Does Firm Size Effect Wages and Labor productivity?
-Micro data analysis in case of Japan-

Chief Economist, Policy Research Institute,
OKU Ai
Researcher ,Policy Research Institute
INOUE Shun
Officer ,Policy Research Institute
MASUI Tsubasa

January 2020

Does Firm Size Effect Wages and Labor productivity?
-Micro data analysis in case of Japan-[1]

OKU Ai[2]; INOUE Shun[3]; MASUI Tsubasa[4]

Abstract

This paper analyzes the relationship of "firm size and wages" and "firm size and labor productivity" by using micro data of Financial Statements Statistics of Corporations by Industry FY2018. We find that 1) in the manufacturing sector, the larger the firm is, the higher the wages and labor productivity are, 2) in the services sector, especially large firms (250 employees or over), the relationship between "firm size and wages" and "firm size and labor productivity" is not as strong as that in the manufacturing sector, 3) in both the manufacturing sector and the services sector, wages and labor productivity have a positive correlation.

---

1. Introduction

Japan is facing a declining population. Increasing productivity is one of the top priorities in Japan. What policies are needed to increase productivity? What policies are needed to increase wages? Recently, the question "whether firm size is correlated with both wages and productivity" has been paid much attention in Japan.

Regarding the relationship between firm size and wages, Moore (1911) is the first analysis. After that, Brown and Medoff (1989) analyze the size-wage effect with U.S. data, and find that large firms hire higher-quality workers and have more ability to pay higher wages. Troske (1999) analyze manufacturing workers and establishments in the U.S. using the Worker-Establishment Characteristic Database and find the employer size-wage premium. Barth et al. (2018) analyze panel employee-establishment data for U.S. manufacturing and find that one of the most observable employer characteristics in the case of earnings is the number of workers. Bloom et al. (2018) use individual data administrated by U.S. Social Security Administration and find the large-firm wage premium has declined significantly since early 1980s.

Regarding firm size and productivity, Lucas (1978) find that resisting conglomerates in advanced economies may be misguided. Syverson (2011) survey the factors of businesses' productivity levels, and refer to the firm size. Melitz (2003) find that only the more productive firms enter the export market and will simultaneously force the least productive firms to exit.

More directly, Berlingieri et al. (2018) analyze "whether firm size is correlated with both wages and productivity". Berlingieri et al. (2018) use OECD MultiProd dataset which cover the data of 1) both the manufacturing sector and the services sector, 2) 17 countries including Japan, 3) firm size, wages, and productivity. Berlingieri et al. (2018) find 1) in the manufacturing sector, both productivity and wages are increasing with firm size, 2) in the services sector, the size premium is much weaker, 3) linking wages to productivity, they increase monotonically with productivity in both the manufacturing and especially the nonfinancial market services, where the correlation between wages and productivity is stronger than in manufacturing. Then, Berlingieri et al. (2018) conclude that "when looking beyond manufacturing we might be in the presence of a 'productivity-wage premium' rather than a 'size-wage premium'"

The OECD MultiProd dataset, which Berlingieri et al. (2018) used in their paper, also included the Japanese data. More specifically, the Japanese data used in OECD MultiProd was based on the "Basic Survey of Japanese Business Structure and Activities" and the "Census of Manufacturers" during 1999-2014[1]. However, the "Basic Survey of Japanese Business Structure and Activities" targets the firms whose paid-up capital or investment fund is over 30 million yen and 50 or more employees. The "Census of Manufacturers" targets establishments with 4 or more employees in the manufacturing

---

[1] Desnoyers-James et al. (2019).

sector. Therefore, the former statistics don't fully cover the firms with less than 50 employees, the latter statistics don't cover the services sector.

In this paper, we use the micro data of the "Financial Statements Statistics of Corporations by Industry (FSSCI)" in Fiscal Year 2018, which cover the firms with less than 50 employees and the services sector. We analyze how firm size is correlated with both wages and labor productivity. We find that 1) in the manufacturing sector, the larger the firm is, the higher the wages and labor productivity are, 2) in the services sector, especially large firms (250 employees or over), the relationship between "firm size and wages" and "firm size and labor productivity" is not as strong as that in the manufacturing sector, 3) in both the manufacturing sector and the services sector, wages and labor productivity have a positive correlation.

This paper is structured in the following way. Chapter 2 explains the data and procedure, Chapter 3 shows the results of the data analysis, and Chapter 4 is the conclusion.

2. Data analysis
2.1 Advantages of the Data

We use the latest micro data of the annual survey of "FSSCI" in FY2018[2] to research the latest situation of Japan. "FSSCI" is a fundamental statistical survey conducted by The Ministry of Finance in Japan. The survey aims to clarify the current situation of the business activities of corporations in Japan.

In the FSSCI, the firms with capital stock of 500 million yen or over are all selected, and the firms with capital stock of less than 500 million yen are selected by equal probability systematic sampling. Therefore, the FSSCI covers all size categories with balanced numbers of firms from small to large firms[3].

The FSSCI is a sample survey. Samples (surveyed firms) are extracted from all commercial firms in Japan (population), classifying by industry and capital size, and population is estimated as a whole based on the survey results of the sample.

We use the FSSCI data with these advantages.

---

[2] "Economic Census" is the other statistics targeting the actual situation of business activities of establishments. However, "Economic Census for Business Frame" is currently under survey. Therefore, the released data was surveyed in 2014. In addition, "Economic Census for Business Activity" was surveyed in 2016. The purpose of this paper is to research the latest situation in Japan, so we choose FSSCI FY2018. "Basic Survey of Japanese Business Structure and Activities" covers enterprises with 50 or more employees and whose paid-up capital or investment fund is over 30 million yen. But the survey doesn't use the Statistical Business Resister, so that the selected firms have the possibility to be biased. Also, "Basic Survey on Small and Medium Enterprises" includes the small and medium firms' activities in Japan, but response rate of the sample survey is at the 40% level low.

[3] Total response rate of FY 2018 FSSCI is 76.2%, and its breakdown response rate by firms' capital stock are; 1) 1 billion yen or over: 92.8%, 2) 100 million to 1billion yen: 77.2%, 3) 10 million to 100 million yen: 74.5%, 4) less than 10 million yen: 59.4%.

2.2 Definitions of each categories of FSSCI

We clarify the words of the FSSCI as followings.

(1) Firms

The firms of FSSCI represents firm level, not establishment level. The figures in the FSSCI are based upon non-consolidated firm, not consolidated as one.

(2) Employees

The number of employees is based upon FSSCI's "average number of employees during the period". The number of employees is counted as the employees who earn "employee salary". In the FSSCI, "employee" doesn't include "directors". The FSSCI counts contract employees, temporary and part-time staff as "employee", but doesn't count temporary employees accepted from temporary companies, secondary employees who are not directly paid salaries and unpaid staff.

It should be noted that, in the FSSCI, the way to count the number of temporary and part-time employees is by taking their total working hours and dividing by average working hours of regular employees, and using the integer number by rounding[4].

(3) Classification of firm size by the number of employees

Firm size is based on the FSSCI's "average number of employees during the period", and we classify 8 size classes, as Berlingieri et al. (2018) used.
1) 1-4 employees (L1-4)
2) 5-9 employees (L5-9)
3) 10-19 employees (L10-19)
4) 20-49 employees (L20-49)
5) 50-99 employees (L50-99)
6) 100-249 employees (L100-249)
7) 250-499 employees (L250-499)
8) 500 employees or over (L500+)

(4) Employees' salary

Total amount of salary, labor costs, allowances and wages (before deduction of income tax and insurance premiums) for all staff (either regular staff or temporary staff) except directors booked in that business year[5].

---

[4] "FY2018 FSSCI survey procedures (except finance and insurance)" p.16.
[5] "FY2018 FSSCI survey procedures (except finance and insurance)" p.15.

(5) Employees' bonus

Total amount of bonuses (before deduction of income tax and insurance premiums, including provision for bonuses) for all staff (either regular staff or temporary staff) except directors booked in that business year[6].

