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How to make industrial structure resilient in post COVID-19 era? *1

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Abstract

Japan has been struggling not only with the spread of COVID-19 but also with a declining and aging population. To make resilient industrial structures, we analyzed the labor productivity of each industry based on micro-data of Japanese firms. We found that (1) labor productivity tends to increase as the firm size increases, (2) the difference of the ratio of full-time employees in each industry is thought to explain the labor productivity gap among industries, and (3) the higher the ICT equipment ratio, the higher the labor productivity. These results will help further discussion to consider industrial policy.

1. Need to make resilient industrial structure

The IMF forecasted that Japan's real GDP (annual percent change) of 2020 would be -5.8% via the World Economic Outlook released in June. After the spread of COVID-19, it is thought that labor-intensive and low-wage industries would be particularly damaged.[1] For Japan to recover its damaged economy, it is necessary to stop the spread of COVID-19, of course. Furthermore, while combating COVID-19, Japan has also been facing a declining and aging population. Hence, under these situations, improving labor productivity is required not only to achieve sustainable economic growth but also to make resilient industrial structure.

The negative effects of the declining and aging population and the spread of COVID-19 will continue long term, therefore we need to make resilient industrial structure. Japanese society also needs its workers to maintain social distance from others in the workforce while raising the levels of labor productivity. It is due to these reasons that strengthening our businesses using ICT is paramount.

2. Recent research regarding labor productivity

Reviewing recent research on firms' productivity in Japan, Atkinson (2019, 2020) insists that the large

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1 ILO (2020).

share of small firms are the main reason for low labor productivity in Japan, after comparing with other leading countries. Based on this analysis, he stresses the need to enlarge the size of firms.

Various research on the relationship between firm size and labor productivity using Japanese firm-level data have been published recently. Takizawa (2020) divides the firms into two groups based on their sales amount using the firms' micro data from Tokyo Shoko Research Co. Ltd. (TSR) from 2015 to 2018. She finds that; the larger the firm size is, the higher its labor productivity is; the manufacturing industry has higher labor productivity than the non-manufacturing industry on average; low labor productivity of the non-manufacturing industry because of its industrial diversity.

Moreover, Oku, Inoue, and Masui (2020) define firm size based on the number of employees using the annual survey of the Financial Statements Statistics of Corporations by Industry in FY 2018. They find that the larger the firm size is, the higher the wage per person and labor productivity; the relationship between the firm size and labor productivity in the service sector is not as strongly correlated as in the manufacturing sector. They also confirm that labor productivity is positively correlated with wages in both manufacturing and service sectors.

Furthermore, the *White Paper on Small and Medium Enterprises in 2020* defines firm size based on the number of employees and the amount of capital stock as per the Small and Medium-sized Enterprise Basic Act. The data used in the white paper is from the Economic Census for Business Activity in 2016. The white paper points out that labor productivity increases as the size of the firm become larger, but it depends on the types of industries.[2]

These evidences support the fact that there is a positive correlation between firm size and labor productivity, but the level of the correlation differs among industries. However, the definitions of "size" are different in the above researches. In this paper, we define firm "size" based on the number of employees as Atkinson (2019, 2020) and Oku, Inoue, and Masui (2020) define. In addition, we use individual firm data from the Economic Census for Business Activity in 2016 (research period: from January to December 2015).[3]

