International Comparison of Japanese Industrial Productivity

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Measurement of Productivity

There are many indices aimed at evaluating firms' performance. Share price, ROE, ROA, and market share are examples of indices commonly used to evaluate performance. However, the evaluation of an industry to which firms belong, differing somewhat from the evaluation of the firms themselves, is often conducted from a policy perspective. If the products are high-quality and are produced through efficient use of the necessary production factors, the industry is considered to be showing high productivity. High productivity in an industry is desirable from the perspective of the consumers of the goods or services that the industry produces, as well as other industries that use the goods or services as intermediate input. Moreover, enhancing productivity usually implies that employees in that industry will be able to secure higher wages, which means that if the productivity of many industries in the country can be improved, then it is possible to enable the country to enjoy higher income. This is why enhancing industrial productivity is a critical policy objective for the improvement of economic welfare as a whole.

The very first step in enhancing the productivity of an industry is to know and measure its level of productivity. Economic analysis has focused on productivity by looking at how efficiently an industry conducts production by its use of such factors as intermediate input, labor and capital. The most typical indices of this productivity are labor productivity and total factor productivity (TFP).

Labor productivity is derived by dividing the total quantity of production in an industry by the labor input required for that production (usually represented by the total number of labor hours of all workers). This index is easy to understand and also relatively easy to estimate. Measuring TFP is different. It is necessary here to adapt the concept of production functions that are used in economics; the methodology behind the estimate is somewhat complicated and depends on the assumptions used in the production function. On the other hand, labor productivity does not explicitly consider the impact of other production factors such as intermediate input and capital. (For example, it makes sense in a country with cheap labor to use more labor input relative to other production factors. This results in lower labor productivity, but this is a natural outcome.) TFP does explicitly consider the impact of important production factors other than labor, enabling more meaningful analysis of productivity.

There are two ways to measure TFP of an industry: on the basis of gross output (total production volume), which includes intermediate input; or value-added, which excludes it. In principle, it is desirable to estimate the gross output-based TFP, rather than value-added-based TFP. A gross output-based TFP makes it possible to conduct a more general analysis, since this measurement is based on a more flexible form of production function.

Labor productivity measured on a value-added basis is a concept similar to income *per capita* and brings intuitive clarity to the policy implications of enhancing labor productivity. Therefore, this report focuses its arguments mainly on labor productivity measured on a value-added basis.

Common Currency Unit Necessary for International Comparison of Productivity

To make an international comparison of productivity in an industry, it is necessary to convert the value of production in each country into a common currency unit. For example, the value of production in the Japanese auto industry can be derived in yen terms by adding up the value of production in each of its car models, while the value of production in the US auto industry can be similarly obtained in dollar terms by adding up the value of production in each of its car models. However, the value of production in yen and the value of production in dollars cannot be compared directly since they are denominated in different currencies. Thus they must be converted into a common currency unit. The simplest way is to use the market exchange rate. However, the market exchange rate fluctuates significantly on a day-to-day basis as a result of financial and speculative factors, which means that the value of production also changes significantly depending on the timing of the exchange rate. Moreover, exchange rates do not necessarily reflect the price levels of any given country, since they are affected mainly by the state of international trade and interest rate differentials. These problems, which come up when using market exchange rates, can be solved to some extent by using purchasing power parity (PPP), which takes inter-country price level differences into consideration.

The PPP required for the international comparison of the values of production of individual industries is the PPP on the production side, and not the PPP on the expenditure side that the World Bank, OECD and others use in international comparisons of *per capita* income. Using PPP on the expenditure side as the purchasing power parity for production means including indirect taxes, distribution margins, transport costs and other elements, which moves the outcome away from the actual production costs.

PPP on the production side is derived by directly comparing

between each country the unit values of similar production items. The unit value of a product is derived by dividing the value of its production by its volume. The unit value ratio (UNR) is used for the international comparison between similar products of the unit values thus derived. The UNR at the industrial level is derived from these UNRs at the individual product level as the weighted average of the individual products proportionate to the value of production of the industry as a whole. The University of Groningen in the Netherlands has taken the lead in estimating PPP to be used in international comparisons of values of production and productivity.

Issues in Measuring Productivity in the Service Industries

There are service industries in which it is inherently difficult to define and measure output. The output from many services such as education and medical care cannot be measured by market prices since they are under government control and are not delivered directly through the marketplace. In services such as distribution and entertainment, where increasingly longer business hours are not necessarily generating more revenue, this is not captured as increased output. Moreover, it is often difficult to evaluate the quality of the output in services in contrast to manufacturing. This makes it difficult to arrive at the appropriate deflator in calculating the size of the output in real terms. A deflator is used to measure the price of an identical amount of the service received. If improvements in the quality of the service are not captured, it will be difficult to understand whether a rise in the price in real terms is due to an improvement in quality, an overall rise in the level of prices, or something else.