(6) Wages

Wages are the total amount of employees' salary and bonuses[7]. In this paper, "wages" mean total yearly wages per employee (total wages divided by the number of employees).

(7) Estimates of labor productivity

The FSSCI defines labor productivity as the following[8].

| labor productivity = value added * / number of employees |

Notes:

* value added = salaries and wages** + interest + rental or leasing expenses for fixed and liquid assets + taxes and public charges + net operating income (operating income - interest and discounting expenses)

** salaries and wages = directors' remuneration + directors' bonus + employees' salary + employees' bonus + welfare expenses

(8) Labor productivity classification

Following Berlingieri et al. (2018), we classify firms into 5 bins by the labor productivity distribution.
- 0 to 10th percentile   (p0-p10)
- 10th to 40th percentile (p10-p40)
- 40th to 60th percentile (p40-p60)
- 60th to 90th percentile (p60-p90)
- 90th to 100th percentile (p90-p100)

(9) Industry

As Berlingieri et al. (2018) explains in footnote 2, we select the following industries as the "services sector" in the FSSCI non-manufacturing sector[9].

---

[6] "FY2018 FSSCI survey procedures (except finance and insurance)" p.15.

[7] Under Labor Standards Act article 11, wage is defined as "Wage is anything paid by an employer to a worker in compensation for work, regardless of wage, salary, benefits, bonuses or other names", so that we define employees' salary and bonus as wages in this paper. In FSSCI, it includes "welfare expenses", but the amount is sum of employees and directors. Therefore, we don't include welfare expenses as wages.

[8] "Financial Statements Statistics of Corporations by Industry, Annually" p.7.
   https://www.mof.go.jp/english/pri/reference/ssc/h30e.pdf.

[9] In FSSCI, it defines "Services sector" as Accommodations, Eating and Drinking Services, Living-related and Personal Services, Services for Amusement and Hobbies, Advertising, Pure Holding Companies, Miscellaneous Scientific Research, Professional and Technical Services, Medical, Health care and Welfare, Education, Learning

Table 1 Industry classification comparison

Nonfinancial market services which Berlingieri et al. (2018) used	The industry name of FSSCI which Berlingieri et al. (2018) used
Wholesale and retail trade, repair of motor vehicles and motorcycles	Wholesale Trade, Retail Trade, Miscellaneous Services
Transportation and storage	Railway, Road Passenger and Road Freight Transport, Water Transport, Miscellaneous Transport
Accommodation and food service activities	Accommodations, Eating and Drinking Services
Publishing, audiovisual and broadcasting activities	Information and Communication
Telecommunications	
IT and other information services	
Legal and accounting activities	Miscellaneous Scientific Research, Professional and Technical Services
Scientific research and development	
Advertising and market research, other professional, scientific and technical activities, veterinary activities	Advertising, Miscellaneous Scientific Research, Professional and Technical Services
Administrative and support service activities	Goods Leasing, Miscellaneous Goods Rental and Leasing, Employment and Worker Dispatching Services, Living-Related and Personal Services, Miscellaneous Services

Note: Industry classification of FSSCI refers to"FY2018 FSSCI survey procedure(except "finance and insurance")" p.19-23.
Source:"FY2018 FSSCI survey procedure(except "finance and insurance")".

2.3 Outline of the data

(1) Data information of FY2018 FSSCI

Table 2 shows the data information of FY2018 FSSCI. We divide the data between the "Manufacturing sector" and the "Non-Manufacturing sector". Furthermore, we select the industries as "Services sector" in the Non-Manufacturing sector" as Berlingieri et al. (2018) use in their paper.

Table 2　FSSCI data of FY 2018

Total number of firms including the data	23,453
The number of firms excluding the firms with missing data	20,767
Manufacturing sector	6,613
Services sector	8,908
Non-Manufacturing sector (except services sector and finance and insurance)	5,246

Table 3 shows descriptive statistics by firm size in the FSSCI data of FY 2018[10]. In labor productivity, standard deviation of the firms with less than 10 employees (L1-4 and L5-9) is extremely

---

Support, Employment and Worker Dispatching Services, Miscellaneous Services. However, we use the same industry category as Berlingieri et al. (2018) used in their paper for comparison purpose.

[10] Descriptive statistics by industry in FY2018 FSSCI is posted as Supplemental-Table 1 in Reference1.

large. Therefore, we should be noted that there is a possibility that outlier is existed in the firms with less than 10 employee categories.

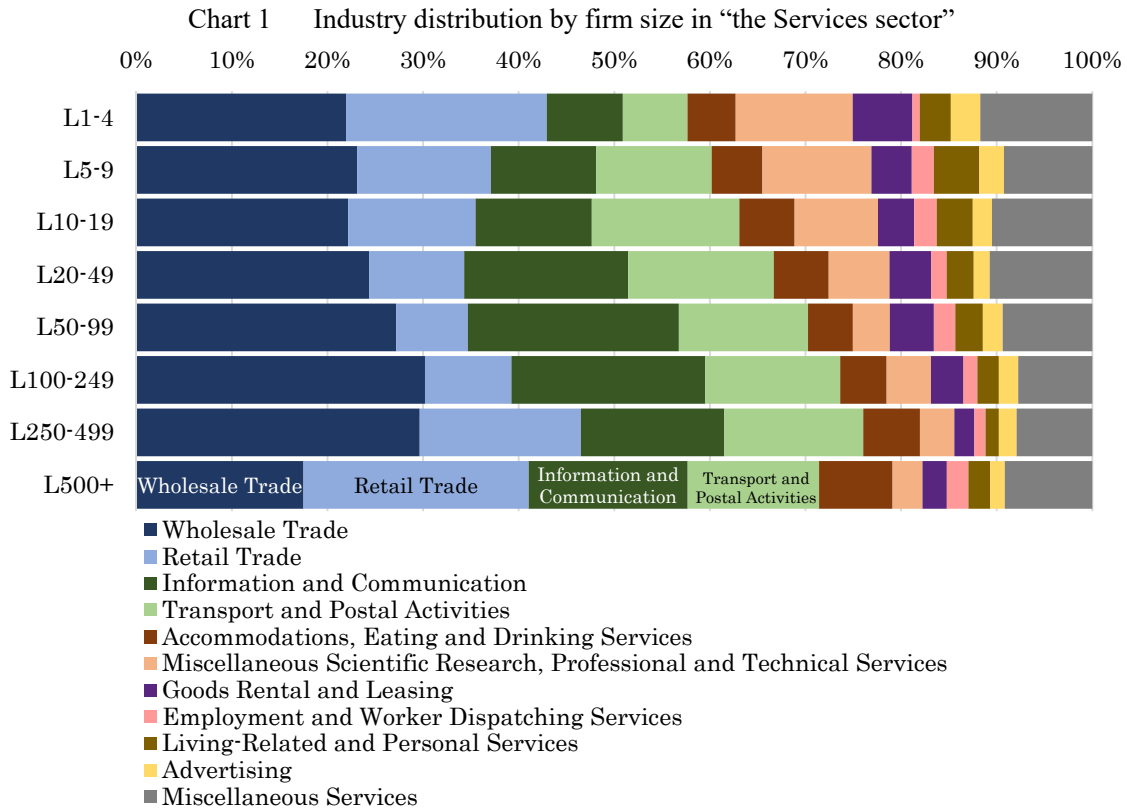Table 3 Descriptive statistics by firm size in FSSCI data of FY 2018

| | Firms | | Wages (1,000yen) | | | Labor Productivity (1,000yen) | | |
| | Manufacturing sector | Services sector | Manufacturing sector+Services sector | | | Manufacturing sector+Services sector | | |
			mean	median	standard deviation	mean	median	standard deviation
L1-4	572	1,169	3,298	2,667	3,345	28,940	6,500	430,925
L5-9	336	736	3,815	3,400	2,431	10,651	6,000	39,368
L10-19	506	848	3,959	3,626	2,237	9,317	6,179	17,649
L20-49	870	1,306	4,219	3,966	2,126	8,499	6,309	13,316
L50-99	801	1,110	4,625	4,381	2,318	9,484	7,212	9,572
L100-249	1,286	1,381	4,919	4,735	2,075	10,043	8,188	9,818
L250-499	905	860	5,132	5,093	1,815	9,976	8,541	8,054
L500+	1,337	1,498	5,405	5,421	2,162	11,163	8,980	14,461
total	6,613	8,908	4,555	4,347	2,412	12,053	7,555	145,217

(2) Industry distribution by firm size in the services sector

As Industry classification of Table 1 shows, the services sector has large industry variation compared with the manufacturing sector. Chart 1 makes clear the share of each services sector industry, which we use in this paper. As Chart 1 shows, the data which we use in the services sector have the following characteristics[11].

