Panel Data Analysis of the Generational Replacement Effect on Employment in Japanese Companies

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In Japan population aging has been particularly drastic, and since the 1990s there has been a growing body of studies on the so-called "generational replacement effect," which relates to the substitutability of elderly workers for younger ones. For this paper, panel data was constructed for fiscal 2007 to fiscal 2013 from the Survey on Corporate Social Responsibility conducted by Toyo Keizai, and the status of the generational replacement effect in recent years was re-examined. In estimations using "employees aged 50–59 as a percentage of employees aged 30 or above (%)" as an aging index, both a pooled OLS estimation and a fixed-effects estimation that controls for the effects of specific companies, we observed a generational replacement effect, with firms with a higher proportion of older workers hiring fewer new graduates. In terms of factors underlying the generational replacement effect, effects of the burden of labor costs due to aging and effects on corporate performance, which have been indicated in previous studies, were found to be limited. Although these are limited findings based on data primarily from large companies, it was shown that in recent years as well a higher percentage of employees aged 50–59 is negatively correlated with the percentage of new graduates.

I. Introduction

The objective of this study is to examine, using corporate panel data particularly from major companies, trends in recent years in the "generational replacement effect," defined as a "situation in which middle-age and older workers continue to occupy positions they received in the past, thereby stealing jobs that by right young workers ought to be doing" (Genda 2006, 35).

In Japan, where society is aging drastically even compared to other developed countries,[1] the social safety net for elderly persons has become a significant policy concern. Under these circumstances, the Act on Stabilization of Employment of Elderly Persons[2] was amended and put into effect on April 1, 2013 as a part of efforts to promote employment among the elderly. As a result, the scope of companies employing

elderly persons who are subject to a continuous employment system was expanded to include corporate groups, and the law includes a provision to make public the names of companies that do not comply with recommendations regarding measures for securing elderly persons' employment. Furthermore, policies are taking the direction of promoting employment until the age of 70, including a policy going into effect on April 1, 2021 that makes it mandatory for companies to take steps to guarantee employment for elderly persons between the ages of 65 and 70.

The introduction of such systemic changes is highly likely to facilitate elderly persons' employment.[3] However, it is possible that in the Japanese labor market, where the "generational replacement effect" has repeatedly been observed and verified since the 1990s, maintenance and promotion of employment among the elderly has a dampening effect on employment of young persons, including new graduates.

With this in mind, this study will re-examine recent trends relating to the generational replacement effect using micro-panel data for individual companies over the seven years from 2007 to 2013. In particular, as Japanese society rapidly ages there have been a number of studies in recent years that observed a phenomenon opposite to the generational replacement effect (i.e. a complementary relationship between elderly persons' employment and youth employment) as Section II discusses in detail. As of September 2020, the spread of COVID-19 has severely affected the youth labor market, and the number of unemployed young people aged 15–24 has increased significantly.[4] In Japan, curtailment or total stoppage of hiring of new graduates are among the employment adjustment measures companies take under harsh economic conditions, and in general the youth labor market can be seen as an unstable one, easily affected by changes in demographic makeup and economic trends. For this reason, verifying the current state of the generational replacement effect and examining its relationship to companies' specific characteristics appears to be a highly meaningful approach to discussion of appropriate complementarity between elderly persons' employment which is set to expand in the future, and youth employment which will surely play a central role in the Japanese economy in the long run.

This paper is structured as follows: the next section (II) contains an outline of previous studies and clarifies the objectives of this paper. Section III presents data used for analysis, and Section IV explains variables used for estimation. After summarizing the estimate's outcomes in Section V, the conclusions obtained in this paper are described in the final Section VI.

II. Literature review and objectives of this paper

This section contains an overview of previous studies on the generational replacement effect and clarifies the objectives of this paper. A summary of previous studies is shown in Table 1.

Genda (2000) can be called the pioneering study on the generational replacement effect. Using data from the 1996 Ministry of Health, Labour and Welfare (MHLW) *Survey on Employment Trends*,[5] Genda (2000) employed a tobit model to estimate factors determining the number of job openings available to those scheduled to graduate in March 1997 (with scope of analysis limited to private business establishments with more than 5,000 employees). The study found that a high share for "employees aged 45 or above as a percentage of all employees at a business location" was correlated with significant negative impact on the number of job openings available to high school graduates, vocational school graduates, technical college or junior college graduates, and university and graduate school graduates (both humanities and sciences) alike, and the higher the percentage of employees aged 45 or above, the greater the curtailment of hiring of new graduates at the business location. In terms of underlying factors, the study indicates the possible effect of significant increases in labor costs due to aging under a seniority-based wage system.

Genda (2004) discusses criticism that was directed at Genda (2000). The first critique regarding the generational replacement effect is that the causal relationship is reversed, i.e. it is actually the curtailment of hiring of youth that leads to aging in the company, and the second critique is that badly performing companies

Table 1. Summary of previous studies

Study	Data used	Dependent variable(s)	Aging index	Results
Genda (2000)	*Survey on Employment Trends*, 1996	Number of hires among those scheduled to graduate in March 1997 compared to number of existing employees	Percentage of employees aged 45 or above	The higher the share for "employees aged 45 or above as a percentage of all employees at business establishments, " the greater the curtailment of hiring of new high school, vocational school, technical college or junior college, and university or graduate school graduates (both humanities and sciences).
Genda (2004), Chapter 4	*Survey on Employment Trends*, 1997	Percentage of workers entering company, percentage of workers leaving company	Percentage of employees aged 45 or above	At business establishments with a high percentage of employees aged 45 or above, there is a significant negative impact on both of labor inflow rate and labor outflow, regardless of full-time hiring (turnover), part-time hiring (turnover), transfer or relocation.
Genda (2004), Chapter 5	*The Survey on Employment Trends*, 2000	Rate of employment change	Percentage of employees aged 45 or above, dummy for employees aged 45 or above accounting for more than 40% of all employees, employees aged 45 or above as a percentage of regular employees aged 30 or above	A significant negative effect on rate of employment change was confirmed with all three aging indexes.
Hara (2005)	"Survey on the Current State of Recruitment/ Employment Management for Young People," 2004	New graduates to be hired in fiscal 2004 as a percentage of all regular employees at the end of fiscal 2003	Percentage of regular employees aged 50 or above	A higher percentage of regular employees aged 50 or above at a company is correlated with significantly lower numbers of new graduates hired.
Kawaguchi (2006)	"Survey on Company Recruitment, Retirement, and Capacity Development," 2005	Percentage of new graduates hired over the past two years, percentage of employees hired mid-career over the past two years	Perceived excess of employees aged 45–59	Companies with a perceived excess of employees aged 45–59 were more likely to curtail new graduates hire.
Ohta (2009)	*The Survey on Employment Trends*,1994–2003	Youth hiring rate, youth employment growth rate	(1) Workers aged 30 or above as a percentage of all workers, (2) Workers aged 45 or above as a percentage of all workers, (3) Workers aged 55 or above as a percentage of all workers, (4) Average age	In industries with a high-age structure, the rate of youth hiring is low. Regarding the youth employment growth rate, the effect of the age structure variable was positive (though not significant).
	Basic Survey on Wage Structure, 1991–2003	Youth employment growth rate		In industries with a high-age structure, the youth employment growth rate is significantly higher.
	JIP Database, 1991–2006	Youth employment growth rate		In industries with a high-age structure, the youth employment growth rate is higher.
Ohta and Yasuda (2010)	Fact-Finding Survey on Young People's Career Formation, 2003	Number of new graduates among all regular employees (logarithm), number of employees hired mid-career among all regular employees (logarithm)	Average age of regular employees	The average age of regular employees had a significant negative impact on hiring of both new graduates and mid-career employees.
Ohta (2012)	*The Survey on Employment Trends*, 2004–2008	Youth hiring rate	Employees aged 60 or above as a percentage of regular employees aged 55 or above	Since 2006, an increasing male aging index has had a negative impact on youth hiring. The effect on female part-time workers is particularly significant.