The possibility cannot be denied that the production and productivity of the service industries are being underestimated because it is difficult to keep track of quality in these industries. It is likely that even though the quality of the services provided by service industries has been improving, that is not being captured as increased output. As an economy develops, its center of gravity shifts from primary industries to secondary, then tertiary, industries, a phenomenon known as Petty-Clark's law. The Japanese economy is no exception; tertiary industries in recent years have produced more than 70% of Japan's GDP. As the service industries come to command the lion's share of the national economy, it becomes difficult to keep track of production volume and productivity. International comparisons are particularly difficult to make with accuracy since the substance of demand regarding services and the quality of those services differ widely and it is difficult to grasp the volume of production in a way that reflects the specific quality of the services in each country.

International Comparison of Labor Productivity

Charts 1-4 compare the labor productivity of Japan and Germany in 2000, 2005 and 2009, fixing US labor productivity at 1 for each year. The EU-KLEMS and World Input-Output (WIO) databases, developed with the University of Groningen in the lead, were used for this comparison. *Charts 1-4* represent the overall economy, the market economy, the manufacturing industry, and non-manufacturing industries, respectively. In this context, the term "market economy" means all industries except sectors — such as government, medical care, education and housing — where the services are not being provided at prices determined in the market.

A comparison of the labor productivity of the overall economy shows Japan stagnating, at approximately 0.6 (US=1; same hereafter). Germany was relatively productive in 2000 at 0.9, but declined gradually to 0.8 by 2009.

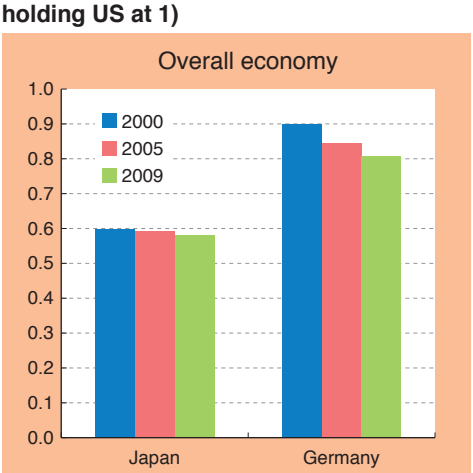
Chart 2 shows labor productivity excluding government, medical care, education and others, where there are the aforementioned serious problems regarding errors in the measurement of the quality of services. The time series shows trends similar to *Chart 1* for all three countries. However, the level of productivity for the market economy is almost 0.1 point lower than those in the total economy in *Chart 1* in all three countries.

Chart 3 compares labor productivity in the manufacturing

CHART 1

Comparison of labor productivity in overall economy

(labor productivity in Japan and Germany, holding US at 1)

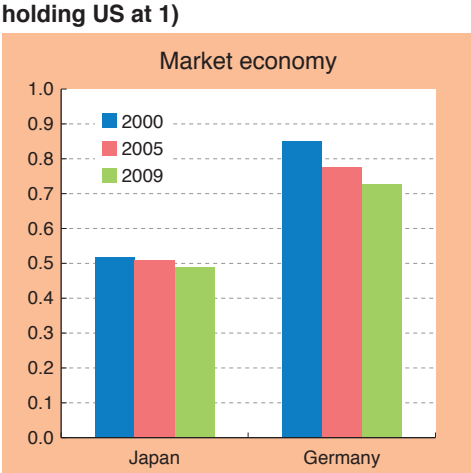


Source: Calculated by author using EU-KLEMS and WIO databases

CHART 2

Comparison of labor productivity in market economy

(labor productivity in Japan and Germany, holding US at 1)



Source: Calculated by author using EU-KLEMS and WIO databases

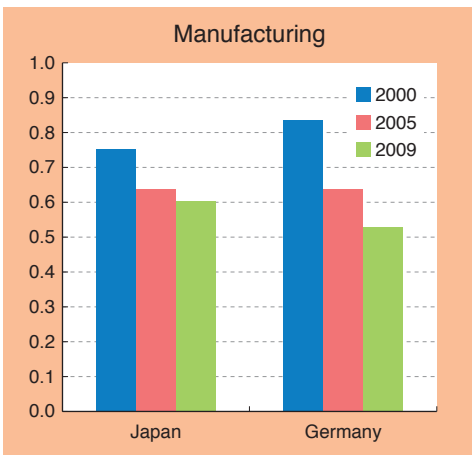
industry. Japan's figures in comparison to the US's are slightly lower than for the market economy as a whole, while Germany's are higher. However, Japan, which had registered more than 0.7 in 2000, sagged to 0.6 in 2009. Germany has seen its manufacturing productivity decline in comparison to the US from over 0.8 in 2000 to slightly under 0.5 in 2009. When it comes to the non-manufacturing industries in the market economy, labor productivity in Japan trails the US by a vast margin, while Germany's is not that far behind, as *Chart 4* shows.