・The firm size from "L1-4" to "L250-499", the share of "Wholesale Trade" is the largest one.

・The firm size of "L500+", the share of "Retail Trade" and "Accommodations, Eating and Drinking Services" is larger than other firm size levels, and the share of "Wholesale Trade" is smaller than other firm size levels.

---

[11] It defines "Railway, Road Passenger and Road Freight Transport", "Water Transport" and "Miscellaneous Transport" as "Transport and Postal Activities", "Goods Leasing" and "Miscellaneous Goods Rental and Leasing" as "Goods Rental and Leasing", "Accommodations" and "Eating and Drinking Services" as "Accommodations, Eating and Drinking Services".

Chart 1　　Industry distribution by firm size in "the Services sector"

- ■ Wholesale Trade
- ■ Retail Trade
- ■ Information and Communication
- ■ Transport and Postal Activities
- ■ Accommodations, Eating and Drinking Services
- ■ Miscellaneous Scientific Research, Professional and Technical Services
- ■ Goods Rental and Leasing
- ■ Employment and Worker Dispatching Services
- ■ Living-Related and Personal Services
- ■ Advertising
- ■ Miscellaneous Services

3. Results of analysis

3.1 Results 1 (Plot diagram)

(1) Firm size and wages

　　Chart 2 (Mean) and Chart 3 (Median) shows the relationship between firm size and wages[12]. Both charts show the same tendency. In the manufacturing sector, the larger the firm size is, the higher the wages are. On the other hand, in the services sector, Chart 2 (Mean) shows wages increase with firm size until less than 250 employees, but the curve downward at 250 employees or over. Chart 3 (Median) shows wages increase with firm size until less than 500 employees, but the curve downward at 500 employees or over. The reasons of this tendency are, 1) the firm size of 500 employees or over includes a high proportion of retail trade firms and a low proportion of wholesale trade firms, compared with other firm size levels, as we check in Chart 1[13], 2) the larger firms hire many temporary and part-time staff[14].

　　Comparing the manufacturing sector to the services sector, both Chart 2 (Mean) and Chart 3

---

[12] Comparing with 5 years ago, we post the comparison charts between FY 2013 and FY 2018 in Reference 2 as Supplemental Chart 1and 2.

[13] Refer to Supplemental-Table 1 of Reference1.

[14] As the explanation of the number of employees of FSSCI (2.2(2)), the way to count the number of temporary and part-time staff is that their total working hours are divided by average working hours of regular employees, and rounding the number to use integer number. Therefore, if large firms of 250 employees or over hire many temporary or part-time staff, total wages seem to have downward pressure.

(Median) show when the firm size is below 250 employees, the wages level in the services sector is higher than that of in the manufacturing sector. However, when the firm size is above 250 employees, the wages level is higher in the manufacturing sector than in the services sector.
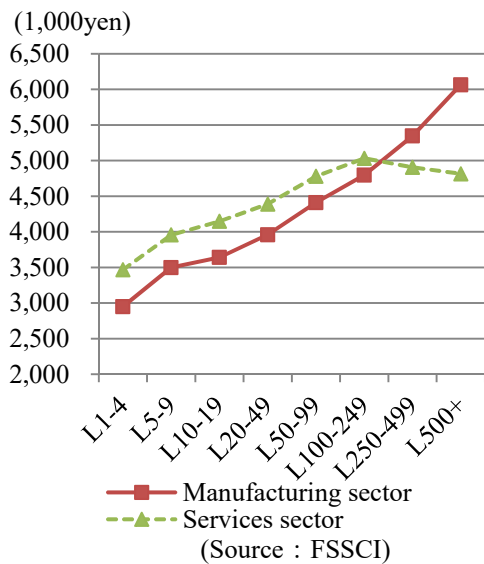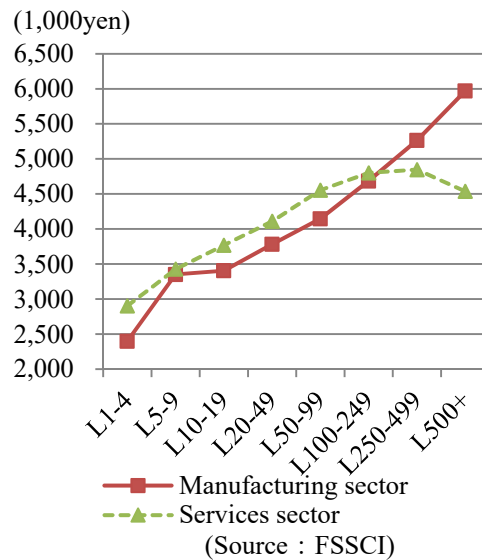
Chart 2　Firm size and wages (Mean)

(1,000yen)

— Manufacturing sector
--▲-- Services sector
(Source：FSSCI)

Chart 3　Firm size and wages (Median)

(1,000yen)

— Manufacturing sector
--▲-- Services sector
(Source：FSSCI)

(2) Firm size and labor productivity

Chart 4 (Mean) and Chart 5 (Median) show the relationship between firm size and labor productivity[15]. In Chart 4 (Mean), which is the mean of productivity by each firm's size category, the curve of small firms' group is very high. As we check descriptive statistics by firm size in Table 3, a few outlier firms in L1-4 and L5-9 have a possibility to push the mean results[16]. To solve this tendency, we check the median of productivity by each firm's size category in Chart 5.

The manufacturing sector in Chart 5 (Median) shows that productivity tends to increase with firm size when firm size is above 10 employees.

The services sector in Chart 5 (Median) shows that productivity tends to increase with firm size when firm size is from 5 to 250 employees. In addition, until the firm with less than 250 employees, labor productivity in services sector is higher than that in the manufacturing sector.

However, at 250 employees or over, labor productivity in the services sector slightly fall, and is lower than that in the manufacturing sector. The reasons of this tendency can be considered that the proportion of Retail Trade, which shows lower labor productivity than Wholesale Trade, is high in L500+, as we check in Chart 1. In addition, in terms of wages, regular employees tend to be higher

---

[15] To compare with 5 years ago, we post the comparison charts between FY 2013 and FY 2018in Reference 2 as Supplemental Chart 3 and 4.
[16] Rejecting the number of 0.05% at both ends of the data and taking average, labor productivity especially in L1-4 and L5-9 lowered, so we confirm that outliers are included in these categories.

