Productivity Is Key to Sustainable Growth in Japan

A Statistical Analysis Based on Macro- & Micro-Data

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Introduction

Japan has been mired in economic stagnation for almost two decades, during which time its nominal GDP has remained unchanged. Recently, business has been picking up thanks to the Bank of Japan's drastic loose monetary policy and a recovery in earnings of exporting companies benefiting from the yen's depreciation since the end of last year. But the serious difficulties facing the Japanese economy, such as public debt having reached around 200% of GDP and the continuing aging of the population and low birth rate, make the economic outlook for Japan over the long term as gloomy as ever.

We need to consider the outlook for productivity, that is to say the improvement of economic efficiency, as one of the most important factors, as well as demographics, when thinking about long-term economic growth. In this article, I will introduce the latest academic econometric analyses in measuring productivity in Japan and their outcomes to show the long-term outlook for the Japanese economy and the issues to be considered in achieving growth.

Measuring Productivity Growth Rate in Japan

Productivity has drawn the attention of economists in reflecting on not only business activities but also macroeconomic policy as an indicator of Japan's competitiveness or sources of wealth. For example, in order to raise *per capita* income it would be necessary to produce more goods and services per person or hour by boosting productivity. Labor productivity, a well-known and frequently used measure, originally stems from this perception, namely the concept is output divided by labor input. However, this indicator does not take into consideration the input rather than the labor, such as renovated production facilities and improvement in the quality of raw materials. Given the demerit of this concept, we use Total Factor Productivity (TFP) more often as an indicator in measuring overall productivity in economic analysis.

TFP is a comprehensive productivity indicator that takes into consideration not only labor input but also capital input (production facilities) and intermediate input (raw materials). It is thus referred to as an indicator of the impact of the introduction of new technology, new know-how, and new management upon production efficiency in business and is considered a vital element in thinking about economic growth.

The OECD and other international organizations, national government research institutes and universities are actively engaged in measuring TFP growth rates. In the case of Japan, the Japan Industry Productivity (JIP) database project, of which the author is a part, publishes its research outcomes on TFP on the Research Institute of Economy, Trade and Industry (RIETI) website. This database covers TFP on 108 industrial sectors, or macroeconomic level TFP, by aggregating the sectorial outcomes annually, and in its most updated version the data from 1970 to 2009 (calendar year) are included.

More specifically, how exactly is the TFP growth rate to be measured? It would evidently be difficult to measure the impact of the introduction of a new technology or an improvement in management formulas only by statistical data. So the TFP growth rate should be measured by so-called growth accounting, which is an indirect way of measurement defined as the residual after subtracting from the GDP growth rate the contribution of each production factor, labor and capital (production facilities) to the whole national economic growth. If we can compare growth accounting to changes in a person's weight, it would be like measuring each ingredient's contribution to the change in a child's weight — such as a 20-kilogram increase from the age of 10 to 15. In this example, we can resolve this 20-kg increase into the possible increase caused by each ingredient such as carbohydrate or protein. In this analogy, TFP can be compared to the efficiency of energy absorption from nutrition, and thus any further increase of weight due to absorption of the same calories through the improved efficiency of energy absorption would be like the improvement of productivity through an increase of the TFP growth rate.

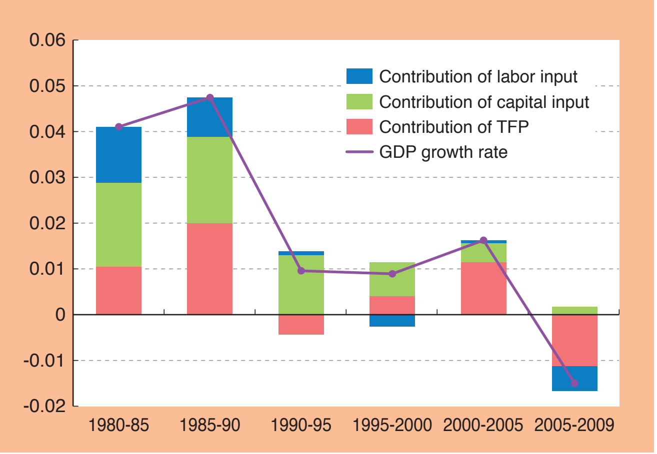
Chart 1 shows a breakdown of the average economic growth of Japan during every five-year period since 1980. The Japanese economy achieved almost 5% growth annually on average until 1990, but since then the annual growth rate has been only 1%, slowing down significantly. In Japan, we call this long-term stagnation the "lost two decades". We can clearly see from the chart why economic growth has slowed down.