are in a less favorable position for hiring young workers, thus exhibiting a higher share of middle-aged and elderly employees, and are more likely to go bankrupt. Because companies included in the data tend to be in better financial shape than those that aren't, there is a sample selection bias, and the observed relationship between aging within the company and the employment of new graduates may be spurious.

Genda (2004) conducted an analysis that addressed the above two problems. First, to address the first critique regarding the purported reverse causal relationship, "employees aged 45 or above as a percentage of all employees aged 30 or above" was used as the aging index, rather than "employees aged 45 or above as a percentage of all employees." Using this index makes it possible to eliminate the influence of trends relating to April hires at the time of the survey (as of June), and indeed, the existence of generational replacement effect is also verified when estimation is carried out with "employees aged 45 or above as a percentage of all employees aged 30 or above" as an independent variable.

Second, to address the second critique regarding sample selection bias, Genda conducted an analysis using Heckman's two-step estimator. Specifically, after performing a probit estimation as to whether or not it belongs to the employment loss (creation) category, the inverse Mills Ratio was added to the independent variable and the employment loss (creation) rate was estimated. The aging index used was "employees aged 45 or above as a percentage of all employees aged 30 or above." As a result, even after controlling for sample selection bias, "employees aged 45 or above as a percentage of all employees aged 30 or above" had a significant effect on employment loss and a negative effect on employment creation, confirming the robustness of the generational replacement effect.

Both Genda (2000) and Genda (2004) used data from the 1990s, but the existence of the generational replacement effect has been confirmed since 2000 as well, in studies using microdata. First, Hara (2005) used the "Survey on the Current State of Recruitment/Employment Management for Young People" conducted by the Japan Institute for Labour Policy and Training (JILPT) in 2004 to analyze factors that determine hiring of new graduates as a percentage of all employees. The findings were that a higher percentage of regular employees aged 50 or above has a significant negative influence on percentage of new graduates.

Second, Kawaguchi (2006) utilized data from the "Survey on Company Recruitment, Retirement, and Capacity Development," conducted by the Research Institute for Advancement of Living Standards in 2005, to perform a tobit estimation of a more direct causal relationship in which a "perceived excess of" middle-aged and elderly workers affects the percentage of regular new graduates. It was found that a "perceived excess of employees aged 45–59 years" had a significant negative effect on the percentage of regular new graduates. Specifically, the percentage of regular new graduates was about 2.3 percentage points lower at companies with an "excessive" proportion of regular employees aged 45 to 59 years than at companies where the latter proportion was considered "appropriate." Similar results were also obtained using median regression analysis and SCLS (Symmetrically Censoring Least Squares) estimation.

Third, Ohta and Yasuda (2010) analyzed the factors determining numbers of new graduates and employees hired mid-career using data from the Fact-Finding Survey on Young People's Career Formation, 2003, conducted by Mitsubishi UFJ Research and Consulting in 2003. The result was that a higher "average age of regular employees" was found to have a significant negative impact on hiring both of new graduates and mid-career workers.

In addition, Ohta (2012) used pool data from the *Survey on Employment Trends*, 2004 to 2008, to analyze the effects on youth hiring of "workers aged 60 and above as a percentage of workers aged 55 and above" (referred to as the "60/55 ratio.") The results showed that from 2006 onward, a higher 60/55 ratio among men was correlated with curtailment of hiring of younger workers, and there was shown to be a clear negative effect on hiring of part-time workers (including new graduates), especially women.

Existing studies confirmed the existence of a generational replacement effect in Japan in the 1990s to the 2000s as the above shows, but in some studies different results were obtained. Ohta (2009) performed an analysis by industry using pool data from *Survey on Employment Trends* from 1994 to 2003, and in an

estimation with "youth employment growth rate" as an dependent variable, found that "workers aged 30 or above as a percentage of all workers" was a positively significant factor, and industries with few young people had a high youth employment growth rate (sample size: 31 industries × 10 years = 310). Similar tendencies have also been observed in estimations utilizing the *Basic Survey on Wage Structure* (MHLW) and JIP Database 2009 (Japan Industrial Productivity Database by Research Institute of Economy, Trade and Industry, RIETI).

Thus, there is evidence that in part appears to disrupt the presence of the generational replacement effect, which has been consistently confirmed in recent years.[6] It appears that underlying the disparities in results obtained in previous studies are differences in the time-frames of analysis, data used for analysis, and variables used for the analysis, as summarized in Table 1.

In this paper, we will re-examine whether the generational replacement effect can be observed in the recent labor market in Japan, where aging has advanced yet further. The following three points can be cited as contributing to differentiation of this study from previous studies. First, data used for this study dates from 2007 to 2013, meaning it is newer than that utilized in previous studies and includes the global financial crisis of 2008 and the period before and after the 2011 Great East Japan Earthquake. This makes it possible to analyze the substitutability of elderly employees and youth hiring during the periods after these economic shocks.

Second, data used for analysis in this study includes data on company characteristics, such as labor costs and financial indicators for each company, that have not been adequately controlled for in previous studies due to data constraints. Therefore, estimation was performed with controls for corporate factors that could affect the generational replacement effect, such as the rising labor costs pointed out in Genda (2000) and the impact of corporate performance indicated in Ohta and Yasuda (2010), and it is possible to examine the relationship between the generational replacement effect and company characteristics.

Finally, data used for analysis in this study is from large companies. In light of the observation that the proportion of elderly persons has a stronger effect at large companies (Ohta 2010), it is likely that an analysis using data from large companies can make a not insignificant contribution to the body of research on the generational replacement effect.