than temporary and part-time staff. However, in terms of labor productivity, this relationship is not clear.
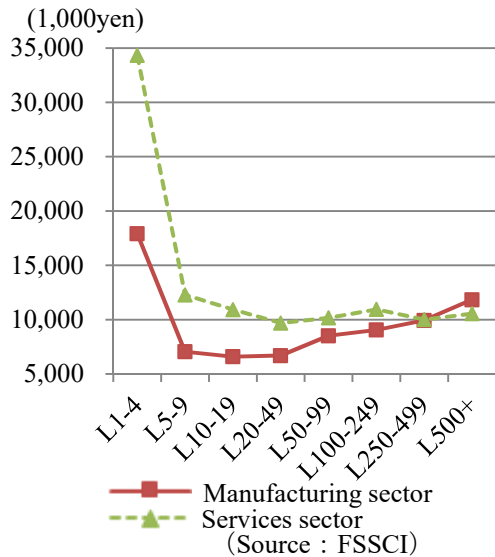
Chart 4 Firm size and labor productivity (Mean)   Chart 5 Firm size and labor productivity (Median)
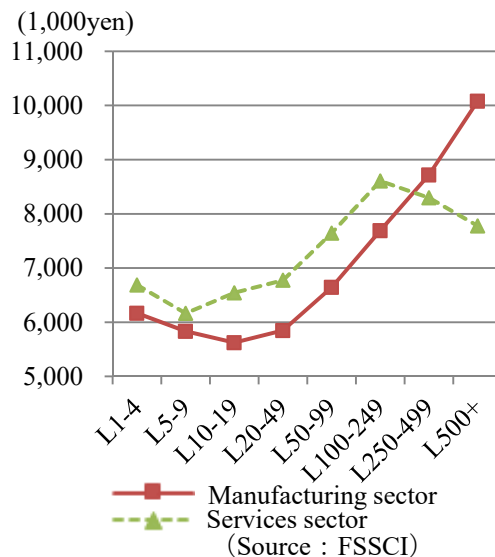
Chart 4 (Mean) and Chart 5 (Median) count only employees to decide firm size. In Chart 6 (Mean) and Chart 7 (Median), we add the number of directors to the number of employees in each firm size because of two reasons 1) especially smaller firms may not distinguish duties of employees from those of directors, 2) directors' remuneration and bonuses are included in the numerator (value added) of the equation of labor productivity.

Chart 6 (Mean), which includes the number of directors and employees, shows the same tendency as Chart 4, which includes only the number of employees. Chart 7 (Median), which includes the number of directors and employees, labor productivity tends to increase with firm size in the manufacturing sector compared with Chart 5, which includes only the number of employees. On the other hand, in the services sector, labor productivity declines slightly at 250 employees or over, and this tendency is the same as in Chart 5.

Chart 6 Firm size and labor productivity (Mean) including Directors

(1,000yen)
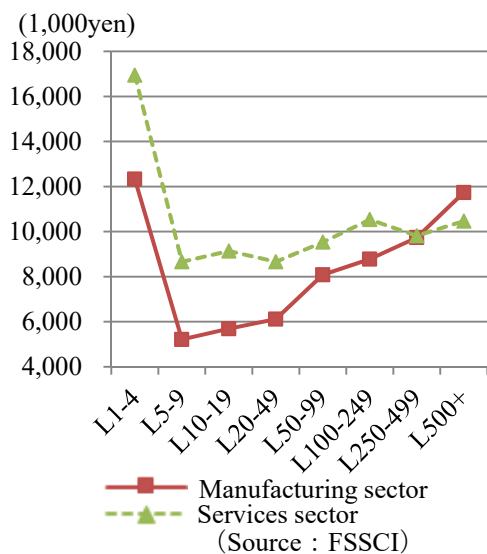
Chart7 Firm size and labor productivity (Median) including Directors

(1,000yen)

Manufacturing sector
Services sector
（Source：FSSCI）

Manufacturing sector
Services sector
（Source：FSSCI）
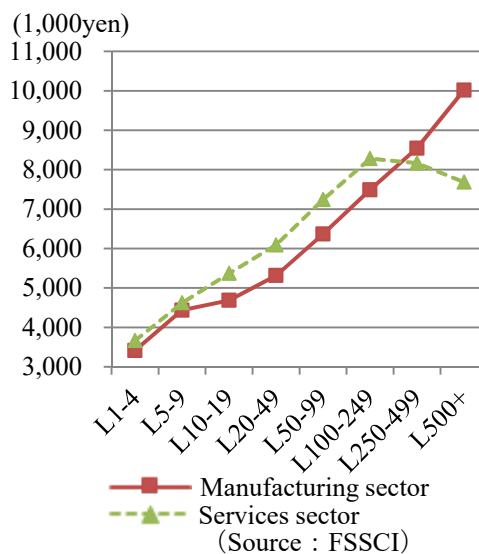
(3) Labor productivity and wages

Lastly, we check the relationship between labor productivity and wages in Chart 8 (Mean) and Chart 9 (Median)[17]. Both charts show that the higher labor productivity is, the higher the wages are.

Chart 8 Labor productivity and wages (Mean)

(1,000yen)
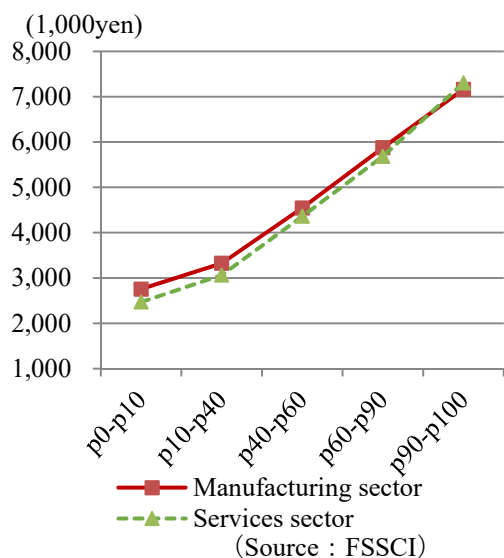
Chart 9 Labor productivity and wages (Median)

(1,000yen)

Manufacturing sector
Services sector
（Source：FSSCI）

Manufacturing sector
Services sector
（Source：FSSCI）
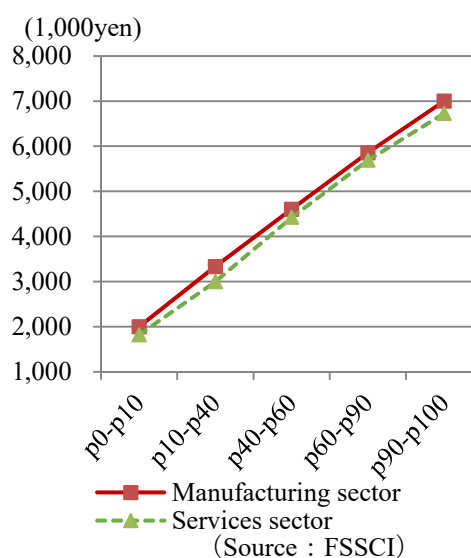
[17] To compare with 5 years ago, we post the comparison charts between FY 2013 and FY 2018in Reference 2 as Supplemental Chart 3 and 4. In addition, we post a table of Industrial composition ratio by labor productivity category in Reference3as Supplemental-Table 2.

11

3.2 Results 2 (regression analysis)

(1) Estimation model

We confirm the relationship "firm size and wages", "firm size and labor productivity" and "labor productivity and wages" in above 3.1. We use the following estimation formula to check whether there is a significant difference between the manufacturing sector and the services sector.

$$\ln(W_i) = cons + \sum_j \left[\beta_j D_{size,ij} + \gamma_j \left(D_{size,ij} \times D_{serv,j} \right) \right] + \varepsilon_i$$

$$\ln(LP_i) = cons + \sum_j \left[\beta_j D_{size,ij} + \gamma_j \left(D_{size,ij} \times D_{serv,j} \right) \right] + \varepsilon_i$$

$$\ln(W_i) = cons + \sum_k \left[\beta_k D_{prod,ik} + \gamma_k \left(D_{prod,ik} \times D_{serv,k} \right) \right] + \varepsilon_i$$

Dependent variables are wages (W) or labor productivity (LP) of logarithms, D_{size} is firm size dummy (j =L10-19, L20-49, L50-249, L250+)[18], D_{prod} is labor productivity dummy ($k = $ p10 − p40, p40 − p60, p60 − p90, p90 − p100), D_{serv} is services sector dummy (if Manufacturing sector=0, Services sector=1). Therefore, β represents premium of the manufacturing sector, γ represents additional premium of the services sector.