First of all, the contribution of labor input has significantly decreased due to a decline in the working population resulting from a falling birth rate and the aging of society. The contribution of the labor input from 1975 to 1990 to annual economic growth was around 1%, but after 1990 its contribution fell to nearly zero and since 2005 has been negative.

A decline in TFP's contribution to growth since 1990 has been another principal cause of the stagnant economic growth rate. TFP's contribution to economic growth used to be 1-2% before 1990 but since then it has largely declined to much less than 1%. In the first half of the 2000s this figure came back to 1%, but it has fallen to nearly

CHART 1

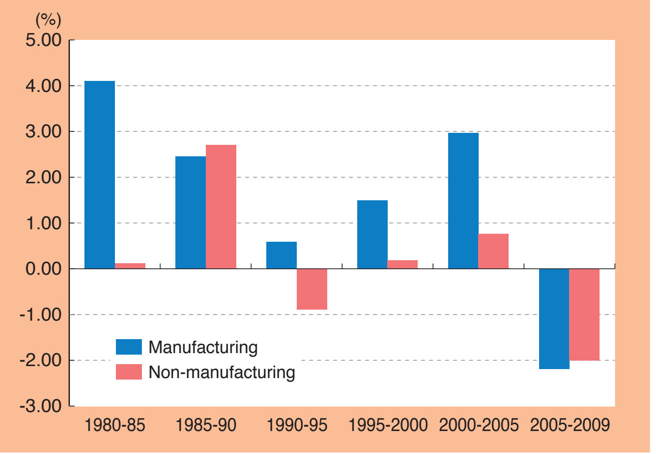
Breakdown of GDP growth rate
(growth accounting)



Source: Compiled by author by referring to RIETI, JIP database

CHART 2

TFP growth rates of manufacturing industry & non-manufacturing industry



Source: Compiled by author by referring to RIETI, JIP database

minus 1.5% annually on average since 2005.

Chart 1 highlights the crucial role of the TFP growth rate in the future long-term economic growth of Japan. It is clear that in the future Japan's working population growth will be very stagnant due to aging and the low birth rate. Given this, substantive growth in labor input can scarcely be expected.

Stagnant economic growth in Japan has meant stagnant effective demand on the whole and thus companies have not actively expanded private investment to meet any newly created demand. Instead, their business investment has been principally aimed at renewing their outdated production facilities. If this trend continues in the future, we cannot expect an expansion of capital input, since the firms' investment will be mostly for the renewal of such facilities. If this happens, TFP growth will be vital to restoring Japan's GDP growth rate.

The sectoral differences in TFP growth rates would be an important issue. *Chart 2* shows a comparison of TFP growth rates between the manufacturing and non-manufacturing industries. Except for the periods 1985-90 and 2005-2009, the TFP growth rate in the manufacturing sector has been higher than the one in the non-manufacturing sector. The proportion of the manufacturing sector's contribution to GDP is decreasing in Japan and declined in 2009 (the last year for which data is available) to 25%. If this trend of declining weight of the manufacturing industry continues, it will become increasingly important as a policy for Japan to raise the TFP growth rate of the non-manufacturing sector.

New Frontier of Productivity Analysis: How Can We Utilize Enterprise Statistics to Measure Productivity in Japan?

As we have seen, existing productivity analysis has been based on the differences in productivity growth levels among nations and industrial sectors by using data at the macro level, or industry level. But such analysis is based upon data totaling micro-data collected from each individual enterprise, and therefore it is difficult to correlate such macro-data with each individual enterprise's activities.

