay & stones | 893 | 3,605 | 0.66 | 0.63 | 3,003 | 1,812 | 0.20 | 1.25 | 0.41 | 0.38 |
| Chemical | 2,320 | 7,165 | 0.26 | 0.40 | 3,133 | 1,892 | 0.19 | 1.53 | 0.40 | 0.32 |
| Lumber products | 854 | 2,630 | 0.65 | 0.53 | 2,975 | 1,958 | 0.19 | 0.72 | 0.53 | 0.49 |
| Paper and printing | 1,076 | 4,557 | 0.41 | 0.59 | 3,256 | 1,896 | 0.14 | 1.43 | 0.53 | 0.18 |
| Food | 2,161 | 10,237 | 0.14 | 0.29 | 2,958 | 1,962 | 0.10 | 1.53 | 0.82 | 0.08 |
| Other manufacturing | 774 | 6,238 | 0.37 | 0.40 | 3,075 | 1,682 | 0.09 | 1.48 | 0.18 | 0.34 |
| Manufacturing average | 1,340 | 5,469 | 0.25 | 0.42 | 3,132 | 1,817 | 0.11 | 1.26 | 0.53 | 0.16 |

Source: Compiled by this writer and Dr. Tangjun Yuan.

In the manufacturing industry as a whole, Japan's labor productivity was 16 percent of that of the United States (the column on the far right). Japan's specialization in textiles and other labor-intensive industries was one of the factors in Japan's low productivity. When the weighted average of labor productivity by industry is obtained based on the same weight of distribution of workers among industries in Japan, Japan's labor productivity was 20 percent of that of the United States, which was somewhat higher than the 16 percent.

Judging from the results of comparative studies between the developing nations and the advanced, industrialized nations since the end of World War II, it is estimated that price differentials between the United States and Japan in the service industries were greater than in the manufacturing industries, because of the absence of international trade in the former.

Technology gaps on the other hand, are thought to have been smaller. This writer took part in an earlier joint study for the estimation of 1935 PPPs on the purchaser's side between the United States and Japan. The study showed that the level of prices relating to gross domestic expenditure in Japan was 43 percent of that of the United States and that Japan's per capita GDP, after taking into account price differentials between the two countries, was 32 percent of that of the United States. Thus, it is safe to say that the outcome of the present study is consistent with these findings.

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