3. Analysis of labor productivity among industries

3.1 The number of employees by industry, firm size

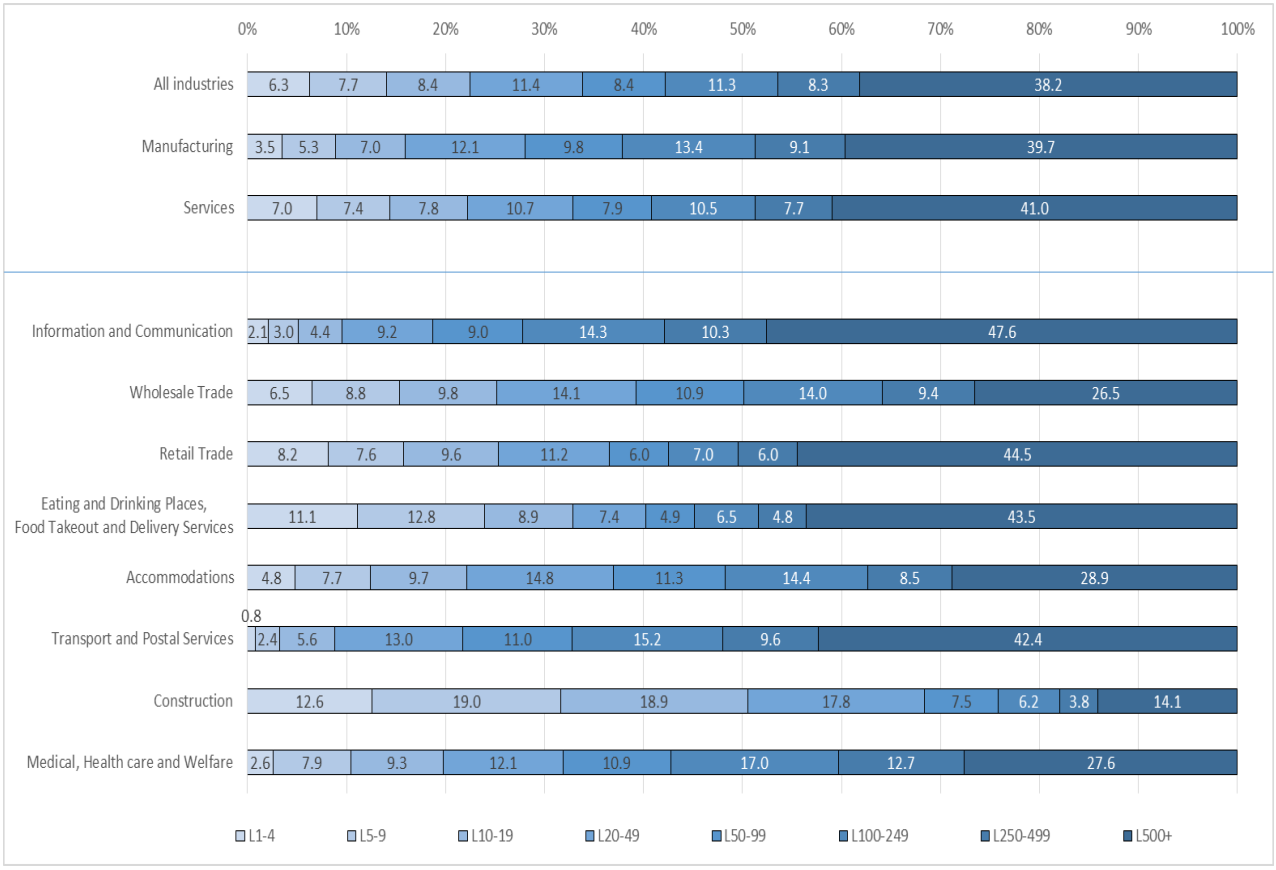
First, Chart 1 shows the number of employees in each industry. For example, in "Information and communication," around half of the employees work at a firm with a size of more than 500 employees

[2] Small and Medium Enterprise Agency (2020) pp. 98-100.

[3] Economic Census for Business Activity in 2016 collected the number of employees data as both regular employees (those who are employed for an unspecified period, and those who are employed for over one month of a specified period) and temporary employees. In this paper, we count the number of regular employees as the number of employees.

(L500+). On the other hand, in "Construction," more than 10% of employees work at a firm with a size of only 1 to 4 employees (L1-4). The degree of firm size differs among industries.

Chart 1 The share of the number of employees in each industry[4]



(Note)
1. We divide firms into 8 categories (L1-4, L5-9, L10-19, L20-49, L50-99, L100-249, L250-499, L500+) based on the number of employees. For example, "L1-4" in the chart indicates firms with 1 to 4 employees.
2. Featured major industries.

(Source) Economic Census for Business Activity in 2016.

