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博 士 論 文

令和 3 年 12 月

神戸大学大学院経済学研究科

経済学専攻

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Empirical Analyses of Employment of Older People in Japan (日本における高齢者雇用の実証分析)

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December 02

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Abstract

This doctoral dissertation aims to empirically examine the employment of older people in Japan from the perspectives of labor supply and demand. More specifically, this dissertation focuses on three topics, including the impact of elderly employment promotion policies, the impact of older people's employment on individuals and firms.

First, regarding the study of the effect of elderly employment promotion policies in Japan, this dissertation investigates the effectiveness of Elderly Employment Stabilization Law (EESL), which imposes an obligation to employ older persons after retirement as a measure to promote employment of the elderly. This policy is worth investigating as they are unique, flexible, and moderate compared to other countries' policies, and their results can provide many insights. Although there are already several studies on the effects of this law, this study focuses on the main point of the revisions, that is, job transfer, which is an important issue faced by older people in Japan when they continue to work after the mandatory retirement age.

Second, this dissertation investigates the causal relationship between employment and the subjective well-being of older people. Many previous studies have examined the correlation between employment and subjective well-being. However, individuals' well-being might, in turn, have an impact on their employment decisions, leading to reverse causality bias. This dissertation addresses the endogeneity of employment decisions in Japan. Moreover, when examining the well-being of older adults, it is vital to determine not only the effects of employment itself but also the heterogeneous effects of different types of employment, such as regular and non-regular employment.

Third, this dissertation focuses on the impact of an aging workforce on firm performance in Japan. Japan has a rapidly aging population and is currently the most aged country in the world. However, the impact of firm-level aging on productivity in such an aging country remains largely unexplored. Moreover, this study uses firm-level panel data and accounts for both time-invariant and time-variant heterogeneity across firms. This study examines the differences in estimation results between ordinary least squares estimation (OLS) and firm fixed effects models (FE), which were not examined in previous studies due to data limitations. This study not only analyzes single firms but also considers the transfer of elderly workers within a group of firms using data from

consolidated firms.

A summary of Chapters 2 through 4 is as follows. Chapter 2 examines labor supply responses to the increase in pension eligibility age and labor demand responses to changes in companies' discretion regarding continued employment. Since employment law revisions and social security revisions are inextricably linked, this study examines the combined effects of these revised laws. Specifically, using the Japan Household Panel Survey from 2008 to 2018, this study compares the unaffected cohort born between April 1949 and March 1953 with the revision-affected cohort born between April 1953 and January 1956 using a difference in differences model. The results show that the revisions had almost no impact on the employment of older adults and their receipt of pensions. However, they did have significant positive effects on job transfers and retirement. Thus, although the revised law obligated companies to continue to employ older workers, it gave companies the option of placing older adults in affiliated companies, which encouraged older workers to retire.

Chapter 3 examines the effect of employment on the subjective well-being of older people, based on Japanese national survey data (Japanese General Social Surveys) from 2000 to 2012. To address the endogeneity problem of employment choice, this study estimates a probit ordinary least square (POLS) using the exogenous employment change due to the 2006 EESL and pension revision as an instrumental variable (IV). While the POLS results show that employment increases satisfaction with the household situation, the IV-POLS method shows that the effect disappears. Furthermore, the effect of employment on well-being depends on the type of employment (regular or non-regular), but the difference disappears when household income is controlled. These results suggest that employment has both positive and negative effects on subjective well-being, and the two cancel each other out.

In Chapter 4, using a panel data set of Japanese firms covering the period 2004-2016, this study examines the effect of the age structure of employees on labor productivity and wages. The OLS results indicate a negative relationship between the employment share of older employees and labor productivity. However, the effects disappear after applying the FE or generalized method of moments methods. We further find that the

share of older employees does not significantly affect firms' labor costs. Thus, there is no evidence of overpayment by older workers.

The final chapter gives a brief review of research in Chapters 2 to 4. It summarizes the main findings of this doctoral dissertation and future studies on these topics.

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Chapter 1 Introduction

Recent declines in fertility rates and increases in life expectancy have contributed to rapid population aging in many industrialized countries. The average median age (in years) of the population across the OECD countries has surpassed 40, which is anticipated to increase to approximately 45 in the next three decades. Moreover, the ratio of older people aged 65 years and over to people aged 15-64 years is expected to rise from 25% in 2018 to 40% in 2050 (OECD, 2019).

With an ageing population, a number of issues have attracted widespread attention around the world, mainly including the effects of policies (Adams, 2004; Neumark and Song, 2013; Neumark et al., 2019) and the impact of employment of older people on individuals (Charles, 2004; Bonsang and Klein, 2012) and firms (Göbel and Zwick, 2013; Mahlberg et al., 2013).

In recent years, Japan's population continues to age rapidly at a rate unlike any other country in the world. Furthermore, Japan recently surpassed other countries as the world's fastest aging country. Due to the rapid population aging, the special elderly employment promotion policies implemented by the government, and the labor market characteristics, the Japanese evidence could provide other countries with many insights.

This doctoral dissertation aims to empirically examine the employment of older people in Japan from the perspectives of labor supply and demand. More specifically, this dissertation focuses on three topics, including the impact of elderly employment promotion policies, the impact of older people's employment on individuals and firms.

First, regarding the study of the effect of elderly employment promotion policies in Japan, this dissertation investigates the effectiveness of Elderly Employment Stabilization Law (EESL), which imposes an obligation to employ older persons after retirement as a measure to promote employment of the elderly. This policy is worth investigating as they are unique, flexible, and moderate compared to other countries' policies, and their results can provide many insights. Although there are already several studies on the effects of this law, this study focuses on the main point of the revisions,

that is, job transfer, which is an important issue faced by older people in Japan when they continue to work after the mandatory retirement age.

Second, this dissertation investigates the causal relationship between employment and the subjective well-being of older people. Many previous studies have examined the correlation between employment and subjective well-being. However, individuals' well-being might, in turn, have an impact on their employment decisions, leading to reverse causality bias. This dissertation addresses the endogeneity of employment decisions in Japan. Moreover, when examining the well-being of older adults, it is vital to determine not only the effects of employment itself but also the heterogeneous effects of different types of employment, such as regular and non-regular employment.