III. Data

The data used for analysis in this paper is from the Toyo Keizai Corporate Social Responsibility (CSR) Survey conducted by Toyo Keizai (referred to below as "the CSR Survey").[7] The CSR Survey is conducted in or around June every year, administered to all listed companies and major unlisted companies. This paper employs data from CSR Surveys covering the seven years from 2007 to 2013 (the 2009 through 2015 editions), which is converted into panel form and used for analysis. In the 2013 survey (2015 edition), questionnaires were sent to all listed companies and major unlisted companies, a total of 3,606 companies, with 1,063 responses received (response rate 29.5%). In addition to these 1,063 companies, an additional survey was performed on 147 companies based on data held by Toyo Keizai, making a total of 1,210 companies (1,157 listed companies, 53 unlisted companies).

The survey form addresses three areas: [1] Hiring and Human Resource Utilization, [2] General CSR, Social Contribution, Internal Governance, etc., and [3] Environment. For this paper estimation was carried out with data from [1] related to the employment status of each company, such as the number of new graduates, number of employees in each age group, length of service, turnover rate, number of administrative workers, number of temporary employees, etc.

Since the CSR Survey does not address items related to companies' financial status, the Corporate Financial Charts, which like the CSR Survey was released by Toyo Keizai, was linked to CSR data. The Corporate Financial Charts are based on annual securities reports from April 2001 onward for all listed companies

excluding the securities and insurance sectors, and contains the main items from financial statements and approximately 170 items covering various indicators necessary for fiscal and business analysis.

IV. Definitions of variables and methods of estimation

This paper analyzes relationships between company characteristics and the current status of the "generational replacement effect" in the Japanese labor market in recent years. This section explains definition of variables and the methodology.

The dependent variable used is "new graduates hired for the next fiscal year as a percentage of all employees (%)." Specifically, it is the value (%) obtained by dividing the number of new graduates in the April following the survey year by the total number of employees in the survey year.[8]

Variables introduced into the estimation as independent variables are as follows.

First of all, two indexes are used as companies' aging indexes, which are the most noteworthy point in this paper. One, "employees aged 50–59 as a percentage of all employees aged 30 or above (%)" (referred to below as the "percentage of employees aged 50–59")[9] follows Genda (2004) in considering the possibility that elderly persons are being utilized because it is not possible to hire young workers, and the possibility of reverse causality in which the curtailment of youth hiring is causing aging in the company. The second index is "employees aged 50 or above as a percentage of all employees aged 30 or above (%)" (referred to below as the "percentage of employees aged 50 or above"). Estimations were performed by introducing these two aging indexes into the set of independent variables, and the two estimations were compared.

The reason for using two different aging indexes is to take into account the diversity of employment systems of employees aged 60 and over. Employees aged 60 and over may include both employees who have not yet retired and employees rehired after reaching retirement age. In particular, the period analyzed in this study was one in which the age at which payment of the fixed-amount part of employees' pensions was raised and measures for securing employment for elderly persons were being implemented, and as a result systems of employment for people over 60 years old became more diversified than in previous studies and it is thought that the influence on youth hiring is more complex.

Actually, when percentages at business locations are examined according to system of employment for continuously employed workers, based on the 2008 Ministry of Health, Labour and Welfare Survey on Employment Conditions of Elderly Persons, among rehired workers, "short-term contract workers and contract workers" accounted for 60.0%, "regular employees and regular staff" for 32.9%, and "part-time workers" for 15.0%, and employees rehired after reaching retirement age are often counted as temporary employees, meaning they would not be included in the number of employees (in this paper's data). On the other hand, in some companies, many of the rehired elderly persons may be included in the number of employees as regular employees. Therefore it is possible that the employees percentage, including those over the age of 60, does not necessarily show an accurate value as an indicator of the size of the elderly contingent at each company. Therefore, estimation was performed using two aging indexes, one with a variable including employees aged 60 and over, and one with a variable not including them.

Secondly, this analysis controls for various factors expected to affect decisions regarding new graduates. At first, variables related to company size and wages were introduced. "Dummy variable for companies with 1,000 or more employees" was used for the variable related to company size, and "labor costs per employee (logarithmic value)" as a variable for wages.[10] As noted in Genda (2000), at large companies that often adopt seniority-based wage systems, aging is equated with increases in labor cost burden, and can have the effect of curtailing the number of new hires. On the other hand, a company with high labor costs is likely to be one that emphasizes firm-specific skills, and may be proactive in hiring new graduates.

Next, a "dummy variable for companies with negative profit the previous fiscal year" and a "dummy variable for companies with negative profit two fiscal years prior" were introduced as variables relating to

the financial status of companies. There is a significant body of studies suggesting that companies make major employment adjustments when the company falls into the red, which is known as the "negative profit adjustment model." Muramatsu (1995) finds that dismissals are likely to occur when a company is in the red for the second consecutive fiscal year, while on the other hand, adjustments are slow to be made in industries that emphasize firm specific skills. Furthermore, it is thought that business performance in the two preceding fiscal years has a direct effect on decisions on employment adjustment relating to new graduates. For example, the dependent variable numerator "new graduates" for the 2013 sample consists of persons who entered the company April 2014, that is, who graduated university or completed a master's program in March 2014. The hiring process for this contingent begins in the middle of the 2012 academic year (although there may be some differences depending on the fiscal year due to employment agreements, etc.), when they are in the third year of university (or in the first year of a master's program), and continues until the middle of the 2013 academic year. In other words, financial indicators that may affect judgments on hiring new graduates in April 2014 are considered to be the figures for fiscal 2011 and 2012. This is why a "dummy variable for companies with negative ordinary profit the previous fiscal year" and a "dummy variable for companies with negative ordinary profit two fiscal years prior" were introduced into the estimation in this paper. These are dummy variables assigned a value of 1 if the fiscal year in question had negative profit, and 0 otherwise.[11]

Added next to the estimation were "turnover rate (%: average for previous two fiscal years)" and "Temporary employees as a percentage of all employees[12] (%)." In previous studies only Ohta and Yasuda (2010) introduced turnover rate as an independent variable, and here, more specifically, "turnover rate within one year of regular employees hired the previous fiscal year" was used. A high turnover rate may generate new hiring so as to secure the labor force. On the other hand, a high turnover rate makes it difficult to recoup training costs, and this may negatively affect new hiring. The value for turnover rate used in this paper is defined as "employee turnover as a percentage of all employees," and the average value for the last fiscal year and the fiscal year before that is used. This is because turnover rates vary greatly from year to year, and also because the turnover rate thought to affect hiring is not the turnover rate for the year of hiring, but rather the turnover rate at the stage of hiring plan formulation, that is, one or two fiscal years prior.