3.2 Labor productivity by industry, firm size

Chart 2 shows the average labor productivity of each industry by firm size. There are industries of high labor productivity such as "Wholesale trade" and "Information and communication." On the other hand, industries such as "Retail trade," "Eating and drinking places, Food takeout and delivery

[4] "Services" in Chart 1 includes "Information and communication," "Wholesale trade," "Retail trade," "Eating and drinking places, Food takeout and delivery services," "Accommodations," "Transport and postal services," "Goods leasing," "Living-related and personal services," "Services for amusement and hobbies," "Scientific research, Professional and technical services," "Employment and worker dispatching services," and "Miscellaneous services." In the case of "Medical, Health care and welfare," there are industry-specific circumstances such as official prices being set, and a wide range of industries, from medical care to welfare, are included in one category, so that we have not taken "Medical, Health care and welfare" as an analysis target in this paper.

services," and "Accommodations" are relatively low.

Looking at the firm size in Chart 2, the level of labor productivity tends to increase as firm size increases. Some industries such as "Manufacturing," "Information and communication," "Wholesale trade," and "Construction" have a strong positive correlation between firm size and labor productivity. It means that the larger the firm size, the more labor productivity increases. This tendency is also applied in "Accommodations," even though the level of labor productivity is lower than in the former categories. Therefore, there is a positive correlation between firm size and labor productivity among these industries.

On the other hand, in "Retail trade" and "Eating and drinking places, Food takeout and delivery services," the correlation between the firm size and labor productivity is weak. Specifically, the peak of labor productivity of the "Retail trade" is the firm size of 250 to 400 employees (L250-499), and the peak of the "Eating and drinking places, Food takeout and delivery services" is the firm size of 50 to 99 employees (L50-99).

These results imply that labor productivity is generally correlated to firm size. But some types of industry, such as "Retail trade" and "Eating and drinking places, Food takeout and delivery services" are not so strongly correlated. Why is the relationship between firm size and labor productivity not so strong in these industries?

Chart 2　Comparison of labor productivity levels by each industry and firm size

(10,000yen)

		All industries	Manufacturing	Non-manufacturing								
				Services	Information and Communication	Wholesale Trade	Retail Trade	Eating and Drinking Places, Food Takeout and Delivery Services	Accommo-dations	Transport and Postal Services	Construction	Medical, Health care and Welfare
Labor productivity												
firm size	L1-4	393.0	365.9	338.9	569.8	557.3	311.3	178.9	225.5	870.4	430.3	402.5
	L5-9	403.1	402.5	371.2	474.1	594.5	365.7	180.4	212.8	454.2	420.0	458.4
	L10-19	449.7	453.1	439.4	561.8	684.1	375.7	213.0	255.6	435.9	465.6	445.6
	L20-49	483.3	493.8	496.1	568.6	725.8	340.8	233.9	292.2	445.2	523.5	394.1
	L50-99	505.4	552.5	522.3	647.0	788.2	373.3	236.2	357.4	573.2	597.4	334.5
	L100-249	538.1	633.7	547.2	751.9	858.4	437.8	234.0	359.9	475.9	704.0	289.9
	L250-499	604.5	766.3	574.0	897.8	916.8	521.9	227.3	413.6	490.5	836.5	422.0
	L500+	647.5	894.4	565.9	1006.0	1009.4	435.0	197.1	469.5	498.7	966.0	402.5
	All sizes	417.1	425.9	378.3	571.2	614.4	336.2	185.6	244.6	535.5	442.3	422.7
Correlation coefficient		0.75** (0.031)	0.82** (0.012)	0.49 (0.2187)	0.83** (0.011)	0.76** (0.029)	0.37 (0.364)	−0.20 (0.634)	0.77** (0.026)	−0.12 (0.771)	0.82** (0.012)	0.02 (0.970)

(Note)
1. The labor productivity is calculated by dividing the added value (sales value - total cost + total wages and salaries + tax and public imposition) by the number of regular employees for each firm and obtained average number for each category.
2. The correlation coefficient shows the relationship between the average number of employees and labor productivity of each firm size. ( ) as p-values.
3. Featured major industries.

(Source) Economic Census for Business Activity in 2016.