Today, to supplement the shortcomings of the macro-based analysis, analysts have started using micro-data such as firm-level or plant-level data on their activities to investigate the correlation between a wide range of business activities such as new entries, capital and fund procurement, and M&As with the performance of productivity at the macro level or sectoral level. In Japan, such research has been developed in earnest since around 2000, with the Japanese government having started to open to academic researchers the data it contains on individual firms in a variety of statistics to encourage academics to undertake productivity analysis, stimulated by the evolution of policy research in the United States and Europe using such micro-data.

I would like to introduce a couple of recent examples of such productivity analysis using micro-data.

Breakdown of Productivity Change: Methodology

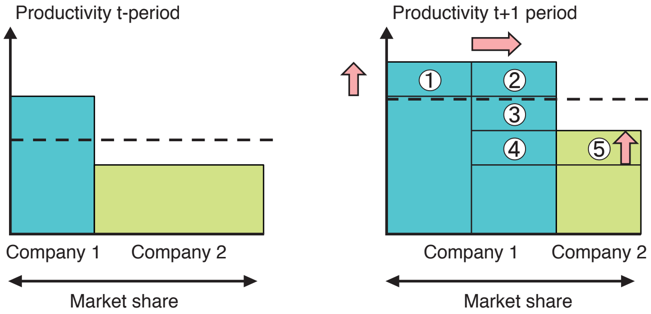
Analysts working on the micro-data of firms or plants for productivity analysis often break down the macro or sectorial productivity change into the impact of each individual firm's or plant's innovation or rationalization of activities, the entry and exit of the firms in each industry, and the change in share among enterprises and plants with differentiated productivity levels.

Chart 3 shows a simple example of this decomposition method, with a company's productivity marked on the vertical axis and its market share on the horizontal axis. Assuming that there are two companies in this market and that Company 1 (higher productivity) and Company 2 (lower productivity) both raise their productivity from the t-period to t+1-period, and simultaneously the market share of Company 1 increases and that of Company 2 decreases, the productivity of the whole industry consisting of these two companies can be calculated as the weighted average of these two firms' productivity levels with their market shares (shown as a dotted line in the chart). Since both companies raise their productivity, the whole industry's productivity also rises.

If we use only macro and industrial data, we can only see the

CHART 3

Breakdown of productivity growth



Source: Kazuyuki Motohashi, "Quantitative analysis of IT innovation: how Japanese economic performance has been changed?" (Nikkei Inc., 2005)

changes shown by the dotted line in *Chart 3*, but by using micro-data from firms or plants we can analyze the details of the sources of such industrial productivity changes.

First, these two companies' productivity growth in total would be the sums of 1 to 5 in this chart. Among these changes, the sums of 1, 4, and 5 — namely changes in productivity over time — are called the within effect. On the other hand, the sums of 3 and 4 are called the share effect, since they are multiplications of the productivity differential and change of share. This effect signifies the impact of the change of market share among the firms upon the whole industry's productivity level, assuming each firm's productivity level is kept unchanged. And 2 corresponds to the effect of Company 1's raising its productivity and an increased market share at the same time, whereas 4 corresponds to the effect of Company 2's raising its productivity and a reduced market share simultaneously. The sums of these two are called the covariance effect. The share effect and covariance effect both signify a change in productivity with a change of market share, and therefore we may call the sum of these two effects a reallocation effect. In *Chart 3*, new entries and exits are not considered, but the new entries of many high-productivity companies or exits of low-productivity companies would bring about improved productivity for the whole economy through a change of market shares among the companies. In that sense, the impact of new entries and exits can be considered the same as the share effect. Incidentally, we call the effect of productivity improvement caused by entries and exits on collected data a new entry effect or an exit effect.