Third, this dissertation focuses on the impact of an aging workforce on firm performance in Japan. Japan has a rapidly aging population and is currently the most aged country in the world. However, the impact of firm-level aging on productivity in such an aging country remains largely unexplored. Moreover, this study uses firm-level panel data and accounts for both time-invariant and time-variant heterogeneity across firms. This study examines the differences in estimation results between ordinary least squares estimation (OLS) and firm fixed effects models (FE), which were not examined in previous studies due to data limitations. This study not only analyzes single firms but also considers the transfer of elderly workers within a group of firms using data from consolidated firms.

This doctoral dissertation consists of three empirical studies in Chapter 2 to 4. Chapter 2 focuses on the impact of elderly employment promotion policies, and Chapter 3 and Chapter 4 focus on the impact of older people's employment on individuals and firms, respectively. The objectives of these studies are as follows.

Chapter 2 estimates the impact of employment promotion policies on employment or job transfers of older adults based on individual panel data. Chapter 3 investigates the effect of continued employment after mandatory retirement age on the subjective well-being of older people. Moreover, this study also analyzes whether the effect of employment on well-being varies depending on the employment status-regular or non-regular. Chapter 4 examines the effect of the age structure of employees on labor

productivity and wages in Japan based on a panel dataset of listed companies. We also compare the age-productivity profiles and age-wage profiles at the company level to investigate whether older workers are rewarded according to their productivity.

The final chapter gives a brief review of research in Chapters 2 to 4. It summarizes the main findings of this doctoral dissertation and future studies on these topics.

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Chapter 2 Do Employment Promotion Policies Affect Employment or Job Transfer among Older Adults? Evidence from Japan

2.1 Introduction

In recent years, with the improvement of life conditions and the decline in the birth rate, ageing has become an important social issue. According to the 2019 Revision of World Population Prospects (United Nations, 2019), the percentage of the population aged 65 and above rose globally from 5.1 per cent in 1950 to 8.2 per cent in 2015, and it will increase to 17.8 per cent in 2060. Many countries worldwide are now facing the challenge of a rapidly ageing population, leading to a shrinking number of workers and a growing social security solvency problem. Therefore, research on social security and employment for the older adults has become more important than ever.

This paper is related to the extensive literature addressing governments' supply-side labour interventions with respect to the employment of older adults (Krueger and Pischke, 1992; Gustman and Steinmeier, 2005; Mastrobuoni, 2009; Behaghel and Blau, 2012; Hanel and Riphahn, 2012; Staubli and Zweimüller, 2013; Atalay and Barrett 2015; Engels et al., 2017). Most of these studies find that reductions in social security benefits or increases in the retirement age have significant positive effects on the labour supply of older workers.

There are also extensive studies on the effect of governments' demand-side labour interventions, but with mixed results. The broader literature documents positive labour demand effects from anti-age discrimination laws in the United States. Neumark and Stock (1999) document positive employment effects of anti-age discrimination legislation on workers in the covered age ranges. Ashenfelter and Card (2002) find that the abolition of mandatory retirement for college faculty reduced retirement after an amendment to the anti-age discrimination law. Adams (2004) suggests that anti-age

discrimination leads to a decrease in retirement among protected workers. Neumark et al. (2019) conclude that there is less discrimination against older men and women in those states where the anti-age discrimination laws are stricter. Conversely, some studies find that anti-age discrimination laws have limited and even negative effects on employment. Shannon and Grierson (2004) suggest that making mandatory retirement illegal has little effect on the size of the older workforce. Lahey (2008) reports that white male workers over the age of 50 in states with strict anti-age discrimination laws are more likely to retire and less likely to be hired than workers in states with lax ones. These findings suggest that such legislation has the unintended consequence of firms seeking to avoid litigation by not employing older workers in the first place or trying to remove older workers through retirement incentives.

While there is an extensive literature examining the effects of demand-side and supply-side effects, the literature on the complementarity of demand- and supply-side interventions is relatively scarce. For example, using Health and Retirement Study data from the United States and a triple difference method, Neumark and Song (2013) examine the complementarity of demand-side and supply-side interventions, such as anti-age discrimination laws and social security reforms, finding that in the United States, an increase in employment due to reduced pension benefits and a rise in the full retirement age is more significant in states with strict anti-age discrimination protection. The authors argue that strong laws reduce the demand-side barriers.

In Japan, the government has implemented many social policies to solve the problems of an ageing society.¹ Of these, the pension revision and Elderly Employment Stabilization Law (EESL) revision², linked to each other, were two of the most significant amendments and attracted widespread attention. Under the 2000 pension revision, Japan gradually increased the remuneration-based proportional part of the pension eligibility age from 60 to 65 from 2013.³ Moreover, the EESL revision, aimed at companies, was also implemented in 2013. There were two important changes. The first was the abolition of the selection mechanism by which companies could select continued employment for older employees according to selection criteria. Whereas before the 2013 EESL revision, companies could refuse older employees who wished

to continue working for the same company after mandatory retirement age by setting selection criteria, after the 2013 revision they had to employ them all. The second change meant that companies could transfer older adults to their subsidiaries or affiliated companies, regardless of whether they were willing or not. The government made this transitional measure to avoid putting too much pressure on companies. However, this may have offered a new potential strategy for companies to exclude older adults.

In Japan, many empirical studies have examined the effects of the 2006 revision of the EESL. Regardless of the data source and method, all studies indicate that this law has been effective in increasing the employment rate of older workers (Yamamoto, 2008; Kondo and Shigeoka, 2013; Kondo and Shigeoka, 2017). Kondo and Shigeoka (2017), using Labour Force Survey, estimated the impact by comparing cohorts affected by the 2006 revision (such as those born in 1946) with those unaffected (those born in 1945). Their results indicate that the 2006 revision had increased the employment rate of men in their early 60s, with the impact of supply-side labour enforcement being slightly larger when combined with demand-side enforcement. Yamada (2017) analyses the combined effects of the 2013 EESL and pension revisions by using individual data from the Longitudinal Survey of Middle-aged and Elderly Persons and employing a difference-in-difference (DD) model, with his results indicating that the employment rate among men rose due to these revisions. However, the paper used ‘whether he is engaged in a paid job’ as the dependent variable, which may have led to some bias in the results. According to the definition, self-employed workers are also in paid jobs. However, it should be noted that they are not the target of the 2013 EESL and pension revisions, which are applied to salaried workers who are employed by companies. Thus, inclusion of this non-target group may have led to some bias in the results.

In 2013, the EESL abolished the selection mechanism, enhancing the obligation of companies to employ older adults. In the same year, the pension revision raised the eligibility age for retirement. These modifications aimed to increase the continued employment of older adults. However, the 2013 EESL did not prohibit companies from transferring older adults to their subsidiaries or affiliated companies. Therefore, the

revision might impact the continued employment of older adults; that is, companies might be more likely to use the measure of job transfer or company transfer.