3.3 Ratio of full-time employees by industry, firm size

Chart 3 shows the average ratio of full-time employees of each firm by industry and by firm size. The ratio of full-time employees in "Retail trade," "Eating and drinking places, Food takeout and delivery services," and "Accommodation" is relatively low. This tendency is almost the same as the industry with relatively low labor productivity analyzed in Section 3.2.

Next, we focus on the ratio of full-time employees by firm size within the same industry. In "Manufacturing," the ratio of full-time employees increases as the firm size increases. Especially, in "Information and communication" and "Construction," the ratio of full-time employees gradually increases as the firm size becomes larger. In addition, the level of full-time employees is relatively higher than the others. On the other hand, "Retail trade" has a low ratio of full-time employees, and the ratio of full-time employees varies with firm size. Looking at "Eating and drinking places, Food takeout and delivery services," the ratio of full-time employees decreases as the firm size increases. From these results, it implies that the difference in the ratio of full-time employees is related to the difference in labor productivity due to the difference in treatments such as wages between regular employees and temporary employees.

Chart 3 Comparison of ratio of full-time employees by industry type and firm size

		All industries	Manufacturing	Non-manufacturing								
				Services	Information and Communication	Wholesale Trade	Retail Trade	Eating and Drinking Places, Food Takeout and Delivery Services	Accommo-dations	Transport and Postal Services	Construction	Medical, Health care and Welfare
Ratio of full-time employees/full-time staffs												
firm size	L1-4	0.652	0.719	0.611	0.733	0.704	0.645	0.371	0.511	0.731	0.793	0.597
	L5-9	0.603	0.653	0.545	0.784	0.719	0.534	0.246	0.374	0.797	0.805	0.544
	L10-19	0.611	0.700	0.538	0.845	0.762	0.369	0.249	0.336	0.833	0.852	0.516
	L20-49	0.638	0.734	0.573	0.877	0.776	0.349	0.267	0.393	0.839	0.884	0.545
	L50-99	0.663	0.769	0.613	0.878	0.789	0.437	0.260	0.468	0.814	0.891	0.601
	L100-249	0.668	0.780	0.610	0.886	0.786	0.494	0.240	0.503	0.778	0.879	0.646
	L250-499	0.665	0.786	0.592	0.888	0.789	0.534	0.204	0.540	0.749	0.874	0.687
	L500+	0.628	0.814	0.526	0.876	0.764	0.412	0.190	0.543	0.692	0.882	0.683
	All sizes	0.634	0.706	0.584	0.796	0.727	0.560	0.318	0.431	0.802	0.813	0.560

(Note)
1. The ratio of full-time employees is calculated for each firm and obtained average number of each category.
2. Featured major industries.

(Source) Economic Census for Business Activity in 2016.

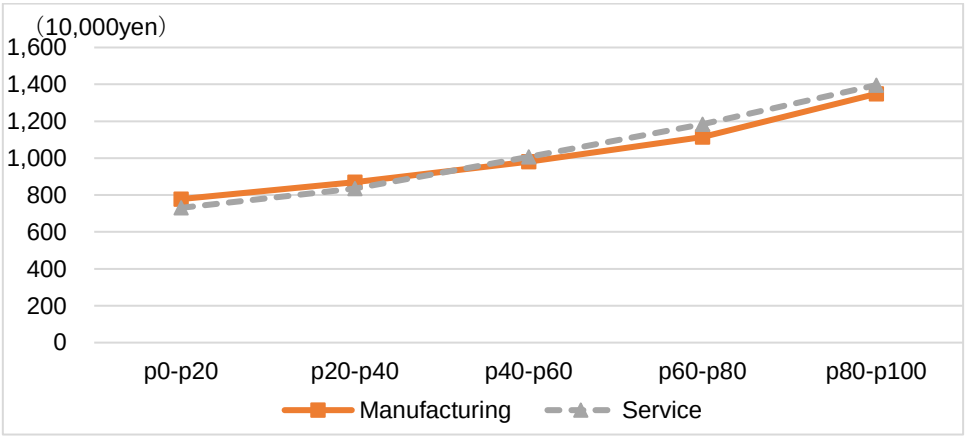
To summarize this section, we find a positive correlation between firm size and labor productivity in many industries. But in some industries, such as "Retail trade" and "Eating and drinking places, Food takeout and delivery services," labor productivity is lower than the other industries, and furthermore, labor productivity declines as firm size increases from a certain firm size. One of the reasons of these differences could come from the difference of the ratio of full-time employees among these industries.