Also, "percentage of temporary employees (%)" means the value for "temporary employees as a percentage of all employees (%)." It is possible that temporary employees and newly hired graduates may be mutually substitutable, as none of them are highly skilled and experienced workers, thus the estimation controlled for the influence of this factor. For the "percentage of temporary employees" variable, the value for the current fiscal year was used instead of the last two fiscal years, but this is because it is assumed that employment of temporary employees is relatively easily adjustable.[13]

In addition, "percentage of administrative workers" and "percentage of female employees" were introduced as independent variables. "Percentage of administrative workers" signifies "administrative workers as a percentage of all employees." Genda (2004) introduced "percentage of clerical, administrative workers" as a value for percentage of white collar workers, and found that in companies with many white collar workers, there is proactive hiring of new graduates from university or graduate school as future human resources.[14] Since a value for percentage of clerical or administrative workers could not be obtained for this study, "percentage of managerial personnel" was introduced.In terms of "percentage of female employees," as noted by Yamamoto (2014), a higher percentage of women is directly correlated with higher profitability, and percentage of female employees is likely to be an indicator of the efficiency and rationality of corporate management. Therefore, the estimation controlled for this effect.

In order to address the endogeneity of the aging index "percentage of employees aged 50–59," "capital investment expenses (unit: million yen, average for previous two fiscal years)" and "R&D expenses (unit: million yen, average for previous two fiscal years)" were introduced as variables. Here the term "endogeneity" refers to the possibility that aging within a company may progress as a result of companies with low future growth prospects refraining from hiring new employees (especially young employees), as observed in Genda

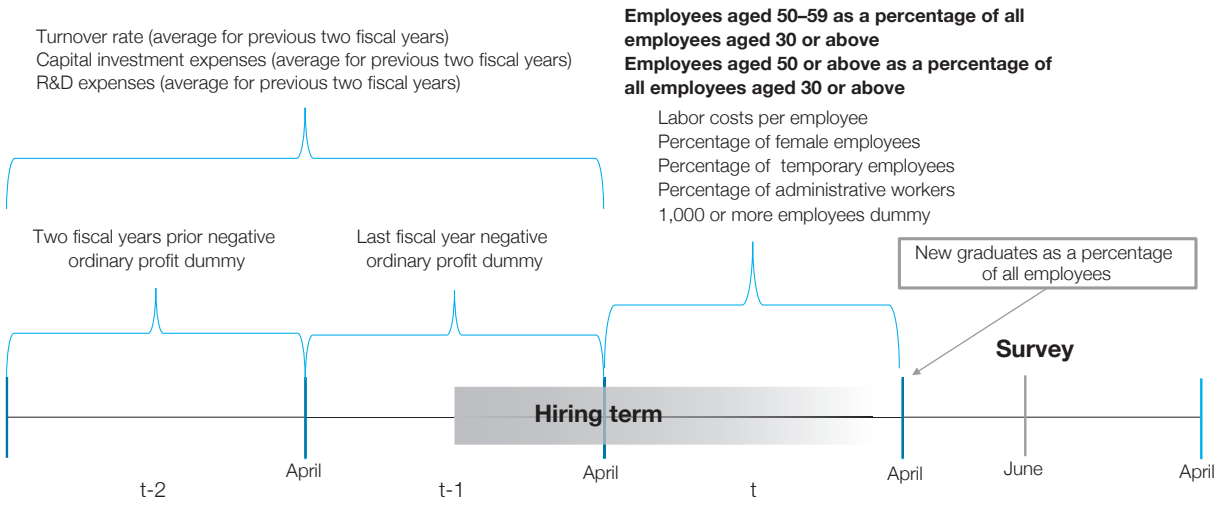

Figure 1. Summary of variables used

Table 2. Descriptive statistics

Variables	Mean	Standard deviation	Min.	Max.
New graduates as a percentage of all employees (%)	2.63	4.49	0.00	145.45
Employees aged 50–59 as a percentage of all employees aged 30 or above (%)	21.71	8.88	0.00	56.12
Employees aged 50 or above as a percentage of all employees aged 30 or above (%)	24.17	10.04	0.00	65.91
1,000 or more employees dummy	0.51	0.50	0.00	1.00
Temporary employees as a percentage of all employees (%)	40.56	147.86	0.00	4,500.00
Percentage of administrative workers (%)	24.73	14.13	0.00	100.00
Turnover rate (average for previous two fiscal years, %)	5.07	6.24	0.00	91.67
Percentage of female employees (%)	18.93	12.44	0.00	93.70
Negative ordinary profit dummy (last fiscal year)	0.15	0.36	0.00	1.00
Negative ordinary profit dummy (two fiscal years prior)	0.16	0.36	0.00	1.00
Labor costs per person (logarithm)	9.09	0.37	5.14	11.27
Capital investment expenses (Average for previous two fiscal years, million yen units)	12.92	44.73	0.00	507.73
R&D expenses (Average for previous two fiscal years, million yen units)	8.47	40.19	0.00	794.18
Employees aged 50–59 as a percentage of all employees aged 30 or above (%) ×Capital investment expenses (Average for previous two fiscal years, million yen units)	0.29	1.03	0.00	12.84
Employees aged 50–59 as a percentage of all employees aged 30 or above (%) ×R&D expenses (Average for previous two fiscal years, million yen units)	0.20	0.98	0.00	19.06
Employees aged 50 or above as a percentage of all employees aged 30 or above (%) ×Capital investment expenses (Average for previous two fiscal years, million yen units)	0.32	1.11	0.00	13.87
Employees aged 50 or above as a percentage of all employees aged 30 or above (%) ×R&D expenses (Average for previous two fiscal years, million yen units)	0.22	1.06	0.00	19.71
Number of observations		4,017		

(2004). To deal with such endogeneity, this study introduced into the estimation "capital investment expenses" as an index showing physical capital investment tendencies in accordance with companies' medium- to long-term business plans, and "R&D expenses" as an indicator of medium- to long-term productivity.[15] Due to the nature of accounting for both capital investment expenses and R&D expenses, these expenses for the year may not accurately indicate the company's future investment situation. For this reason an average-value

variable, which is the average for previous two fiscal years for both variables, was created and introduced into the independent variables along with the interaction term with the aging index.[16]

Other control variables include dummy variable for year, dummy variable for industry,[17] and interaction term of dummy variable for industry and dummy variable for year. Figure 1 summarizes the time period of each of the independent variable data points used for the estimation.

Table 2 shows the descriptive statistics of the main variables used in the analysis. Using these variables, we create an unbalanced panel dataset of companies to perform OLS estimation controlling for firm-level fixed effects to account for company-specific heterogeneity.