It will be very important in terms of policy implications to analyze productivity improvement in the macroeconomy by using firm-level or plant-level data. For example, if the productivity growth of existing firms, namely the within effect, is a major factor in improving productivity at the macroeconomic level, then innovation policies to encourage existing companies' technological progress, such as promotion of R&D investment, will be important. But if a change of market share among existing companies contributes to improvement of productivity at the macroeconomic level, then competition policy to invigorate new entries into the market or prompt the exit of inefficient companies will be more important.

The latter's impact upon productivity growth in Japan since the 1990s attracts much attention today. This is because the argument predominates that stagnant growth of productivity in Japan is mainly caused by the megabanks' financing of inefficient and less competitive companies, enabling companies that should be eliminated from the market to survive and thus preventing the "natural selection" mechanism of the market from functioning.

History of Economic Analysis Using Japan's firm-level and plant-level data

Let me introduce a brief history of analysis of the micro-data on enterprises. The research done by Prof. Kiyohiko G. Nishimura and others at the University of Tokyo was the first attempt to measure productivity by using Japan's enterprise statistics and analyzing the natural selection mechanism. They used data on individual firms collected for METI's "Basic Survey of Japanese Business Structure and Activities" from 1994 to 1998 and after having compared the productivity of existing firms, entering firms and exiting firms, provided a few noteworthy observations. For example, in the period 1996-1998, among the young firms active for only a year or two after their entry, in some cases exiting firms' productivity was higher than that of existing ones. This suggests the possibility that the natural selection mechanism was not working well in the second half of the 1990s.

Research by Prof. Kyoji Fukao at Hitotsubashi University and Prof. Hyeog Ug Kwon at Nihon University attempted to break down productivity growth by using individual firms' data for METI's enterprises statistics from 1994 to 2001 *(Table 1)*.

The main results of this research were:

1. The exiting effect in the manufacturing industry overall was negative.
2. The share effect and the covariance effect were both positive, but their contribution was rather small.
3. The internal effect was relatively large and its contribution to the TFP growth rate of 2.1% was 1.2%.
4. By industry, the within effect was large in sectors such as pharmaceutical products, telecommunications machinery, electronics components and automobiles, while in the sector of telecommunication equipment the net effect of new entries was large, and in the sector of electronics components the reallocation effect was large.

Furthermore, the research paper published by Prof. Fukao and Prof. Kwon in 2008 (listed as a source in *Table 1*) introduced an analysis of productivity changes using additional data from 2002 to 2005 with largely expanded samples, including part of the non-manufacturing industry such as the wholesale and retail business, also based upon METI's enterprise statistics.

In this research, they tried to clarify the reasons why the productivity growth rate increased in the first half of the 2000s as shown in *Chart 1* by using micro-data. Their conclusion was that the contribution of the internal effect in the non-manufacturing sector as well as the manufacturing one was significantly large. They observed a little improvement in the reallocation effect, but pointed out that the exit effect continued to be negative. According to these observations, the paper concluded that the rise in the productivity growth rate in the first half of the 2000s was brought about by productivity improvement through the restructuring of existing firms.

Finally, I would like to note the result of an analysis of the retail industry based on research done by Dr. Saki Sugano of the Japan Society for the Promotion of Science and myself. Our research analyzed the productivity change in the retail industry by using METI's statistics on the commercial industry's activities in 1997 to 2004 and tried to clarify the role of entries and exits in this change.

According to a study by Prof. John Haltiwanger at the University of Maryland, it is well known that the expansion of a large retail chain store like Walmart following its entry had a great positive impact upon productivity in the retail industry. In Japan as well, considering that large retail stores have continued to increase in number since the abolition of the Large Retail Store Law in 2000, a big regulatory reform, we can assume that productivity increase in this sector has been brought about by expansion of the reallocation effect.

TABLE 1

Breakdown of productivity growth by enterprise statistics

(%)

		Productivity growth rate	Within effect	Reallocation effect			Net entry		
					Share effect	Covariance effect		Entry	Exit
Fukao & Kwon [2006] 1994-2001	Manufacturing	2.10	56	16	-4	20	29	53	-24
Kwon et al. [2008]									
1996-2000	Manufacturing +service	0.96	67	1	9	-8	32	53	-20
2001-2005	Manufacturing +service	1.98	68	7	3	5	25	38	-13

Note: Contribution of each ingredient to productivity growth is shown as rate of contribution by %.