(2) Firm size and wages, labor productivity

Table 4 shows the results of regressions analyzing the link between wages and labor productivity by firm size. We analyze the data after rejecting 0.05% of both ends of the distribution to handle outliers, as we check in descriptive statistics by firm size of Table 3.

First, in the case of wages in column 2 of Table 4, the wages are increasing as the firm size increases in the manufacturing sector. From Small to Small medium firm sizes, wages in the services sector are higher than those in the manufacturing sector, but the difference decreases with increasing firm size. In Large firm size, wages in the services sector is lower than that in the manufacturing sector.

Next, in the case of labor productivity in column 3 of Table 4, the larger the firm, the higher the labor productivity is in the manufacturing sector. From Small to Medium firm size, labor productivity in the services sector is higher than that in the manufacturing sector, the difference decreases with increasing firm size. In Large firm size, labor productivity in the services sector is lower than that in the manufacturing sector.

Based on the results of Table 4, we confirm that there is a positive relationship between "firm size and wages" and "firm size and labor productivity" in the manufacturing sector. These results are the

---

[18] We reclass the firm size into 5 categories such as L1-9 (L1-4 and L5-9), L10-19, L20-49, L50-249 (L50-9 and L100-249) and L250+ (L250-499 and 500+) because these firm sizes have the same tendency. In the formula, L1-9 is represented as constant.

same as Berlingieri et al. (2018) and other literature. On the other hand, wages and labor productivity in Small firms of the services sector are larger than those in the manufacturing sector, but the gap gradually decrease as the firm size becomes larger. Finally, wages and labor productivity in Large firms of the services sector is lower than those in the manufacturing sector. In the service sector, the curves of both wages and labor productivity are flatter than those in the manufacturing sector.

Table 4 Regression analysis of labor productivity and wages by firm size[19]

Variables	ln(W)	ln (LP)
Small(L10-19)	0.137***	-0.243***
	(0.0272)	(0.0384)
Small medium(L20-49)	0.285***	-0.178***
	(0.0219)	(0.0311)
Medium(L50-249)	0.466***	0.0443*
	(0.0163)	(0.0230)
Large(L250+)	0.706***	0.294***
	(0.0160)	(0.0225)
Small(L10-19)	0.130***	0.211***
×Services sector	(0.0316)	(0.0444)
Small medium(L20-49)	0.0518**	0.154***
×Services sector	(0.0246)	(0.0348)
Medium(L50-249)	0.0252	0.0910***
×Services sector	(0.0167)	(0.0232)
Large(L250+)	-0.234***	-0.207***
×Services sector	(0.0166)	(0.0230)
Constant	7.903***	8.878***
	(0.0107)	(0.0153)
Observations	15,454	15,078
Adj R-squared	0.133	0.027

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

(3) Labor productivity and wages

To analyze the relationship between labor productivity and wages, we find a positive relationship in both the manufacturing sector and the services sector - the higher labor productivity is, the higher wages are. This result is consistent with the results of Berlingieri et al. (2018).

---

[19] In order to handle outliers, we analyze both ends of the distribution by rejecting 0.05% in Table 4, the results including all data is posted as Supplemental-Table3 in Reference 4. Since the relationship between firm size and labor productivity in Table 4 is not significant at Medium firm at the 10% significance level, the interpretation of this part needs to be cautious.

Comparing the manufacturing sector to the services sector, the wage level for labor productivity is slightly higher in the manufacturing sector than in the services sector.

Table 5   Regression analysis of labor productivity and wages[20]

Variables	ln(W)
p10-p40	0.560***
	(0.0160)
p40-p60	0.905***
	(0.0171)
p60-p90	1.165***
	(0.0159)
p90-p100	1.296***
	(0.0306)
p10-p40	-0.0856***
×Services sector	(0.0136)
p40-p60	-0.0534***
×Services sector	(0.0165)
p60-p90	-0.0412***
×Services sector	(0.0137)
p90-p100	-0.00552
×Services sector	(0.0332)
Constant	7.498***
	(0.0122)
Observations	15,454
Adj R-squared	0.389

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

4. Conclusion

This paper analyzes the relationship of "firm size and wage" and "firm size and labor productivity", separating the manufacturing sector and the services sector, by using Japanese firms' micro data of the Financial Statements Statistics of Corporations by Industry FY2018 as Berlingieri et al. (2018) did. We find that 1) in the manufacturing sector, the larger the firm is, the higher the wages and labor productivity are, 2) in the services sector, especially large firms (250 employees or over), the relationship between "firm size and wages" and "firm and labor productivity" is not as strong as that

---

[20] In order to handle outliers, we analyze both ends of the distribution by rejecting 0.05% in Table 5, the results including all data is posted as Supplemental-Table 4 in Reference 4.

in the manufacturing sector, 3) in both the manufacturing sector and the services sector, labor productivity and wages have a positive correlation.

The reasons that the services sector is not so positively correlated as in the manufacturing sector are; 1) a wide variety of industries reflect the results of the services sector, 2) at least in the case of wages, if larger firms in the services sector hire more temporary and part-time staff rather than the firms in the manufacturing sector, wages seem to be lower, based on the FSSCI's employees' definition. However, in the case of labor productivity, the effect on temporary and part-time staff is not clear, so that interpretation must be done with caution.

To develop this research, especially in the services sector, we need to divide each industry and analyze "firm size and wage", "firm size and labor productivity" of each. The number of observations is small in the FSSCI's data if we divide it by industry level. Therefore, we need to use the data with large observations.

In addition, we couldn't divide employees by employment type. But, we need to separate regular staff with temporary and part-time staff to analyze wages and labor productivity by firm size. Especially, firms in the services sector tend to hire more temporary and part-time staff than that in the manufacturing sector. We would like to challenge these the next time.

Reference 1

Supplemental-Table 1 Breakdown of descriptive statistics by industry

Firms

	Manufacturing sector	Services sector	Information and Communication	Railway, Road Passenger and Road Freight Transport	Water Transport	Miscellaneous Transport	Wholesale Trade	Retail Trade	Goods Leasing	Miscellaneous Goods Rental and Leasing	Accommodations	Eating and Drinking Services	Living-Related and Personal Services	Advertising	Miscellaneous Scientific Research, Professional and Technical Services	Employment and Worker Dispatching Services	Miscellaneous Services
L1-4	572	1,169	93	25	29	25	257	245	45	28	18	41	38	36	143	9	137
L5-9	336	736	81	34	25	30	170	103	18	13	11	28	35	19	84	17	68
L10-19	506	848	103	66	30	35	188	113	18	14	22	27	32	17	74	20	89
L20-49	870	1,306	224	92	36	71	318	130	32	25	38	37	37	22	83	21	140
L50-99	801	1,110	245	61	30	59	302	83	32	19	33	19	32	23	43	25	104
L100-249	1,286	1,381	280	90	31	74	417	125	22	25	46	21	31	28	64	20	107
L250-499	905	860	129	70	6	49	255	145	10	8	32	19	12	16	31	10	68
L500+	1,337	1,498	249	129	9	68	262	353	27	11	30	85	34	23	47	34	137
total	6,613	8,908	1,404	567	196	411	2,169	1,297	204	143	230	277	251	184	569	156	850