This study examines the effects of a demand-side labour revision, namely, the 2013 EESL revision, and a supply-side labour revision, namely, the 2000 pension revision on employment of older adults. By doing so, this study extends the literature in three ways. First, while there have been several studies of the effects of the 2006 EESL revisions, this study examines the effects of the 2013 EESL and pension revisions. It is related to an extensive literature on the effects of the 2006 revisions on employment of older adults (Yamamoto, 2008; Kondo and Shigeoka, 2013; Kondo and Shigeoka, 2017). These previous studies have typically found that the employment percentage of people in their 60s has increased. However, there have been few studies on the effect of the 2013 revision (Yamada, 2017). Second, this study investigates the labour supply and demand responses to the revisions. Specifically, this study explores whether the revisions actually led to older adults receiving their pension later and whether they have been employed in subsidiaries, affiliated companies, or the like. To the best of our knowledge, no prior studies have investigated the 2013 revision's effects on job transfers, which is a key point. Third, this study uses Keio Household Panel Survey data to control for individual fixed effects.

The situation in Japan is different to that in Western countries. While legislation in Japan obliges companies to employ older adults, to avoid imposing stress on the companies it also gives companies the right to choose the form that such employment takes. Through the 2013 EESL revision in particular, the restriction on companies transferring older adults has been relaxed. What, then, might the effect of such a moderate policy reform be? The 2013 EESL and pension revisions can serve as typical examples and provide more policy implications for other countries.

The primary results of this study are as follows. First, this study found no significant increase in the employment probability or receipt of pensions for men aged 60 and older. Second, this study found that the revisions of 2013 raised the job transfer probability of men aged 61 by 7.3 per cent and those aged 62 by 5.1 per cent.

2.2 Background

The 2013 EESL and Pension Revisions

According to the White Paper on the Aged Society,⁴

in the 1980s, Japan's population ageing rate was lower than that of the other main developed countries and regions. However, after 1990, the ageing rate accelerated, and Japan transformed from an 'ageing society' (over 7 per cent in 1970) to an 'aged society' (over 14 per cent in 1994) in the space of 24 years. Against this background, the Japanese government implemented the revisions in relation to pensions and employment of older adults.

Since the revisions implemented in 2013 were based on the ones in 2006, this study will first briefly introduce the 2006 EESL and 1994 pension revision. The Pension Reform Act, reversed in 1994, had gradually raised the eligibility age from 60 to 65 for the fixed rate part of the 'specially provided pension' for men by one year every two years from 2001.⁵ The revision for women applied five years later than for men, starting from 2006.

However, at this time, the mandatory retirement age was still 60, and there was a gap between the pension eligibility age and the mandatory retirement age. To close the gap, the EESL revision was implemented in 2006. According to this revision, companies were required to take at least one of the following measures: 1) increase the mandatory retirement age to the pension eligibility age; 2) set up a formal rule for employment extension (*kinmu enchō*) or reemployment (*saikoyō*); or 3) abolish the mandatory retirement age. In practice, however, the transitional measures are as follows. First, companies do not need to employ older adults up to age 65, but they must employ them at least until they reach the age at which they can receive the fixed rate part of their pension. Second, the employment selection criteria can be set by employers through labour-management agreements or employment provisions to select the

continued employment of old employees.

Since the 20th century, the ageing rate in Japan has deepened further, increasing to 28.4 per cent in 2019, the highest in the world.⁶ The Pension Reform Act was revised again in 2000, this time gradually raising the eligibility age from 60 to 65 for the remuneration-based proportional part of the ‘specially provided pension’ for men, again by one year every two years, from 2013, until it reaches 65 for the cohort born in 1961. More specifically, if a man was born in 1953 or 1954, he can start receiving the remuneration-based proportional part of pension when he is 61 years old, in 2014 or 2015, respectively, and so on for those born after that. The revision for women again came into effect five years later than for men, starting from 2018.

Following the pension revision, the EESL was amended again in 2013 to strengthen companies’ obligations further. According to the 2013 EESL revision, in principle, companies were obliged to employ older adults up to 65 without establishing any selection criteria. In practice, as a transitional measure, companies must employ them until they reach the age at which they can receive the remuneration-based proportional part of their pension. Then, companies are obliged to make an effort to employ older adults without criterion from the age of eligibility to 65.

Figure 2.1 summarises how each revision applies to each cohort. The figure shows the timing of each cohort’s eligibility age for the remuneration-based proportional part of their pension (under the pension revision). The parts within the dotted line are the cohort affected by 2013 EESL, under which companies are obliged to employ or make an effort to employ older adults without selection criteria. We can see that the eligibility age for receiving the remuneration-based proportional part of the pension gradually increased for the cohort born after 1953, and that they are also affected by the 2013 EESL revision. Thus, older men born after 1953 have a financial incentive to work because they will not receive a pension at the age of 60. Simultaneously, they are protected by the 2013 EESL revision, which obliges companies to employ them.

The 2013 EESL revision also included the following: 1) abolition of the selection mechanism that could set standards for the selection of older employees; 2) expansion of the categories of companies hiring older employees; 3) introduction of disclosure

rules for companies that breach the law; and 4) the setting of guidelines concerning the implementation and operation of employment for older adults. When compared to previous legal situation, this revision has two main features.

The first is the abolition of the selection mechanism that allowed companies to select the continued employment of older adults according to certain selection standards. In other words, companies were prohibited from establishing standards, with all candidates being eligible for continued employment. Before the 2013 EESL revision, companies had the right to reject continued employment for older workers under certain criteria. Consequently, it is unclear whether older workers were excluded before 2013 on the basis of some subjective and ambiguous selection criteria established by companies. If so, then the 2013 EESL revision will be effective. If not, then it could have less of an impact on employment promotion.

The second is the expansion of the categories of companies. This was a transitional measure to avoid putting too much pressure on companies from employing older adults. Before the 2013 EESL revision, companies were obliged to employ older adults at the same workplace from which they were retiring. However, after the 2013 EESL revision, companies were allowed to transfer the older employees to group companies, such as subsidiaries (see Figure 2.2 ①) or affiliated companies (Figure 2.2 ②) of the company where they had worked before retirement, or to the parent company (③) or its subsidiaries (④) or affiliated companies (⑤). Put differently, older employees could be assigned to a range of companies whether they liked it or not.