V. Outcomes of estimation

Table 3 shows the effects of "employees aged 50–59 as a percentage of all employees aged 30 or above" (percentage of employees aged 50–59) and "percentage of employees aged 50 or above as a percentage of all employees aged 30 or above" (percentage of employees aged 50 or above) on "new graduates, as a percentage of all employees (%)" as the result of pooled OLS estimation, and Table 4 shows the results of estimation using the fixed effects model which controls for the effects of specific companies' practices. Standard errors clustered at the industry level are reported.[18]

Firstly, the effects of two aging indexes, "percentage of employees aged 50–59" and "percentage of employees aged 50 or above," on new graduates were verified. In the estimation using "percentage of employees aged 50–59" as the aging index, in both Table 3 employing OLS estimation and Table 4 which controlled for company-specific fixed effects, all estimations in columns (1)–(6) showed a negative impact with a significance level of 10% or less, with a generational replacement effect observed as new graduates decreased as the percentage of employees aged 50–59 increased. In estimations of (1), which introduced into the independent variables "ordinary profit," not sufficiently taken into account in previous studies, and (2), which introduced "labor costs per person," no change in significance of the coefficient of the aging index was observed, thus it can be inferred that in terms of factors underlying the generational replacement effect, the effects of corporate performance and labor costs on the generational replacement effect are limited. A generational replacement effect was also observed for (3)–(6) which introduced the variables "capital investment expenses" and "R&D expenses," considered to be indicators of companies' medium- to long-term business conditions, and introduced an interaction term with the aging index, suggesting that aging within a company and new graduates are in a substitutional relationship even when controlling for the medium- to long-term business outlook.

Meanwhile, "percentage of employees aged 50 or above" (columns (7)–(12)) shows the same tendency as "percentage of employees aged 50–59" in the OLS estimation in Table 3, and was significantly negative in all estimations except (7), but was not significant in the fixed-effects estimation in Table 4. It is thought that the reason the results differ from those of "percentage of employees aged 50–59" is that employees aged 60 or above include a certain number of rehired workers whose wages were lower than before they were rehired,[19] and it is likely that the aging index reflects a situation in which companies' employment adjustments such as wages and employment numbers have advanced to some extent. However, as shown in Section IV, this "percentage of employees aged 50 or above" does not include many employees rehired after reaching retirement age, who are non-regular employees, and it should be noted that the index may not accurately reflect the size of the contingent of people in their 60s or older, and caution should be exercised in interpreting the results.

In the OLS estimation (Table 3), "percentage of administrative workers" had a significant positive effect on the percentage of new graduates, mainly in the estimation using "percentage of employees aged 50–59" as the aging index (columns (2)–(6) and column (12)). Also, in the fixed-effects estimation utilized for the employment exam (Table 4), there is a significant positive effect in all estimations employing "percentage of

Table 3. Effects of employee age composition on number of new graduates (OLS estimation)

	Aging index (1): Employees aged 50–59 as a percentage of all employees aged 30 or above (%) Aging index (2): Employees aged 50 or above as a percentage of all employees aged 30 or above (%)											
Dependent variable: New graduates as a percentage of all employees (%)	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Aging index	−0.116*	−0.084**	−0.084**	−0.085**	−0.087**	−0.087**	−0.097	−0.052***	−0.052***	−0.052***	−0.053***	−0.053***
	(0.062)	(0.037)	(0.037)	(0.037)	(0.039)	(0.039)	(0.061)	(0.017)	(0.017)	(0.017)	(0.017)	(0.017)
1,000 or more employees dummy	−0.708	−0.405*	−0.423*	−0.398	−0.429*	−0.390	−0.818	−0.490*	−0.509*	−0.483*	−0.515*	−0.479*
	(0.459)	(0.234)	(0.241)	(0.238)	(0.244)	(0.235)	(0.515)	(0.267)	(0.277)	(0.272)	(0.279)	(0.272)
Temporary employees as a percentage of all employees (%)	−0.001*	−0.001*	−0.001*	−0.001*	−0.001*	−0.001*	−0.001**	−0.001**	−0.001**	−0.001**	−0.001**	−0.001**
	(0.001)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.001)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Percentage of administrative workers (%)	0.044	0.012*	0.011*	0.012*	0.012*	0.012**	0.043	0.010	0.010	0.011	0.010	0.011*
	(0.035)	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)	(0.035)	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)
Turnover rate (average for previous two fiscal years, %)	0.049	0.054**	0.054**	0.053**	0.053**	0.052**	0.051	0.062*	0.062*	0.062*	0.061*	0.061*
	(0.045)	(0.025)	(0.025)	(0.025)	(0.025)	(0.025)	(0.051)	(0.032)	(0.032)	(0.032)	(0.031)	(0.031)
Percentage of female employees (%)	0.018	0.032**	0.032**	0.032**	0.032**	0.032**	0.020	0.035**	0.035**	0.035**	0.035**	0.035**
	(0.024)	(0.015)	(0.015)	(0.015)	(0.015)	(0.015)	(0.025)	(0.016)	(0.016)	(0.016)	(0.016)	(0.016)
Negative ordinary profit dummy (last fiscal year)	−0.221	−0.060	−0.057	−0.061	−0.057	−0.062	−0.202	−0.051	−0.048	−0.053	−0.047	−0.053
	(0.162)	(0.153)	(0.152)	(0.153)	(0.152)	(0.153)	(0.156)	(0.148)	(0.148)	(0.148)	(0.147)	(0.148)
Negative ordinary profit dummy (two fiscal years prior)	0.051	−0.201	−0.198	−0.202	−0.199	−0.204	0.053	−0.204	−0.202	−0.205*	−0.201	−0.206*
	(0.191)	(0.121)	(0.121)	(0.120)	(0.122)	(0.121)	(0.194)	(0.120)	(0.120)	(0.120)	(0.120)	(0.120)
Labor costs per person (logarithm)		0.579***	0.575***	0.579***	0.572***	0.557***		0.472***	0.469***	0.473***	0.468***	0.460***
		(0.145)	(0.144)	(0.144)	(0.143)	(0.140)		(0.128)	(0.129)	(0.128)	(0.129)	(0.128)
Capital investment expenses			0.001		−0.006				0.001		−0.003	
(Average for previous two fiscal years, million yen units)			(0.001)		(0.006)				(0.001)		(0.003)	
R&D expenses				−0.001		−0.014				−0.001		−0.009
(Average for previous two fiscal years, million yen units)				(0.001)		(0.010)				(0.001)		(0.006)
Aging index × capital investment expenses					0.338						0.200	
(Average for previous two fiscal years, million yen units)					(0.283)						(0.129)	
Aging index × R&D expenses						0.570						0.320
(Average for previous two fiscal years, million yen units)						(0.435)						(0.238)
Constant term	3.220**	−2.468*	−2.429*	−2.483*	−2.323	−2.221	2.874*	−2.260	−2.219	−2.275*	−2.163	−2.129
	(1.551)	(1.400)	(1.412)	(1.401)	(1.455)	(1.457)	(1.525)	(1.334)	(1.350)	(1.336)	(1.371)	(1.356)
Number of observations	4756	4017	4017	4017	4017	4017	4756	4017	4017	4017	4017	4017
Coefficient of determination	0.222	0.124	0.125	0.125	0.125	0.125	0.221	0.115	0.116	0.115	0.116	0.116

Note: *** indicates 1%, ** indicates 5%, and * indicates 10% level of statistically significance. Figures in parentheses indicate robust standard errors clustered at the industry level. Independent variables include fiscal year dummy and interaction term for industry and fiscal year dummy.