Wages (1,000yen)

mean

	Manufacturing sector	Services sector	Information and Communication	Railway, Road Passenger and Road Freight Transport	Water Transport	Miscellaneous Transport	Wholesale Trade	Retail Trade	Goods Leasing	Miscellaneous Goods Rental and Leasing	Accommodations	Eating and Drinking Services	Living-Related and Personal Services	Advertising	Miscellaneous Scientific Research, Professional and Technical Services	Employment and Worker Dispatching Services	Miscellaneous Services
L1-4	2,949	3,469	5,434	4,281	4,328	3,417	3,639	2,539	3,872	2,915	2,735	2,468	2,731	3,552	3,744	2,743	3,486
L5-9	3,499	3,959	5,000	3,331	6,868	4,510	4,155	2,787	5,205	3,184	2,203	2,922	3,166	3,584	4,132	4,145	3,781
L10-19	3,641	4,149	5,212	3,375	5,256	4,782	4,463	3,102	4,372	3,651	2,313	1,723	2,871	4,321	4,893	2,855	4,857
L20-49	3,960	4,391	5,032	3,289	6,298	4,555	4,796	3,087	5,332	3,609	2,688	2,375	3,003	4,812	5,294	2,855	4,717
L50-99	4,411	4,780	5,703	3,502	5,259	4,830	5,344	3,284	5,076	3,736	2,796	2,973	3,066	5,250	4,812	3,042	4,603
L100-249	4,796	5,034	5,666	4,171	6,011	5,014	5,509	4,187	5,021	3,805	3,252	2,844	3,761	5,189	5,066	4,858	4,800
L250-499	5,346	4,906	5,646	4,152	7,022	5,721	5,623	3,640	5,037	3,606	4,002	3,003	3,190	5,607	5,574	3,004	4,706
L500+	6,065	4,815	6,499	4,833	6,661	5,550	5,514	3,501	6,342	4,136	3,827	2,681	3,595	5,914	5,664	3,352	4,786
total	4,657	4,480	5,630	3,966	5,754	4,927	4,977	3,253	4,961	3,530	3,092	2,594	3,158	4,712	4,669	3,394	4,465

median

	Manufacturing sector	Services sector	Information and Communication	Railway, Road Passenger and Road Freight Transport	Water Transport	Miscellaneous Transport	Wholesale Trade	Retail Trade	Goods Leasing	Miscellaneous Goods Rental and Leasing	Accommodations	Eating and Drinking Services	Living-Related and Personal Services	Advertising	Miscellaneous Scientific Research, Professional and Technical Services	Employment and Worker Dispatching Services	Miscellaneous Services
L1-4	2,400	2,904	4,000	3,187	4,500	3,667	3,000	2,000	3,500	2,844	2,390	1,902	2,125	3,197	3,000	2,500	3,000
L5-9	3,351	3,429	4,556	3,044	6,285	4,163	3,750	2,610	5,000	3,200	1,933	1,486	2,800	3,167	3,500	3,148	3,381
L10-19	3,406	3,769	4,500	3,376	5,346	4,700	3,974	3,000	4,348	3,419	2,154	1,467	2,409	4,412	4,451	2,825	4,267
L20-49	3,783	4,111	5,000	3,365	6,300	4,625	4,446	2,953	4,869	3,531	2,229	2,178	2,794	4,690	4,550	2,220	4,014
L50-99	4,147	4,556	5,280	3,702	5,032	5,052	5,038	3,172	5,283	3,638	2,533	2,288	2,866	5,600	4,938	2,714	4,118
L100-249	4,685	4,802	5,308	4,120	6,315	5,015	5,286	3,616	5,533	3,704	3,178	2,860	3,453	4,651	4,921	3,721	4,759
L250-499	5,264	4,848	5,505	4,341	7,059	5,770	5,504	3,406	4,680	3,441	3,807	2,685	3,354	5,757	5,122	2,808	4,591
L500+	5,970	4,538	6,225	4,855	6,115	5,702	5,331	3,128	6,399	4,081	3,777	2,649	3,718	5,135	5,877	3,075	4,761
total	4,536	4,190	5,323	3,835	5,837	4,968	4,707	3,000	5,000	3,333	2,838	2,288	2,969	4,469	4,207	3,004	4,044

standard deviation

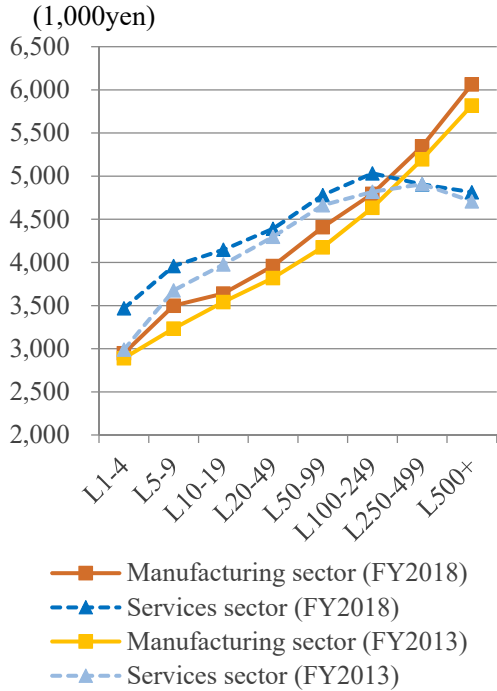|	Manufacturing sector	Services sector	Information and Communication	Railway, Road Passenger and Road Freight Transport	Water Transport	Miscellaneous Transport	Wholesale Trade	Retail Trade	Goods Leasing	Miscellaneous Goods Rental and Leasing	Accommodations	Eating and Drinking Services	Living-Related and Personal Services	Advertising	Miscellaneous Scientific Research, Professional and Technical Services	Employment and Worker Dispatching Services	Miscellaneous Services
L1-4	2,566	3,655	6,874	5,497	2,442	1,418	3,255	2,341	3,836	2,133	1,941	3,119	2,563	2,506	4,420	2,307	2,780
L5-9	1,678	2,694	3,031	1,602	3,877	2,154	2,541	1,324	3,321	1,116	1,099	4,489	1,411	1,733	2,514	3,717	2,797
L10-19	1,915	2,389	2,514	1,408	2,363	1,414	2,783	1,508	1,331	1,443	1,127	1,278	1,209	1,327	2,516	1,352	2,765
L20-49	1,647	2,377	1,964	1,342	3,020	1,421	2,058	1,479	2,167	1,794	1,427	1,077	1,659	1,888	3,497	1,726	3,360
L50-99	2,512	2,155	2,261	1,159	2,870	1,718	2,059	2,174	1,417	1,624	1,049	1,956	1,598	1,638	2,187	1,214	2,274
L100-249	1,532	2,471	2,272	1,253	2,870	1,770	1,706	4,863	1,628	1,378	1,148	1,335	1,952	2,403	1,873	4,333	2,061
L250-499	1,586	2,004	1,954	1,521	1,169	1,559	1,853	1,432	1,590	1,479	1,324	1,915	1,040	1,958	2,291	1,746	2,314
L500+	1,829	2,265	2,316	1,535	2,275	2,001	2,260	1,440	1,983	2,166	1,500	1,485	1,093	2,632	2,196	1,690	2,080
total	2,128	2,600	2,852	1,871	2,843	1,786	2,378	2,230	2,603	1,713	1,432	2,258	1,707	2,262	3,204	2,469	2,651

Labor Productivity (1,000yen)

mean

	Manufacturing sector	Services sector	Information and Communication	Railway, Road Passenger and Road Freight Transport	Water Transport	Miscellaneous Transport	Wholesale Trade	Retail Trade	Goods Leasing	Miscellaneous Goods Rental and Leasing	Accommodations	Eating and Drinking Services	Living-Related and Personal Services	Advertising	Miscellaneous Scientific Research, Professional and Technical Services	Employment and Worker Dispatching Services	Miscellaneous Services
L1-4	17,914	34,335	19,475	88,269	111,533	49,486	91,202	7,815	24,923	7,468	8,887	6,838	9,676	12,994	12,953	5,356	13,047
L5-9	7,057	12,292	5,293	11,446	37,278	18,277	11,070	5,248	44,202	4,707	96,882	8,416	7,192	7,591	9,368	7,353	12,657
L10-19	6,602	10,937	12,932	10,770	9,677	17,602	12,402	6,434	17,592	6,890	4,160	3,094	8,659	8,424	9,718	6,163	15,905
L20-49	6,693	9,703	10,112	5,090	14,791	14,009	11,779	5,552	16,848	10,546	6,176	5,201	5,577	8,009	8,257	5,657	10,909
L50-99	8,518	10,181	11,554	5,599	11,889	11,582	11,531	8,062	14,435	9,176	5,893	8,249	5,275	10,384	7,686	4,395	10,591
L100-249	9,062	10,956	10,978	7,784	14,028	14,410	12,575	8,624	14,805	9,356	5,960	6,449	7,516	11,428	9,990	7,643	11,384
L250-499	9,938	10,016	11,701	8,078	13,365	14,802	11,619	7,252	14,063	7,011	7,579	5,277	4,669	9,927	9,757	4,264	9,110
L500+	11,838	10,560	14,770	9,251	53,605	22,944	10,654	7,174	23,397	9,612	7,590	4,358	6,347	10,830	9,190	4,723	8,674
total	9,841	13,695	12,058	11,598	32,364	18,081	21,152	7,120	21,240	8,395	10,829	5,613	7,078	10,316	10,102	5,649	11,433