In summary, the pension revision gradually raises the eligibility age from 60 to 65 for the remuneration-based proportional part of the pension benefit from 2013. At the same time, the 2013 EESL revision was also implemented to strengthen the obligation of continued employment for older adults. The revised 2013 EESL mandated companies to employ older adults without setting any selection criteria. However, as a transitional measure, the revision allowed companies to transfer older adults to any affiliated or associated companies.

Abolition of the Selection Mechanism in the 2013 EESL

The abolishment of the selection mechanism has introduced the following nature of the changes. We interpret these selection criteria as either hiring or redundancy criteria. Companies use the criteria to re-employ some older people while rejecting others. This study prefers to think of it as hiring criteria. In Japan, the selection criteria are used when companies re-employ older people after the mandatory retirement age; thus, it is appropriately referred to as hiring criteria. However, regardless of the interpretations, abolishing the selection criteria should essentially mean that companies could no longer select few older people but have to re-employ all older people who wish to continue working after the mandatory retirement age.

This study will then give more details about the abolition of the selection mechanism. To deepen understanding of the precise changes that the revision made, we need to know the situation before the 2013 EESL revision. Here, this study will give an introduction to the pre-reform rules (selection criteria regulations in the 2006 EESL) and the practices of companies.

First, the specific provisions of the selection criteria that were stipulated in the 2006 EESL. According to the 2006 EESL, when formulating the criteria, business owners had to conduct detailed negotiations with labour unions and set the criteria according to each company's situation, with the contents of the criteria depending, in principle, on labour and management agreements. Even if the criteria were stipulated after adequate consultation between the labour force and management, if the criteria were not in line with the standards or were contrary to other labour laws or public order and morals, they were considered illegal (i.e. the criteria had to be specific and objective). The 2006 EESL revision had only basic requirements for employers with respect to the hiring criteria, rather than detailed rules. This meant that until the 2013 EESL abolished the selection mechanism, it was possible for companies to select older workers by setting unreasonable selection criteria.

In practice, the top criteria used by the companies before the 2013 EESL revision were 'willingness to work', 'absence due to health problems', 'attendance rate', 'work attitude', and 'being able to agree with the job content asked by the company'(see

Yamada, 2009). Arguably, ‘willingness to work’ and ‘work attitude’ could be considered subjective and ambiguous criteria. Therefore, even if we consider the statistics on the actual criteria, it is not clear whether older workers were selected on the basis of the criteria established by corporations before the 2013 revision. In other words, it is not clear whether the 2013 revision was effective.

Macroeconomic Background

Below, this study gives background information on Japan’s macroeconomic situation before the EESL was revised in 2013. Trends in the employment numbers and rates of older workers from 2001 to 2018 are shown in Figure 2.3. The employment rate is more appropriate than the number to confirm the impact of the EESL revision. The employment rate sharply increased after the 2006 EESL revision and then fell due to the 2008 financial crisis. However, employment began to rise again beginning in 2012, reaching 72.2 per cent in 2013. Therefore, when the employment rate of older workers rose to a high level, and the labour market for older workers was saturated, even if social policy was reformed, the effect was unlikely to be noticeable. Thus, one might wonder whether the 2013 EESL revision and pension revision were effective.

2.3 Data and Descriptive Statistics

Data

To examine the impact of the 2013 revision of the EESL and the pension revision on labour market behaviour, this study used individual-level data from the Keio Household Panel Survey for the period from 2008 to 2018. The data provide very detailed information on individual characteristics, employment, and living conditions. The data of interest to us include employment, job transfer, and receipt of pension.

This study will focus on the effect on males and will ignore the female sample. The

reason for doing so is that the 2013 EESL and the pension revisions are more likely to affect men than women. In practice, the EESL is mainly applied to regular workers on a full-time contract. However, in Japan, women often retire from full-time employment during the childbirth and child-rearing period, and few women remain in full-time employment until they reach the mandatory retirement age.

Given that our interest is in the effects of the 2013 revision of the EESL and the pension revision, this study used samples of men born between April 1949 and January 1956. As shown in Table 2.1, since the survey was carried out in January each year, this study calculated the age of older adults on the basis of their months of birth in the questionnaire. The sample consisted of individuals aged from 58 to 62 years.

The estimation sample consisted of two subsamples for people who started to receive pensions at different ages. The treatment groups (post-reform cohorts) consisted of individuals born between April 1953 and January 1956, while the control groups (pre-reform cohorts) consisted of individuals born between April 1949 and March 1953. As shown previously in Figure 2.2, the treatment groups could start to receive the remuneration-based proportional part of specially provided pension at the age of 61 or 62, whereas the control groups start to receive it at the age of 60. Hence, when the treatment groups reached 60, they did not reach the age to receive their pension and, simultaneously, their company was obliged to employ them, without setting any criteria, until they reached the age of 61 or 62.

The descriptive statistics for the control and treatment groups are given in Table 2.2. To maximise the sample size, this study cleaned the data to conduct an analysis of the impact of the revision on employment and job transfer. In addition, with respect to group means, the table also shows the differences. As can be seen, there is little difference in the personal characteristics, such as health status, marital status, and non-labour income. The treatment group was more likely to experience job transfer, and chose to leave the company, but was less likely to experience company transfer. However, the differences were rather moderate.

Trends by Cohort Group

To illustrate graphically the labour supply and demand responses affected by the 2013 EESL revision and pension revision, Figure 2.4 displays the employment trends and job transfers over time among the treatment and control groups. As Figure 2.4 illustrates, the employment rate has been declining steadily for these two groups. In comparison to the employment rate of the control group, that of the treatment group increased slightly at the age of 61, suggesting that the revisions may have had little effect on employment. The continuous decline in employment without a job transfer at the age of 61 was larger for the treatment group than for the control group, indicating that the revisions may have had a positive effect on job transfers of older adults.

2.4 Identification Strategy

Since the EESL revision and the social security revision in Japan are inextricably linked, one way to examine the effect of the two revisions simultaneously is to investigate them by cohort. Thus, the effect of the 2013 EESL and pension revisions is estimated by comparing the labour market behaviour of younger birth cohorts to older birth cohorts unaffected by the revisions.