4. ICT investment and labor productivity

To recover from the damage caused by COVID-19 promptly, it is necessary to make a resilient business model. After the spread of COVID-19, Japanese society has been required to minimize face-to-face contact with others as well as to improve labor productivity. Therefore, the utilization of more ICT technology is one of the solutions to improve labor productivity under the current situation.

The expansion of ICT investment has been shown to have a positive effect on improving labor productivity in recent research[5]. To clarify the relationship between ICT investment and labor productivity, we use the individual firm data of Financial Statements Statistics of Corporations by Industry in FY 2018 and divide it into manufacturing and service sectors. In Figure 1, we calculate each firms' ICT equipment ratio and its labor productivity, and categorize them from a low ICT equipment ratio to a high ICT equipment ratio.[6] As Figure 1 shows, the higher the ICT equipment ratio, the higher the labor productivity in both the manufacturing and the services sectors.[7]

Figure 1　Labor productivity according to ICT equipment ratio by industry (Average)



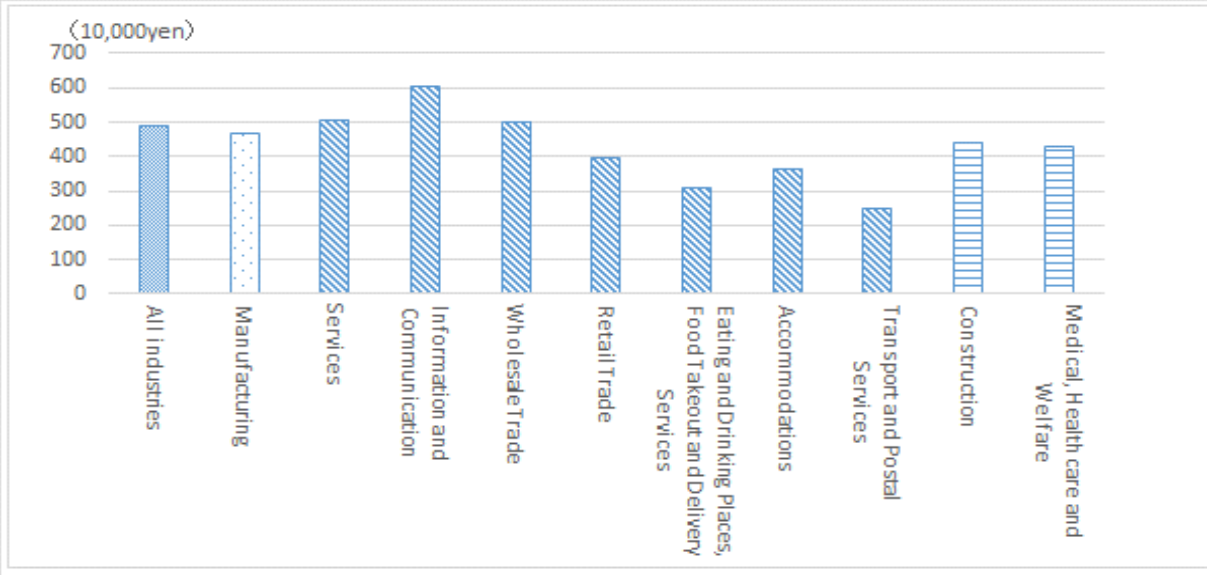
(Note)
1. We divide firms into 5 groups based on the ICT equipment ratio on the X-axis.
2. The labor productivity in each group is calculated by each firms' labor productivity and the obtained average number of each group.
3. We use the data of firms which invest in software.
4. We exclude the data of firms whose labor productivity is in the top 5% and bottom 5% to control for the effect of outliers.
5. This graph references Hiroki (2020).