median

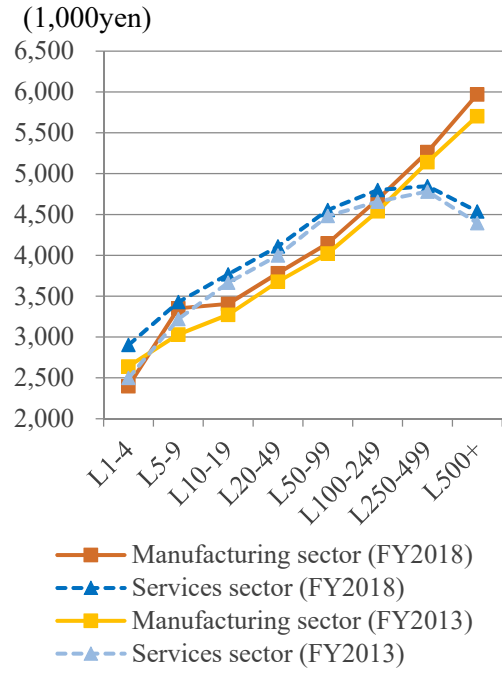|	Manufacturing sector	Services sector	Information and Communication	Railway, Road Passenger and Road Freight Transport	Water Transport	Miscellaneous Transport	Wholesale Trade	Retail Trade	Goods Leasing	Miscellaneous Goods Rental and Leasing	Accommodations	Eating and Drinking Services	Living-Related and Personal Services	Advertising	Miscellaneous Scientific Research, Professional and Technical Services	Employment and Worker Dispatching Services	Miscellaneous Services
L1-4	6,166	6,690	7,000	7,500	9,750	14,911	8,000	5,104	11,667	5,444	2,324	3,500	6,887	8,750	7,508	4,821	7,700
L5-9	5,833	6,165	7,143	4,707	12,833	9,069	8,000	4,500	20,929	5,333	3,143	3,563	4,058	6,286	7,000	4,500	5,437
L10-19	5,622	6,544	8,273	4,840	6,956	10,786	7,398	5,118	9,159	5,974	3,428	2,456	4,278	7,294	6,844	4,211	7,948
L20-49	5,848	6,776	8,571	4,671	10,528	11,000	8,304	4,700	13,466	5,800	2,800	3,256	4,208	8,003	7,000	3,229	6,521
L50-99	6,643	7,647	9,603	5,106	8,110	8,491	9,203	5,350	12,686	5,708	4,350	3,075	4,602	10,308	7,038	3,237	7,336
L100-249	7,689	8,608	9,412	6,192	12,492	9,034	10,444	6,383	12,550	6,226	4,904	3,521	5,835	9,441	8,810	5,329	7,405
L250-499	8,719	8,298	9,151	6,704	13,052	10,756	10,201	6,282	10,640	6,503	6,418	4,570	4,720	8,810	8,693	4,007	7,598
L500+	10,079	7,779	10,569	7,494	12,539	10,122	9,500	5,968	14,805	7,695	7,649	3,976	5,953	10,565	8,725	3,743	6,782
total	7,661	7,470	9,307	5,718	10,292	9,840	9,224	5,500	12,672	6,000	4,713	3,564	5,031	8,537	7,508	4,081	7,136

standard deviation

	Manufacturing sector	Services sector	Information and Communication	Railway, Road Passenger and Road Freight Transport	Water Transport	Miscellaneous Transport	Wholesale Trade	Retail Trade	Goods Leasing	Miscellaneous Goods Rental and Leasing	Accommodations	Eating and Drinking Services	Living-Related and Personal Services	Advertising	Miscellaneous Scientific Research, Professional and Technical Services	Employment and Worker Dispatching Services	Miscellaneous Services
L1-4	168,189	512,561	94,700	180,926	433,770	109,853	1,078,230	18,530	48,260	5,955	22,269	16,062	11,271	16,973	38,474	6,015	29,517
L5-9	8,031	47,121	28,593	46,839	86,261	40,433	16,173	4,259	64,762	4,614	307,507	21,514	9,412	7,181	15,063	5,841	25,164
L10-19	11,127	20,415	18,445	42,025	10,977	18,043	15,056	8,153	20,826	3,577	3,885	2,816	18,805	3,974	12,808	4,769	33,023
L20-49	8,831	15,491	19,606	3,900	17,999	13,164	19,817	5,587	11,232	13,932	13,151	9,555	5,856	4,220	10,064	7,066	15,348
L50-99	8,432	10,264	9,973	3,951	11,055	11,114	9,608	14,041	8,914	7,654	7,939	4,071	5,635	6,419		2,501	13,906
L100-249	6,571	12,011	10,786	6,868	10,182	28,946	9,130	12,520	10,589	11,179	3,835	7,802	6,462	11,487	9,458	6,206	7,598
L250-499	6,657	9,305	10,622	6,564	3,946	20,062	6,925	6,876	9,781	4,167	4,743	3,656	1,661	4,107	6,812	2,885	12,058
L500+	9,647	17,666	20,135	6,568	120,549	48,300	5,837	5,613	18,674	7,549	3,353	2,795	2,496	5,467	4,623	2,982	8,450
total	50,169	186,735	29,180	44,954	172,804	39,375	371,584	10,823	32,453	8,880	67,724	10,692	9,493	9,760	21,430	4,911	20,359

Reference 2   Comparison between FY2013 and FY2018

Supplemental-Chart 1
Firm size and wages(Mean)

(1,000yen)

Manufacturing sector (FY2018)
Services sector (FY2018)
Manufacturing sector (FY2013)
Services sector (FY2013)

（Source：FSSCI）

Supplemental-Chart 2
Firm size and wages(Median)

(1,000yen)

Manufacturing sector (FY2018)
Services sector (FY2018)
Manufacturing sector (FY2013)
Services sector (FY2013)

（Source：FSSCI）

Supplemental-Chart 3
Firm size and labor productivity(Mean)

(1,000yen)

Manufacturing sector (FY2018)
Services sector (FY2018)
Manufacturing sector (FY2013)
Services sector (FY2013)
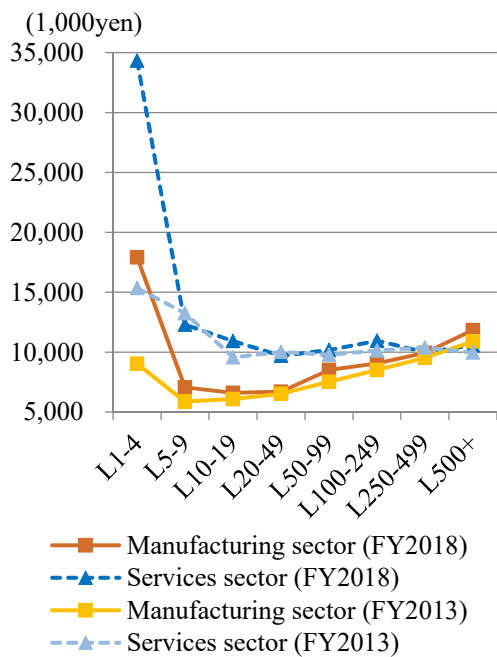
（Source：FSSCI）