To clarify the effect of the 2013 EESL and the pension revision, this study used a DD approach, a method used in other studies that estimate the effect of this type of policy, with its basic regression equation being as follows:

$$Y_{i(t)} = \alpha + \beta \cdot age_{i(t)} + \delta \cdot (age_{i(t)} \cdot cohort_i) + \theta \cdot I_{i(t)} + \vartheta \cdot I_{i(t-1)} + \mu_i + \varepsilon_{it} \quad (2.1)$$

where $Y_{i(t)}$ represents one of the outcome variables, such as a dummy for being a salaried worker or being employed without job transfer, and $cohort_i$ is a dummy variable indicating whether an individual i belongs to the treatment group. Since there are no annual data on non-labour income in the 2008 waves, this study only used data from the 2009 to 2018 waves to estimate the impact of the revisions on employment.

Here, cohort_i equals zero if an individual i was born between February 1950 and March 1953, and one if he was born between April 1953 and January 1956. However, for the analysis of the impact of the revisions on job transfer, we can use data for the 1949 cohort from the 2008 wave. Thus, cohort_i equals zero if an individual i was born between April 1949 and March 1953, and one otherwise. The dummy variable $\text{age}_{i(t)}$ indicates an individual's age, while $I_{i(t)}$ represents the characteristics at period t such as 'self-reported health status' and 'marital status', with the 'self-reported health status' being equal to one if individual i was unhealthy, and zero otherwise. 'Marital status' equals one if individual i is married, and zero otherwise. In addition, $I_{i(t-1)}$ represents the characteristics at period $t-1$, such as 'non-labour income'; $I_{i(t-1)}$ equals one if an individual i earns non-labour income in period of $t-1$, and zero otherwise. The coefficient δ then captures the effect of the 2013 EESL and pension revisions.⁷

This study used an individual fixed-effects model to control for time-invariant factors. In addition, we used individual characteristics as explanatory variables to control the time-varying factors related to employment status. Table 2.2 shows the explanatory variables. In particular, the study controlled for self-reported health status and non-labour income. To avoid the problem of simultaneous decisions, this study used the data for non-labour income from year $t-1$.

Two robustness checks were conducted by adding to discussions of large-sized companies and regular workers' circumstances. The study used a triple difference method (DDD) to investigate the effect of the 2013 EESL and pension revisions on older adults in large-sized companies and on regular employees' circumstances. This approach is useful because the effects may be more concentrated among employees in large-sized companies and in the circumstances of regular employees. Before the 2013 EESL revision was implemented, many small and medium-sized companies already continued to employ staff after the age of 60. Large-sized companies applied the mandatory retirement age of 60 more strictly and may have set selection criteria when continuing to employ older adults. Moreover, since the specially provided pension

system is mainly applied to regular workers, it may be more significant for this group than for non-regular workers, such as fixed-term contract workers, part-time workers, and dispatched workers.

The regression equation is as follows. $Firmsize_{i(59)}$ represents the large-sized company dummy, which takes one if individual i was employed in a company with 500 or more employees at the age of 59 and zero otherwise. In addition, $Regular_{i(59)}$ denotes the regular employment dummy, which takes one if individual i worked as a regular employee at the age of 59 and zero otherwise.

$$L_{i(t)} = \alpha + \beta_1 \cdot age_{i(t)} + \beta_2 \cdot (age_{i(t)} \cdot cohort_i) + \beta_3 \cdot (age_{i(t)} \cdot Firmsize_{i(59)}) + \beta_4 \cdot (age_{i(t)} \cdot cohort_i \cdot Firmsize_{i(59)}) + \theta \cdot I_{i(t)} + \mu_i + \varepsilon_{it} \quad (2.2)$$

$$L_{i(t)} = \alpha + \beta_1 \cdot age_{i(t)} + \beta_2 \cdot (age_{i(t)} \cdot cohort_i) + \beta_3 \cdot (age_{i(t)} \cdot Regular_{i(59)}) + \beta_4 \cdot (age_{i(t)} \cdot cohort_i \cdot Regular_{i(59)}) + \theta \cdot I_{i(t)} + \mu_i + \varepsilon_{it} \quad (2.3)$$

2.5 Empirical Results

The Impact on Employment

Table 2.3 presents the estimated reform effects on employment of older adults based on Eq. (2.1). Of interest is the coefficient δ , which represents the effect of the 2013 revision. However, δ is not statistically significant for the models in which men aged 58 to 59 or men aged 59 are used as control groups. The results indicate that the treatment group was not affected by the revisions more significantly than the control group.

Table 2.4 presents the estimated reform effects on employment of older adults based

on Equations. 2.2 and 2.3. First, this paper studied whether the revisions have been effective when older adults were employed in large enterprises. Column 1 of Table 2.4 presents the effects of the 2013 revision and the pension revision, defined as the difference between the DD estimates of work in large-sized enterprises and others. Second, to confirm the effectiveness of the revisions when older adults were employed as regular employees, this study used the same method as above and changed the data from ‘being employed in large-sized enterprise when aged 59’ to ‘being employed as a regular employee when aged 59’. As shown in Table 2.4, almost all the estimated coefficients are negative but not statistically significant, which indicate that the revisions have almost no effects. More specifically, the treatment group who had worked in large-sized enterprise or were regular employees was not affected by the revisions more significantly than the control group.

Kondo and Shigeoka (2017) find that the effects of the 2006 EESL revision on employment of older adults are more significant on employees at large-sized firms, because reemployment after the mandatory retirement age was already common in small-sized firms even before the EESL revision. However, we found that the 2013 revisions are not effective in large-sized firms. One of the probable reasons for this phenomenon is that older workers were not rejected through the setting of criteria by large-sized firms before the 2013 revision due to the insufficient workforce. Besides, most of the employees of large-sized enterprises are able to receive a ‘company pension’ after retirement,⁸ with the possibility of being affected by a rise in the eligibility age for the ‘specially provided pension’ being slight.

The Impact on Job Transfers and Resignations

As mentioned previously, under the 2013 EESL, companies are allowed to arrange for older adults to work in subsidiaries or affiliated companies, which may affect their job transfer. Owing to the lack of job positions for older adults, the provision of promotion space for young people, or the need to reduce company costs, companies have an incentive to relocate older adults to their subsidiaries or affiliates.

Job transfers involve older adults being employed either in the same company, albeit in a related subsidiary company (i.e. continuous employment with job transfer) or in another company (i.e. company transfer). Table 2.5 presents estimates for the impact of the revisions on continuous employment without job transfer, continuous employment with job transfer, company transfer, and resignations. The dependent variable is a dummy, which is equal to one if the individual is in the state in question and zero otherwise.