Sources: Kyoji Fukao & Hyeog Ug Kwon, "Why Did Japan's TFP Growth Slow Down in the Lost Decade?: An Empirical Analysis Based on Firm-Level Data of Manufacturing Firms", The Japanese Economic Review, 57(2), 2006; Kwon et al., "Why Has Japan's TFP Growth Recovered?: An Empirical Analysis Based on the Basic Survey of Japanese Business Structure and Activities" (in Japanese), RIETI Discussion Paper 08050, 2008

TABLE 2

Breakdown of productivity change of retail industry

(annual growth rate, %)

	Period	Productivity growth rate	Within effect	Reallocation effect			Net entry		
					Share effect	Covariance Effect		Entry effect	Exit effect
Japan	1997-2004	0.83%	-0.07%	-1.00%	0.87%	-1.87%	1.92%	1.29%	0.63%
US	1987-1997	1.14%	0.18%	-0.17%	0.27%	-0.45%	1.13%	0.62%	0.51%

Sources: T. Matsuura & S. Sugano, "The Effect of Relaxation of Entry Restrictions for Large-Scale Retailers on SME Performance: Evidence from Japanese Retail Census", RIETI Discussion Paper 09054, 2009; Lucia Foster, John Haltiwanger & C. J. Krizan, "Market Selection, Reallocation, and Restructuring in the U.S. Retail Trade Sector in the 1990s", The Review of Economics and Statistics, 88(4), 2006

Table 2 shows the annual growth rate of productivity for the whole retail industry and its decomposition, and gives a comparison of the case of the Japanese retail industry with the analysis of the US case by Prof. Haltiwanger. Though the periods covered by both cases are different, the patterns of productivity growth in both are very similar.

For example, the within effect was small both in Japan and the US, at -0.07% and 0.18% respectively. The share effect, on the other hand, contributed significantly to the growth of productivity from 1997 to 2004. It amounted to 0.87% for Japan and 0.27 for the US. On the other hand, the net effect of entries and exits was 1.13% in the US and 1.92% in Japan, and so Japan exceeded the US in this factor. This suggests that Japan's deregulation of entry limitations, such as the Large Retail Store Law, could encourage a restructuring of the market and raise productivity.

In the manufacturing industry, revolutionary innovation could broadly lower production costs. But in the non-manufacturing industry, most of which is labor intensive, it is often said that there should be fewer possibilities for drastic innovation prompting a significant decline in costs. Given this, as shown in the above analysis of the retail industry, policies to promote competition, such as regulatory reform to modify legal impediments to entries and exits, will be very important.

Conclusion

In outlining the current stage of academic analyses in measuring productivity growth, a key to long-term economic growth in Japan, and showing a few results, I have tried to show through macro and sectoral productivity analyses based upon the JIP database that productivity growth will be increasingly important in economic growth from now on, and in particular, assuming a decline in share of the manufacturing industry, that the productivity growth of the non-manufacturing sectors will be crucial.

Analysis based on firm-level or plant-level data shows that the failure of a natural selection mechanism among existing firms could work as an impediment to the whole industry's productivity growth, while the case study of the retail industry suggests that abolishing the Large Retail Store Law to encourage the survival of the fittest in the market could have contributed to the productivity growth of this sector.

More detailed policy analyses will be necessary in the future in order to clarify the factors which could prevent high-productivity companies from entry and low-productivity companies from exit. In these analyses, we will need to reflect the characteristics of any given firm in greater detail. In recent years, attention has been drawn to the utilization of big data all over the world, and firm-level or plant-level data collected by a national government should also be considered among such data.

I hope that further use of such big data will clarify new policy issues regarding productivity and indicate a new path for achieving high efficiency in business activities. JS

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