Table 4. Effects of employee age composition on number of new graduates (fixed-effects estimation)

	Aging index (1): Employees aged 50–59 as a percentage of all employees aged 30 or above (%) Aging index (2): Employees aged 50 or above as a percentage of all employees aged 30 or above (%)											
Dependent variable: New graduates as a percentage of all employees (%)	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Aging index	−0.033**	−0.038**	−0.038**	−0.038**	−0.036*	−0.039**	−0.021	−0.021	−0.020	−0.021	−0.017	−0.020
	(0.015)	(0.019)	(0.019)	(0.019)	(0.019)	(0.019)	(0.015)	(0.018)	(0.018)	(0.018)	(0.018)	(0.018)
Temporary employees as a percentage of all employees (%)	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Percentage of administrative workers (%)	0.059***	0.069***	0.069***	0.069***	0.069***	0.069***	0.059***	0.069***	0.069***	0.069***	0.069***	0.069***
	(0.008)	(0.010)	(0.010)	(0.010)	(0.010)	(0.010)	(0.008)	(0.010)	(0.010)	(0.010)	(0.010)	(0.010)
Turnover rate (average for previous two fiscal years, %)	−0.093***	−0.115***	−0.114***	−0.115***	−0.114***	−0.115***	−0.093***	−0.115***	−0.115***	−0.115***	−0.115***	−0.115***
	(0.013)	(0.015)	(0.015)	(0.015)	(0.015)	(0.015)	(0.013)	(0.015)	(0.015)	(0.015)	(0.015)	(0.015)
Percentage of female employees (%)	−0.086***	−0.106***	−0.107***	−0.106***	−0.108***	−0.106***	−0.085***	−0.104***	−0.105***	−0.104***	−0.106***	−0.104***
	(0.023)	(0.028)	(0.028)	(0.028)	(0.028)	(0.028)	(0.023)	(0.028)	(0.028)	(0.028)	(0.028)	(0.028)
Negative ordinary profit dummy (last fiscal year)	−0.100	−0.062	−0.062	−0.062	−0.062	−0.061	−0.096	−0.059	−0.059	−0.059	−0.061	−0.059
	(0.135)	(0.155)	(0.155)	(0.155)	(0.155)	(0.155)	(0.135)	(0.155)	(0.155)	(0.155)	(0.155)	(0.155)
Negative ordinary profit dummy (two fiscal years prior)	−0.125	−0.143	−0.146	−0.143	−0.147	−0.144	−0.122	−0.137	−0.139	−0.137	−0.143	−0.136
	(0.136)	(0.153)	(0.153)	(0.153)	(0.153)	(0.153)	(0.136)	(0.153)	(0.153)	(0.153)	(0.153)	(0.153)
Labor costs per person (logarithm)		0.237	0.252	0.231	0.243	0.234		0.225	0.238	0.217	0.223	0.210
		(0.389)	(0.389)	(0.392)	(0.389)	(0.392)		(0.389)	(0.389)	(0.393)	(0.390)	(0.394)
Capital investment expenses (Average for previous two fiscal years, million yen units)			0.006		0.011				0.006		0.012	
			(0.005)		(0.010)				(0.005)		(0.010)	
R&D expenses (Average for previous two fiscal years, million yen units)				−0.001		−0.004				−0.001		0.000
				(0.010)		(0.015)				(0.010)		(0.013)
Aging index × capital investment expenses (Average for previous two fiscal years, million yen units)					−0.250						−0.300	
					(0.463)						(0.409)	
Aging index × R&D expenses (Average for previous two fiscal years, million yen units)						0.138						−0.104
						(0.545)						(0.497)
Constant term	4.195	3.679	3.487	3.746	3.548	3.737	3.888	3.324	3.126	3.398	3.221	3.444
	(3.885)	(5.330)	(5.331)	(5.356)	(5.333)	(5.357)	(3.885)	(5.330)	(5.332)	(5.356)	(5.334)	(5.362)
Number of observations	4756	4017	4017	4017	4017	4017	4756	4017	4017	4017	4017	4017
Coefficient of determination	0.117	0.106	0.106	0.106	0.107	0.106	0.116	0.105	0.106	0.105	0.106	0.105

Note: *** indicates 1%, ** indicates 5%, and * indicates 10% level of statistically significance. Estimation controlling for company-specific fixed effects. Figures in parentheses indicate robust standard errors clustered at the industry level. Independent variables include fiscal year dummy and interaction term for industry and fiscal year dummy.

employees aged 50–59" and "percentage of employees aged 50 or above," and it is evident that companies with a high percentage of administrative workers have a high percentage of new graduates.

As in Genda (2004), it is possible that companies with many administrative workers tend to proactively hire new graduates from university or master's programs, who are expected to be key future human resources. Alternatively, a high percentage of administrative workers can be regarded as an indicator of a personnel shortage at a company. Oi (2005) showed that the percentage of executives in Japan rose between the 1970s to the 2000s, and in particular, the number of other positions other than foreman, subsection manager, section manager, and department manager has increased significantly, which may be the result of the introduction of professional/specialist systems that affect division of tasks within the organization. Traditionally, Japanese administrative workers have tended to be cultivated more as generalists than in Western countries,[20] but in recent years, companies with a high percentage of administrative workers may be seen as requiring these workers to develop duties and skills that enable them to be player-manager in the company, due to lack of personnel and aging and thus more actively hiring new graduates. Thorough verification and examination of these interpretations remains as a future task.

Secondly, as for "turnover rate," it had a significantly positive effect in all estimations except columns (1) and (7) in the OLS estimation in Table 3, while in the fixed-effects estimation in Table 4, all estimations in columns (1)–(12) showed a negative effect at the 1% significance level. Underlying these results may be the fact that some companies hire a large number of new graduates on the assumption that there will be early, large-scale turnover. If the fixed-effects estimation controls for such company-specific characteristics, the high turnover rate becomes a variable that indicates low employee retention, and companies with high turnover rates are those that may hire large numbers but also expect to lose them quickly, and one interpretation is that this leads to unwillingness to hire new graduates.