Column 1 of Table 2.5 shows that, for men aged 61 or 62, the revisions reduced the probability of not being transferred to other workplaces by negative 11.1 per cent and negative 17.1 per cent, respectively. Column 2 of Table 2.5 shows that the increase in the probability of being transferred to other workplaces among men aged 61 and 62 was 7.3 per cent and 5.1 per cent, respectively. The results indicate that some older workers may be transferred to related subsidiary companies. In addition, this study finds that the probability of job transfer is considerably larger at the age of 61 than at 62.

However, this study finds that the revisions have almost no impact on company transfers, as shown in column 3. Moreover, this study estimates that the probability of quitting employment increased by 7.0 per cent and 6.0 per cent at ages 60 and 62, respectively.

The Impact on Receipt of Pension

This study also examines why the 2013 EESL and the Pension Reform have almost no impact on the employment of men. The effect of the ‘advance pension payment system’ related to the Pension Reform may affect the results. As mentioned previously, the Pension Reform gradually raised the eligibility age from 60 to 65 for the remuneration-based proportional part of the ‘specially provided pension’. For example, if a man was born in 1953 or 1954, he can start to receive the remuneration-based proportional part of pension when he is 61 years old, in 2014 or 2015, respectively. However, under ‘the advance pension payment system’, if he applied, he could start to receive pension advances at the age of 60, although the pension would be reduced. To verify the result,

this study estimates the effect of the pension revision on receipt of pension using a DD model as in Equation.2.1 and taking ‘whether receiving the welfare pension’ or ‘logarithm of the welfare pension’ as the explanatory variable.

Table 2.6 demonstrates that the revisions had no impact on the probability of receiving one’s welfare pension and the amount of the welfare pension. This may explain why the revisions had almost no effect on employment.

2.6 Discussion

The Impact on Employment

There are four possible reasons for the low impact of the 2013 EESL and the Pension Reform on the employment of older adults. First, although the Pension Reform gradually raised the eligibility age, due to the ‘advanced pension payment systems’ to receive a pension earlier, the revision might not have affected the age at which older adults actually received their pension.

Second, there was an increase in the probability of job transfer among older adults. The revisions significantly increased the possibility of job transfers, since older adults may not have been able to accept the working conditions and could choose to leave the company.

Third, in response to the revisions, firms could cut older workers’ wages to induce them to retire voluntarily. According to a survey⁹ by the Japan Institute for Labour Policy and Training (JILPT), 55.4 per cent of men aged 60 to 64 years saw their wages cut after the mandatory retirement age. Moreover 51.6 per cent of them experienced a 40 per cent or more decline in wages. However, owing to the income effect caused by the reduction in annuities, older adults could increase their working hours. Simultaneously, the substitution effect brought about by the decline in wages would lead to reduced work hours and increased leisure time.

The fourth reason is the difference in the type of revision. Compared to the 2006

revision of the EESL, the 2013 revision was not strong. Before 2006, the EESL asked companies to make efforts to employ older adults, but with the amendment of the EESL, this changed so that it became a duty. In other words, the policies changed from ‘not enforced’ to ‘enforced’. Meanwhile, the 2013 revision strengthened this duty by removing transitional measures, such as setting the employee selection mechanism, but also weakened the duty through expansion of hiring companies.

The results are not consistent with Yamada (2017), who found that the employment rate rose due to these revisions. One explanation for this phenomenon is that Yamada (2017) used ‘whether he is engaged in a paid job’, not ‘whether he is employed by a company’, as the dependent variable. Therefore, the sample may have included people who became self-employed after retirement. Kondo and Shigeoka (2017) found that the employment rate of the self-employed older adults, who are not the policy target group, also increased after the 2006 EESL revision. This was because the EESL revision altered the social norm. Even self-employed workers believe they should continue to work after they reach 60. Thus, inclusion of this non-target group may lead to some bias in the results.

Our results indicate that the employment of males aged 60 and above has not increased due to the 2013 revision of the EESL and the pension revision. This suggests that after the 2013 revision of the EESL, companies were likely to have employed older adults based on somewhat ambiguous criteria, as before.

The Impact on Job Transfers and Resignations

As mentioned earlier, the revision led to a continuous employment increase with job transfers and resignations among older adults. This study suggests that the following reasons explain this phenomenon. About half of older employees saw their wages cut in half after the age of 60. If older adults were to do the same job as before retirement, they would not be able to accept a substantial wage drop. Thus, one strategy pursued by companies has been to transfer them to subsidiaries or affiliated companies. Moreover, some companies are likely to use the job transfers allowed by legislation to

make older adults retire voluntary, because older adults who do not want to work in subsidiaries or affiliated companies could choose to quit. The JILPT questionnaire⁸ surveyed the reasons why older men aged 60–64 did not want to be re-employed or to extend their employment.¹² Apart from reasons such as health and personal interests, the main reasons were ‘bad atmosphere and relationships in the workplace’, ‘not having a job worth doing’, and ‘pay too low’. These three reasons accounted for 19.3 per cent, 18.6 per cent, and 15.3 per cent of the total, respectively.

2.7 Conclusion

The main objective of this paper was to examine the labour supply responses to raising pension eligibility age and the labour demand responses to the 2013 EESL revision. In 2013, the 2013 EESL and pension revisions were implemented to promote employment of older adults. The 2013 EESL had two main points. The first was the abolition of the mechanism that allowed companies to employ older adults according to certain standards. The second was the expansion of the categories of companies that allowed businesses to employ older employees in their group companies, such as the parent company’s affiliated companies or any associated corporations.

This paper shed light on these issues by exploring the impact of EESL in Japan. Understanding the impact of the pension revisions and EESL in Japan is of general interest. Among the Asian nations, Japan was the first country to become an ageing society. As a result, it tried to try to implement many social policies to solve problems associated with the ageing of its population. Of these policies, the EESL has attracted a lot of attention. This policy is unique to Japan due to its amendments and transitional measures. Therefore, the responses of labour demand and supply represent important research issues.

Estimates suggest that the revisions had almost no impact on the employment of older adults and receipt of pensions. On the basis of the results, this paper discussed why the 2013 EESL revision and pension revision had almost no impact on the

employment probability of males aged 60 and above. One reason was that it is affected by the 'advance pension payment system'. Although the Pension Reform Act, which was implemented gradually, raised the eligibility age, older adults could still apply to the government to receive their pensions earlier. In addition, there was a decline in wages and an increase in job transfer likelihood among men after 60. Third, there were differences in the types of EESL revision. Compared to the 2006 revision of the EESL, the 2013 revision was not strong; it simultaneously strengthened and weakened the duty to employ older adults.