(Source) Financial Statements Statistics of Corporations by Industry in FY 2018.

[5] Policy Research Institute (2017).
[6] We used the "software" investment data from the Financial Statements Statistics of Corporations by Industry as the indicator of ICT investment. And the ICT equipment ratio is calculated by dividing the software (average for beginning of year and end of year) with the number of employees. We used 8,866 samples. But it could be a smaller sample size because some firms include the amount of "software" investment in their "tangible fixed assets" in their financial report.
[7] Miyagawa, Takizawa, and Miyakawa (2020) also find that IT investment ratio is positively correlated with labor productivity.

Next, we checked each industry's ICT equipment ratio, shown in Figure 2. The ICT equipment ratio in "Information and communications" is the largest among the industries, but the ratio in "Eating and drinking places, Food takeout and delivery services" and "Transportation and postal services" is relatively small. The gap between these industries is due to the characteristics of each business.

Figure 2　ICT equipment ratio by industry (average)



(Note)
1. The ICT equipment ratio in each industry is calculated for each firm and obtained the average number of each industry.
2. We targeted firms that invest in software.
3. Featured major industries.

(Source) Financial Statements Statistics of Corporations by Industry in FY 2018.

After the spread of COVID-19, working at home (telework) is recommended. According to the Toshihiro Okubo Lab. and NIRA's research, the ratio of telework is high in "Information and communications," but the ratio is low in "Transportation," "Eating and drinking places" and "Accommodations."[8] The tendency of the industries is similar in Figure 2. The gap among industries depends largely on the characteristics of the work. This implies that there is room to improve the work-style in some industries. ICT could be an ideal tool to reduce the burden of the workers, including essential workers.

5. Conclusion

In this paper, we analyzed firms by size and industry with micro-data of Japanese firms. We find that;

[8] OKUBO Toshihiro Research Office, Economics Department of Keio University, & Nippon Institute for Research Advancement (2020).

(1) labor productivity tends to increase as firm size increases, (2) the difference of the ratio of full-time employees in each industry is one of the reasons explaining the labor productivity gap among industries, and (3) the higher the ICT equipment ratio, the higher the labor productivity.

These results confirm that the size of a firm is one of the most important factors to increase labor productivity. Particularly for industries that are composed of many micro and small firms, there is more room to make efforts to grow their firms. In addition, facing both the spread of COVID-19 and the population declining and aging, promoting ICT investment will increase labor productivity further. These results analyzed in this paper will help further policy discussion in industrial policy area.

References

Atkinson, David (2019) *Watershed Moment in the Fate of a Country*, Kodansha +α New Book.*

Atkinson, David (2020) *Chance of Revival of Japanese Firms*, Toyo Keizai Inc.*

Miyagawa, Tsutomu; Takizawa, Miho; and Miyakawa, Daisuke (2020) "Does IT investment contribute to productivity improvement? – Productivity improvement analysis of IT and human resources," *Productivity Report* Vol.14, June 2020.*

Oku, Ai; Inoue, Shun, and Masui, Tsubasa (2020) "Does firm size effect wages and productivity? – Micro-data analysis in case of Japan-," *Finance*, Vol. 55 No. 12, 2020.3, pp. 62-69.*

OKUBO Toshihiro Research Office, Economics Department of Keio University, & Nippon Institute for Research Advancement (2020) "The report on the effect on Telework, Life, Consciousness after Covid-19."*

Policy Research Institute (2017) *Report on Productivity Improvement through Innovation.**

Takizawa, Miho (2020) "A study on Labor Productivity based on firm-level data in Japan," *The Report on Population Decline and Economic Growth*, Policy Research Institute.*

The Small and Medium Enterprise Agency (2020) *SME White Paper*.*

Hiroki, Takashi (2020) "Firms that enhance their reputation after Covid-19," Nikkei Online, 2020.5.15.*

ILO (2020) "ILO Monitor: COVID-19 and the world of work. 2nd edition, updated estimates and analysis," 2020.4.5.

* Japanese titles are translated tentatively by authors of this report.

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