Supplemental-Chart 4
Firm size and labor productivity(Median)

(1,000yen)

Manufacturing sector (FY2018)
Services sector (FY2018)
Manufacturing sector (FY2013)
Services sector (FY2013)
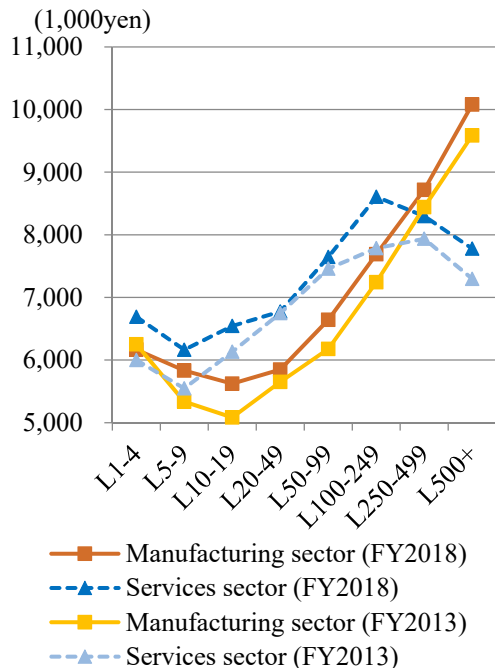
（Source：FSSCI）

Supplemental-Chart 5
Labor productivity and wages(Mean)
(1,000yen)

Manufacturing sector (FY2018)
Services sector (FY2018)
Manufacturing sector (FY2013)
Services sector (FY2013)
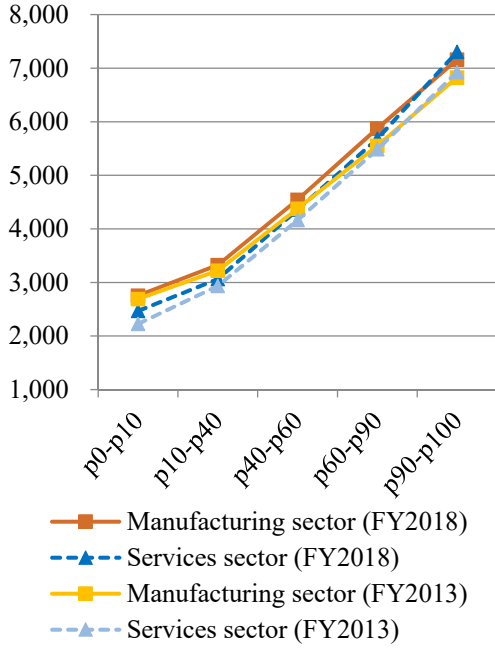
（Source：FSSCI）

Supplemental-Chart 6
Labor productivity and wages(Median)
(1,000yen)

Manufacturing sector (FY2018)
Services sector (FY2018)
Manufacturing sector (FY2013)
Services sector (FY2013)
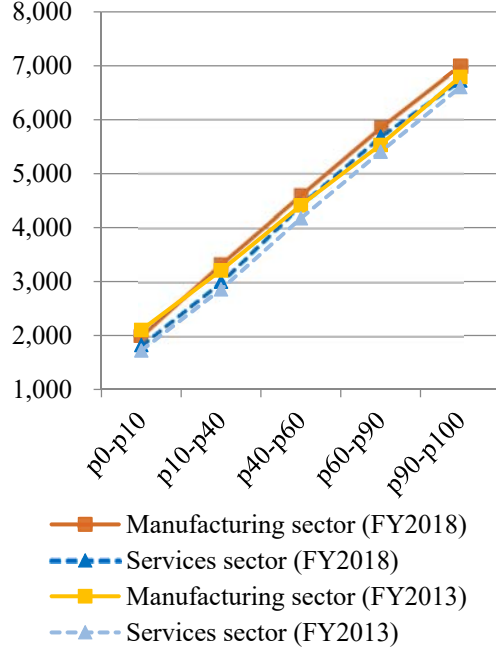
（Source：FSSCI）

Reference 3

Supplemental-Table 2 Industrial composition ratio by labor productivity category

	Firms		Percentage (%)	
	Manufacturing sector	Services sector	Manufacturing sector	Services sector
p0-p10	523	1,010	3.4	6.5
p10-p40	2,114	2,805	13.6	18.1
p40-p60	1,551	1,721	10.0	11.1
p60-p90	2,140	2,652	13.8	17.1
p90-p100	285	720	1.8	4.6
total	6,613	8,908	42.6	57.4

Reference 4

Supplemental-Table 3 Regression analysis of wages and labor productivity by firm size
(all data included case)

Variables	ln(W)	ln (LP)
Small(L10-19)	0.132***	-0.259***
	(0.0272)	(0.0389)
Small medium(L20-49)	0.280***	-0.194***
	(0.0219)	(0.0315)
Medium(L50-249)	0.461***	0.0284
	(0.0163)	(0.0233)
Large(L250+)	0.701***	0.278***
	(0.0160)	(0.0228)
Small(L10-19)	0.130***	0.211***
×Services sector	(0.0316)	(0.0450)
Small medium(L20-49)	0.0523**	0.154***
×Services sector	(0.0247)	(0.0353)
Medium(L50-249)	0.0252	0.0910***
×Services sector	(0.0167)	(0.0235)
Large(L250+)	-0.234***	-0.207***
×Services sector	(0.0166)	(0.0233)
Constant	7.908***	8.894***
	(0.0107)	(0.0155)
Observations	15,468	15,085
Adj *R*-squared	0.131	0.025

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Supplemental -Table 4　Regression analysis of labor productivity and wages
(all data included case)

Variables	ln(W)
p10-p40	0.553***
	(0.0160)
p40-p60	0.898***
	(0.0171)
p60-p90	1.158***
	(0.0159)
p90-p100	1.292***
	(0.0306)
p10-p40	-0.0856***
×Services sector	(0.0137)
p40-p60	-0.0534***
×Services sector	(0.0166)
p60-p90	-0.0412***
×Services sector	(0.0138)
p90-p100	-0.00807
×Services sector	(0.0332)
Constant	7.505***
	(0.0122)
Observations	15,468
Adj R-squared	0.387

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

References

Barth, Erling, James Davis, and Richard B. Freeman (2018). "Augmenting the Human Capital Earnings Equation with Measures of Where People Work," *Journal of Labor Economics*, 36 (S1): 71-97.

Berlingieri, Giuseppe, Sara Calligaris, and Ciara Criscuolo (2018). "The Productivity-Wage Premium: Does Size Still Matter in a Services Economy?" *AEA Papers and Proceedings*, 108: 328-33.

Bloom, Nicholas, Fatih Guvenen, Benjamin S. Smith, Jae Song, and Till von Wachter (2018). "The Disappearing Large-Firm Wage Premium," *AEA Papers and Proceedings*, 108: 317-22.

Brown, Charles and James Medoff (1989). "The Employer Size-Wage Effect," *Journal of Political Economy*, 97(5): 1027-59.

Desnoyers-James, Isabelle, Sara Calligaris, and Flavio Calvino (2019). "DynEmp and MultiProd: Metadata," *OECD Science, Technology and Industry Working Papers* No. 2019/03, OECD Publishing.

Lucas, Robert E. Jr. (1978). "On the Size Distribution of Business Firms," *Bell Journal of Economics* 9(2): 508-23.

Melitz, Marc J. (2003). "The Impact of Trade on Intra-industry Reallocations and Aggregate Industry Productivity," *Econometrica* 71(6): 1695-725.

Moore, Henry Ludwell (1911). "Laws of Wages: An Essay in Statistical Economics," New York: Macmillan Firm.

Syverson, Chad. (2011). "What Determines Productivity?" *Journal of Economic Literature*, 49(2): 326-65.

Troske, Kenneth R. (1999). "Evidence on the Employer Size-Wage Premium from Worker-Establishment Matched Data," *Review of Economics and Statistics*, 81(1): 15-26.