This study further find that the revisions had significant positive effects on job transfer, which increased by 7.3 percentage points among men at the age of 61 and 5.1 percentage points at the age of 62. Finally, this study wants to emphasise the importance of the working environment of older adults. This paper shows that even though older adults continue to be employed, they face a job transfer problem. Therefore, in the future, to solve this problem, companies should provide job training from middle age to update the skills of their employees.¹⁰ In addition, companies should also develop positions so that older adults can find jobs that are more suitable for them without the need for job transfer.

In an ageing society, the issues concerning older people's lives have become important. Since Japan is the first Asian country to become an ageing society and has tried to pursue appropriate social policy changes, its actions will be an important reference source for other countries. On the basis of the results, this study can identify the following implications.

Compared to other countries, Japan has taken a flexible approach in reforming its policies to promote employment of older adults, giving companies more options. However, revisions to the labour demand side could not always achieve the policy objectives. In Japan, although companies were prohibited from establishing standards for selecting older adults, they could still do so and force older adults to retire voluntarily through alternatives unconstrained by the policy. Thus, more attention needs to be paid to the impact of those factors unaffected by the revisions.

This study only analysed the impact on men, and it remains to be seen whether the

revisions affect women. However, as mentioned above, the reason for the focus on men is that the 2013 EESL mainly applied to them. Here, it should be noted that the fact that women are not a concern of the EESL is itself an important policy issue. Because ageing is expected to deepen rapidly in Japan in the future, the Japanese government should make policies to promote the employment of older females in order to keep more of the workforce in the labour market.

Data. The data for this analysis, Keio Household Panel Survey, was provided by the Panel Data Research Center at Keio University.

Notes

1 The social policies also include immigration policies and various countermeasures to the falling birth rate. However, the birth rate in Japan continues to decline. Furthermore, although immigration policies have been extensively discussed recently, the number of immigrants in Japan is still small. The effect of these policies appears to be limited.

2 The ‘Act on Special Measures Concerning Promotion of Employment of Middle-aged and Aged Persons’ of 1971 was revised many times. In 1986, the name was changed to the ‘Elderly Employment Stabilization Law’. Companies were obliged to make an effort not to set the retirement age younger than the age of 60. After that, with the 1994 amendment, enterprises were prohibited from setting the age of retirement before the age of 60 from 1998. Then, after the 2000 amendment, employers were obliged to make an effort to employ older adults until they reached the age of 65. Since then, the Japanese government has revised the EESL twice, with the revisions being implemented in 2006 and 2013.

3 The remuneration-based proportional payment is one part of the ‘specially provided pension’ system. It is based on both number of months the person has contributed and earnings before retirement.

4 Cabinet Office, Government of Japan: Aged Society White Paper data (Heisei 29th

edition).

5 The amendment of the law in 1985 gradually increased the eligibility age of welfare pension insurance from 60 to 65. To raise the age of starting payment smoothly, the ‘specially provided pension’ system was established. Specifically, this amendment has two parts: a fixed rate part and a remuneration-based proportional part. The fixed rate part is determined by the number of months the person has paid the contribution.

6 Ministry of Internal Affairs and Communications: Labour force survey (long term time series data).

7 This study examines the impact of policy revisions and controls for some individual characteristic variables in the analyses. However, some of the control variables might not be entirely exogenous, which is an issue to be addressed in the future.

8 Annuities operated by enterprises and paid to older adults.

9 JILPT: Survey on Employment and Life in the 60s (July 2015).

10 With regard to policies to improve the skills of the middle-aged and older adults, the Japanese government’s 2016 Basic Plan for Human Resources Development has already set out the relevant guidelines. However, this study expects that policies will be further enriched to promote employment of older adults.

Figure 2. 1 Age Limits for Older Adults to Receive the Remuneration-Based Proportional Part of the Specially Provided Pension and the 2013 EESL Revision (For Men)

	Age Cohort born	60	61	62	63	64
Cohort affected by 2013 EESL revision	1949.4.2~ 1953.4.1	remuneration-based proportional part of pension starts				
	1953.4.2~ 1955.4.1		remuneration-based proportional part of pension starts			
	1955.4.2~ 1957.4.1			remuneration-based proportional part of pension starts		
	1957.4.2~ 1959.4.1				remuneration-based proportional part of pension starts	
	1959.4.2~ 1961.4.1					remuneration-based proportional part of pension starts

Note: 1949.4.2 represents 2 April 1949.

Figure 2. 2 Expansion of the Categories of Companies (A Major Point of the 2013 EESL Revision)

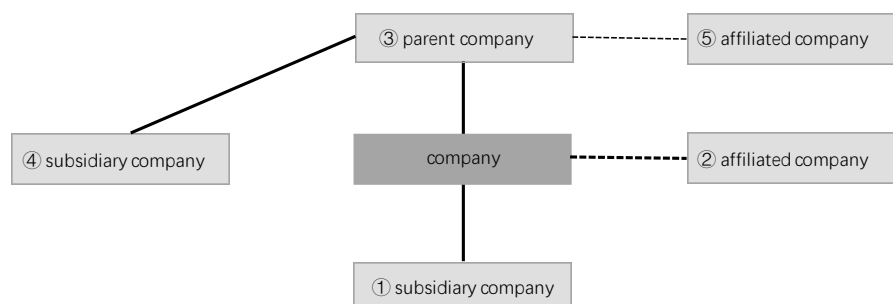
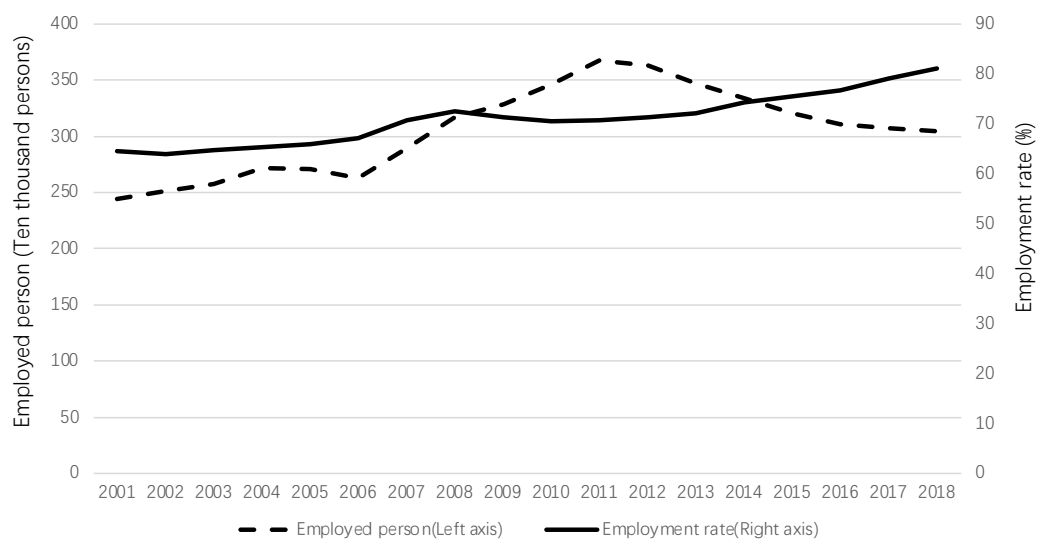