Similarly, for "percentage of female employees," the OLS estimation showed a positive effect at the 5% significance level in all estimations except columns (1) and (7), while in the fixed-effects estimation in Table 4, all estimations in columns (1)–(12) showed a negative effect at the 1% significance level, showing that companies with a high percentage of female employees tend to have a low percentage of new graduates. If the degree of innovation in corporate management is absorbed into fixed effects, female employees and new graduates can be interpreted as being in a substitutable relationship in the fixed-effects estimation, unlike the results of the OLS estimation.

Regarding "percentage of temporary employees," "negative ordinary profit dummy variable," "labor costs per person," "capital investment expenses," and "R&D expenses," no significant results were found in the fixed-effects estimation.

Finally, it should be noted that as shown in Section II, this paper's estimation period includes events such as the global financial crisis (2008) and the Great East Japan Earthquake (2011), which are seen as having a major impact on employment. Thus, in order to observe varying degrees of change in the generational replacement effect for each period (2007–2008, 2009–2010, 2011–2013), Table 5 shows the results of fixed-effects estimations performed for three separate periods.

The results of fixed-effects estimations conducted for each period were that "percentage of employees aged 50–59" in columns (1)–(6) was significantly negative at the 5% level during the 2009–2010 period, and a generational replacement effect was observed. Also, in the 2011–2013 period, "percentage of employees aged 50 or above" in columns (7)–(12) was significantly negative at the 1% level. A possible underlying factor is that if a certain number of workers included in "percentage of employees aged 50–59" in 2009–2010 were still working,[21] their inclusion in "percentage of employees aged 50 or above" in the 2011–2013 estimation several years later may have an effect. For example, a company that reduced hiring of new graduates in 2009 due to a large number of employees in their 50s may later have reduced new graduates in 2013 due to a large number of employees in their 60s. In this case, it can be inferred that the effect of "percentage of employees aged 50–59," which was significant in 2009–2010, may be reflected in the coefficient of "percentage of employees

Table 5. Fixed-effects estimations by term

Aging index (1): Coefficient of "employees aged 50–59 as a percentage of all employees aged 30 or above"

Term	(1)	(2)	(3)	(4)	(5)	(6)
2007–2008	0.009	0.014	0.014	0.014	0.020	0.014
	(0.019)	(0.019)	(0.019)	(0.019)	(0.020)	(0.020)
2009–2010	−0.285**	−0.292**	−0.293**	−0.292**	−0.294**	−0.293**
	(0.118)	(0.121)	(0.121)	(0.121)	(0.122)	(0.123)
2011–2013	−0.045*	−0.030	−0.030	−0.030	−0.028	−0.031
	(0.027)	(0.040)	(0.040)	(0.040)	(0.041)	(0.041)

Aging index (2): Coefficient of "employees aged 50 or above as a percentage of all employees aged 30 or above"

Term	(7)	(8)	(9)	(10)	(11)	(12)
2007–2008	−0.014	−0.010	−0.010	−0.010	0.005	−0.011
	(0.017)	(0.018)	(0.018)	(0.018)	(0.018)	(0.018)
2009–2010	0.068	0.046	0.045	0.046	0.051	0.058
	(0.117)	(0.119)	(0.120)	(0.120)	(0.122)	(0.121)
2011–2013	−0.076***	−0.119***	−0.119***	−0.119***	−0.121***	−0.124***
	(0.024)	(0.037)	(0.037)	(0.037)	(0.038)	(0.038)

Note: 1. The dependent variable is "new graduates as a percentage of all employees (%)."
2. *** indicates 1%, ** indicates 5%, and * indicates 10% level of statistically significance.
3. Estimation controlling for company-specific fixed effects. Independent variables introduced in each column are based on those in Table 3.

aged 50 or above" in 2011–2013.

As Hamermesh (1992) points out, employment adjustments by companies is the result of a dynamic optimization process. Thus companies' employment adjustments are seen as taking a certain amount of time, and this may be the reason the results shown in Table 5 were obtained. It is evidently necessary to continue paying close attention to future trends regarding the relationship between aging index and youth hiring.

Although other studies have found evidence of the generational replacement effect in Japan since the 1990s, we could not find evidence of such effect for the 2007–2008 period. Factors underlying the failure to observe a generational replacement effect during this period may include hiring policy decisions in 2007–2008, influenced by the long-term economic recovery called the "14th cycle"[22] which started under the Koizumi administration, that stimulated demand for new graduates regardless of aging.

VI. Conclusion

This paper describes the relationship between "generational replacement effect" (the effect of aging within companies on curtailment of youth hiring) and company characteristics in the labor market in Japan, which was re-examined using micro-panel data for individual companies from fiscal 2007 through fiscal 2013.

This paper's estimations indicate that the number of new graduates decreases when the percentage of employees aged 50–59 increases, and this was observed in both pooled OLS estimation and fixed-effects estimation that controls for the effects of specific companies' practices. The generational replacement effect was also observed in estimations that incorporate labor costs, corporate performance, capital investment expenses and R&D expenses as variables. As to factors contributing to observation of a generational replacement effect, it was demonstrated that the burden of labor costs due to aging, the effects of corporate performance, and companies' future business outlook, which have been cited in previous studies, were limited in effect.

In estimations using "percentage of employees aged 50 or above," i.e. including employees aged 60 and above in the aging index, no generational replacement effect was observed in the fixed-effects estimation,

and there were no results indicating a significant relationship of substitutability between youth and elderly persons. Furthermore, we observed a significant generational replacement effect for the periods 2009–2010 and 2011–2013, although evidence of such effect could not be observed for the period of 2007–2008.

Furthermore, the limitations of this paper's analysis and future challenges should be touched upon. First, companies with 1,000 or more employees account for nearly 50% of the sample used for analysis in this paper (with companies with 5,000 or more employees accounting for 14.8%), and therefore the sample is not representative of the Japanese labor market as a whole. This is a significant issue that must be taken into account when interpreting the results in this study.

Lastly, our estimates of the intergenerational replacement effect may not strictly be interpreted as showing evidence of a causal relationship between the size of the elderly contingent and reduction in new graduates. For example, it is possible that companies that are not popular with young people (and thus cannot hire them) have no choice but to employ elderly persons. However, as shown in Table 3 and Table 4, the effect of percentage of aged employees on percentage of new graduates is greater in the coefficient estimation values of the OLS estimation than those of the fixed-effects estimation. If company-specific features such as popularity among youth and corporate brand are controlled for by fixed-effects, the OLS estimates are overestimated due to missing variable bias, and the fixed-effects estimates are closer to the true parameter.