As we have seen, Japan's labor productivity has stagnated throughout the first decade of the 21st century, mainly due to the productivity slump in the non-manufacturing industries.

CHART 3

Comparison of labor productivity in manufacturing

(labor productivity in Japan and Germany, holding the US at 1)

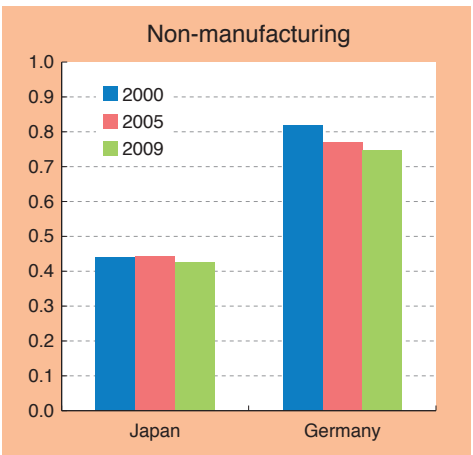


Source: Calculated by author using EU-KLEMS and WIO databases

CHART 4

Comparison of labor productivity in non-manufacturing market economy

(labor productivity in Japan and Germany, holding the US at 1)



Source: Calculated by author using EU-KLEMS and WIO databases

The reason why labor productivity in Japan has been stagnating is mainly because of slow growth rates in value-added in the 1990s and 2000s. We will see the factors contributing to this stagnation in the growth rates in these two decades in the following section.

Growth Accounting by Industry in Japan

Table 1 shows the results of the contribution analysis of GDP or value-added growth (excluding housing and activities not elsewhere classified) in the 1970s, 1980, 1990s and 2000-2009 for labor input growth, capital input growth, and TFP growth. (*Tables 1-3* are based on the Japan Industrial Productivity Databases at the Research Institute of Economy, Trade & Industry.)

Labor input growth and capital input growth are each disaggregated into quality growth and quantity growth. The contribution of labor input growth is disaggregated into the increase in man-hours and improvement of labor quality. The contribution of capital input growth is disaggregated into the increase in capital volume and the improvement of capital quality. Quality improvement signifies the increase of workers' wages and capital with higher production capability.

The 1970s and 1980s saw high TFP growth rates averaging 2.2% and 1.5% annually, respectively. This dropped to 0% in the 1990s. This nearly 2 percentage point deterioration in the TFP growth rate was the major reason why GDP growth stalled in the 1990s.

The GDP growth rate fell further in the 2000s because, in addition to the continued stagnation of TFP and labor input growth, the growth rate of capital input decreased by 0.7-1.6 percentage points compared to the 1970s, 1980s and 1990s.

As *Table 2* shows, manufacturing delivered high annual GDP growth rates of 5-6% in the 1970s and 1980s. The source of most of this growth rate in the 1970s was the TFP growth rate, which averaged 4.2% annually during this period.

The annual GDP growth rate in the 1980s for manufacturing accelerated another percentage point over the previous decade, an outcome mainly attributable to the rise in labor and capital input growths, with each increasing about 1 percentage point during this period. Businesses increased hiring and invested aggressively during the economic bubble in the latter half of the decade. While this increase in the input of production factors was going on, the TFP growth rate declined about 1 percentage point.

Manufacturing GDP growth stalled in the 1990s. Labor input growth, man-hours in particular, plummeted, while the TFP growth rate also dropped significantly and capital input growth also slowed. The 1990s was truly a "lost decade" for manufacturing.

The manufacturing GDP growth rate turned negative in the 2000s. Labor input growth remained underwater (man-hours repeated the more than 1-percentage point decline in the 2000s) and the capital input growth rate remained low, while the TFP growth rate declined slightly in comparison to the 1990s, to an annual average of 0.7%.

Non-manufacturing (market economy only; housing and activities not elsewhere classified excluded), like manufacturing, enjoyed high GDP growth rates in the 1970s and 1980s; unlike manufacturing, there was almost no improvement in the growth rate in the 1980s from the previous decade. The GDP growth rate in the 1990s and 2000s stalled; like manufacturing, the growth rate declined further from decade to decade.

The high non-manufacturing secter GDP growth rates in the 1970s

and 1980s were mainly attributable to the increase in labor and capital input growths; the contribution from the TFP growth rate was small. In the 1990s, the contribution from increased capital input was higher than in manufacturing. The rising market value of stock and real estate during the economic bubble increased collateral values, making it relatively easy to secure funds from financial institutions. Distribution, real estate and construction firms and the like took advantage of this and aggressively made capital investments, leading to a dramatic increase in capital stock.

Meanwhile, the TFP growth rate for non-manufacturing had already stagnated in the 1970s and 1980s, at only slightly above 1%. This already low figure dropped below zero in the 1990s, and has continued underwater since 2000 at -0.5% annually.

In addition to the aforementioned stagnation of the TFP growth rate, the poor GDP performance in the 1990s and 2000s was also attributable to the slowdown in the growth of labor and capital as production factors. However, the decline in labor input growth had less to do with this than in manufacturing; the contributive effect of the decline in man-hour growth is lower than in manufacturing.

TABLE 1

Decomposition of GDP growth rate in overall economy (excluding housing & activities not elsewhere classified) by factor

	1970-80	1980-90	1990-2000	2000-2009
GDP growth rate	4.6%	4.4%	0.9%	0.2%
Contribution of labor input growth	1.2%	1.0%	-0.1%	-0.2%
Contribution of man-hours growth	0.3%	0.4%	-0.6%	-0.7%
Contribution of labor quality growth	0.8%	0.6%	0.5%	0.5%
Contribution of capital input growth	1.3%	1.9%	1.0%	0.3%
Contribution of capital quantity growth	1.6%	1.5%	1.0%	0.2%
Capital quality growth	-0.3%	0.4%	0.1%	0.1%
Contribution of TFP growth	2.2%	1.5%	0.0%	0.1%

Source: From Research Institute of Economy, Trade and Industry website

TABLE 2

Decomposition of GDP growth rate in manufacturing sector by factor

	1970-80	1980-90	1990-2000	2000-2009
GDP growth rate	5.1%	6.1%	0.7%	-0.2%
Contribution of labor input growth	0.1%	1.1%	-1.2%	-1.4%
Contribution of man-hours growth	-0.6%	0.6%	-1.8%	-1.9%
Contribution of labor quality growth	0.7%	0.5%	0.5%	0.5%
Contribution of capital input growth	0.8%	1.7%	0.9%	0.5%
Contribution of capital quantity growth	1.1%	1.3%	0.8%	0.3%
Capital quality growth	-0.3%	0.5%	0.1%	0.2%
Contribution of TFP growth	4.2%	3.3%	1.0%	0.7%

Source: From Research Institute of Economy, Trade and Industry website

TABLE 3

Decomposition of GDP growth rate in non-manufacturing sector (market economy only; excluding housing & activities not elsewhere classified) by factor

	1970-80	1980-90	1990-2000	2000-2009
GDP growth rate	4.2%	4.3%	0.7%	-0.3%
Contribution of labor input growth	1.5%	1.0%	0.0%	-0.1%
Contribution of man-hours growth	0.4%	0.3%	-0.5%	-0.7%
Contribution of labor quality growth	1.1%	0.7%	0.5%	0.5%
Contribution of capital input growth	1.7%	1.9%	1.1%	0.3%
Contribution of capital quantity growth	1.9%	1.6%	0.9%	0.1%
Capital quality growth	-0.2%	0.4%	0.1%	0.2%
Contribution of TFP growth	1.1%	1.4%	-0.4%	-0.5%

Source: From Research Institute of Economy, Trade and Industry website

For the Improvement of Japan's Labor Productivity

We have shown that the TFP growth rate has played a crucial role in determining the growth rates of the overall economy and value-added in industrial sectors. The TFP growth rate for manufacturing has stagnated since the 1990s, while the TFP growth rate for non-manufacturing has endured four straight decades of stagnation since the 1970s. The key to accelerating economic and labor productivity growth in the Japanese economy is to raise the TFP growth rate for non-manufacturing, which accounts for more than 70% of the overall value-added.

What policies, then, are required to raise Japanese non-manufacturing productivity and TFP? Many studies show that the fundamental reason why TFP growth rates have stalled is that employment, capital and other production factors remained tied up in sectors where international competitiveness was lost and demand was stagnating, while labor redeployment and capital investment failed to materialize properly in areas where there was potential for more demand due to regulatory and other obstacles. Therefore the top policy priority must be on regulatory reform in non-manufacturing, particularly in the services sector, where there are expectations for actualizing potential demand, and then Japan can improve its international competitiveness through the rationalization of resource allocation, and enhance the growth and productivity of the economy. JS

Tomohiko Inui is a professor at the College of Economics, Nihon University, specializing in international economics and productivity analysis. He has previously worked for Development Bank of Japan and the Statistics Commission Office at the Cabinet Office.