Although many issues remain unanswered, we believe that studies on the generational replacement effect become more important for Japan as population aging continues. Understanding the effect of demographic shifts on the employment opportunities of the youth and decision making of firms is indispensable for effective labor policy making.

This paper is based on a study in *The Japanese Journal of Labour Studies* (July 2019, no.708) with additions and amendments in line with the gist of *Japan Labor Issues*.

Notes

1. According to the Cabinet Office (2020) Annual Report on the Aging Society, Japan's aging rate (percentage of the population aged 65 and over) reached a record high of 28.4% as of October 1, 2019. This is even higher than other countries with high aging rates such as Germany (21.2%), Sweden (19.6%), and France (18.9%) (figures in parentheses indicate 2015 aging rate), and is among the highest in the world. Increase in the aging rate is expected to continue, reaching 38.4% by 2065.
2. For details of this law, refer to the following webpage: http://www.japaneselawtranslation.go.jp/law/detail/?id=2621&vm=04&re=01.
3. In fact, according to Yamamoto (2008) and Kondo (2014) who analyzed the impact of the Act on Stabilization of Employment of Elderly Persons which went into effect in April 2006, the amendment to the law has been shown to contribute to promoting employment of workers in their early 60s. Other studies have verified the influence of aging on youth employment in other countries, such as a study showing that the number of highly skilled younger workers hired drops in areas of the United States where fewer elderly workers retire (Mohnen 2019), and studies showing that older workers are retiring later as a result of public pension plan reform in Italy, and this has a negative impact on youth employment (Bovini and Paradisi 2019, Bertoni and Brunello 2017, Boeri et al. 2016).
4. According to the *Labour Force Survey*, when total unemployment by age group is examined in January 2020 before the impact of COVID-19 and the in September, the most recent data available, the youngest age group of 15–24 showed the most remarkable increase. The number of unemployed people increased between January and September by a factor of 1.50 for people aged 15–24 (180,000 to 270,000 persons), of 1.24 for those aged 25–34 (410,000 to 510,000 persons), of 1.21 for those aged 35–44 (290,000 to 350,000 persons), of 1.40 for those aged 45–54 (300,000 to 420,000 persons), of 1.37 for those aged 55–64 (270,000 to 370,000 persons), and of 1.38 for those aged 65 or above (130,000 to 180,000 persons). For details of the impact of COVID-19 on the Japanese labor market, refer to Kikuchi et al. (2020).
5. For details of the survey, refer to the following webpage: https: //www.mhlw.go.jp/english/database/db-l/employment_trends.html.
6. Oshio, Shimizutani and Oishi (2010) also did not find evidence of the substitutability of elderly and youth employment.
7. The results of the CSR Survey are published not only in print media but also as a database, and the database was referenced for this study.
8. New graduates refer to those graduated from four-year undergraduate programs and graduate school programs. "Number of employees" does not include executives and temporary employees (including executives who are not directors under commercial law).
9. Genda (2004) uses "employees aged 45 or above as a percentage of all employees aged 30 or above," but because the CSR Survey divides age groups by 10-year units, "employees aged 50–59 as a percentage of all employees aged 30 or above" was used as the aging index for this study.
10. "Labor costs" refers to costs that companies listed as such in their responses, and can be considered to include the employer's share

of social insurance premiums and various allowances in addition to wages. It also refers to a company's overall labor costs, including those relating to temporary employees.

11. The value for ordinary profit value is the non-consolidated rather than the consolidated value.

12. The "number of temporary employees" is the average number of temporary employees per year, and indicates the total of dispatched employees, part-time workers, fixed-term contract employees, etc.

13. See Figure 1 for details of relationships between variables used and time of hiring.

14. As shown in Table 2, among the sample for analysis there was a company for which the percentage of administrative workers was 100% (hereinafter referred to as Company A), but it was included in the scope of analysis for the following reasons. Company A is a holding company that carries out real estate guarantee and debt collection services, and at all times there were only a few regular employees, with only two regular employees in the year when the percentage of administrative workers was 100%. Since Company A is a holding company, it is possible that all of these regular employees are in the positions of executives of affiliated companies, and there is no evidence for judging the figure of 100% administrative workers to be incorrect, thus Company A was not excluded from analysis.

15. Nagaoka (2006) showed that companies with more proactive R&D have higher market value, and Ito and Tanaka (2016) showed that export companies engaged in R&D activities have higher productivity than both non-export and export companies that do not conduct R&D. Thus R&D expenses are considered to be an indicator of a company's market value and productivity.

16. For capital investment expenses and R&D expenses, the averages of the last two fiscal years were used. One reason for this is that the figures for a single fiscal year for these variables fluctuate widely from one fiscal year to another in the same manner as the turnover rate.

17. Industries were classified according to the following 11 categories: 1. Agriculture and forestry 2. Mining and quarrying of stone and gravel 3. Construction 4. Manufacture 5. Electricity, gas, heat supply and water 6. Information and communications 7. Transport and postal services 8. Wholesale and retail trade 9. Finance and insurance 10. Real estate 11. Miscellaneous services N.E.C.

18. The "dummy variable for companies with 1,000 or more employees" was not used for the fixed-effects estimation in Table 4 because there was very little change throughout the year. When the employment exam was examined with regard to individual effects, the null hypothesis that individual effect was zero in all estimations was found to be invalid, and the test result was obtained that it is desirable to employ fixed-effects estimation.

19. According to the JILPTs "2014 Survey on the Work and Lives of People Aged 60–69," 81.0% responded that "wages had decreased" after continuing employment post-retirement age. In terms of amount of decrease, rehired workers saw wages drop significantly, with 24.0% reporting a decrease of 41–50%, 18.3% a decrease of 21–30%, and 14.1% a decrease of 31–40%.

20. A characteristic of Japanese administrative workers, observed by the Japan Institute for Labor Policy and Training (1998), is a strong generalist tendency, as shown by the rates of agreement with the statement "for section managers' career development, it is desirable to experience not only functions relevant to their duties but also other functions": 56.9% in Japan, 30.7% in Germany, and 13.5% in the United States.

21. Turnover rates for those in their late 50s (aged 55–59) in 2009 and 2010, as shown in the *Survey on Employment Trends*, were 9.7% and 9.1% respectively for men and 11.7% and 11.6% respectively for women. Overall the turnover rate for employees in their 50s is low compared to other age groups.

22. January-March 2008 was the peak of the economy during the longest economic recovery period since World War II, during which the economy expanded for 73 months from January 2002 to February 2008. For further details on the economic cycle, please refer to the Cabinet Office website: https://www.esri.cao.go.jp/jp/stat/di/hiduke.html (in Japanese).

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