Figure 2. 3 The Employment Number and Rate for Older Men Aged 60 to 64



Source: Data from the Labour Force Survey.

Table 2. 1 Sample Consisting of Cohorts and Questionnaire Waves

	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
1949.4-1950.1	58	59	60	61	62						
1950.2-1951.1		58	59	60	61	62					
1951.2-1952.1			58	59	60	61	62				
1952.2-1953.1				58	59	60	61	62			
1953.2-1954.1					58	59	60	61	62		
1954.2-1955.1						58	59	60	61	62	
1955.2-1956.1							58	59	60	61	62

Notes: The values in the table are the ages of the individuals. Since the survey was carried out in January each year, this study calculated the age of older adults on the basis of their month of birth in the questionnaire. For example, people born in February 1950 were 58 years old in January 2009. The same applies to the other calculations.

Table 2. 2 Sample Statistics for Treatment and Control Groups

<u>Analysis 1</u>	Control group	Treatment group	Difference
	<i>Mean values(standard errors)</i>		<i>Difference in means</i>
Marital status	0.841 (0.366)	0.729 (0.445)	-0.112
Age	60 (1.416)	60 (1.416)	0.000
Unhealthy	0.174 (0.381)	0.218 (0.413)	0.042
Non-labor income	0.190 (0.393)	0.158 (0.365)	-0.032
Employment	0.624 (0.485)	0.684 (0.466)	0.006
<u>Analysis 2</u>			
Marital status	0.860 (0.348)	0.719 (0.450)	-0.141
Age	60 (1.415)	60 (1.417)	0.000
Unhealthy	0.155 (0.363)	0.223 (0.417)	0.068
	<i>Labor market states(%)</i>		<i>Difference in percentage</i>
Continuous employment without job transfer	80.99	79.03	-1.96
Continuous employment with job transfer	2.48	3.87	1.39
Company transfer	4.30	2.26	-2.04
Resignations	3.31	4.52	1.21
Others	8.92	10.32	1.40

Note: Standard errors in parentheses.

Figure 2. 4 The Employment Rate and Continuous Employment Rate without Job Transfer

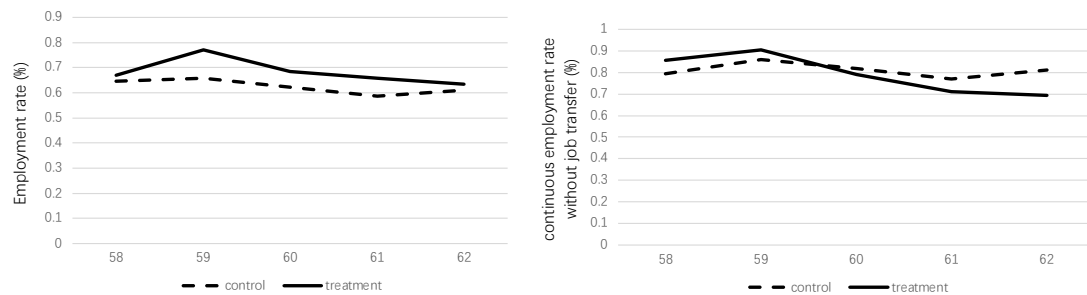


Table 2. 3 Impact of Revisions on Employment

	Employment	Employment
	(1) Control Age58-59=0	(2) Control Age59=0
Age60	-0.016 (0.035)	-0.017 (0.037)
Age61	-0.058* (0.034)	-0.058 (0.037)
Age62	-0.037 (0.034)	-0.039 (0.037)
Cohort*Age60	-0.005 (0.049)	-0.055 (0.052)
Cohort*Age61	0.000 (0.049)	-0.050 (0.052)
Cohort*Age62	-0.042 (0.049)	-0.091* (0.052)
Mar	0.015 (0.134)	0.146 (0.142)
Unhealthy	-0.112*** (0.037)	-0.093** (0.040)
No-labor income	-0.073*** (0.027)	-0.083*** (0.028)
Constant	0.704*** (0.107)	0.625*** (0.114)

Notes: N=805 and 644. * significant at 10%; ** significant at 5%; *** significant at 1%. Standard errors in parentheses.

Table 2. 4 Impact of Revisions on Employment (Large Enterprises and Regular Employees)

	Employment (1) Large enterprises		Employment (2) Regular employees
Cohort*Age60*Large enterprises	0.005 (0.095)	Cohort*Age60*Regular employees	-0.004 (0.090)
Cohort*Age61*Large enterprises	-0.066 (0.095)	Cohort*Age61*Regular employees	-0.062 (0.090)
Cohort*Age62*Large enterprises	-0.147 (0.095)	Cohort*Age62*Regular employees	-0.071 (0.090)
Constant	0.655*** (0.106)	Constant	0.676*** (0.014)

Notes: N=910. Each regression controls for the items of DDD model, health status, marital status as Eq 2.2 and Eq 2.3, * significant at 10%; ** significant at 5%; *** significant at 1%. Standard errors in parentheses.

Table 2. 5 Impact of Revisions on Job Transfer

	(1) Continuous employment without job transfer	(2) Continuous employment with job transfer	(3) Company transfer	(4) Resignations
Age60	-0.007 (0.033)	-0.033** (0.017)	0.025 (0.021)	0.003 (0.021)
Age61	-0.057* (0.033)	-0.041** (0.017)	0.033 (0.021)	0.043** (0.021)
Age62	-0.011 (0.033)	-0.054*** (0.017)	-0.009 (0.021)	0.010 (0.021)
Cohort*Age60	-0.081 (0.057)	0.033 (0.029)	-0.001 (0.036)	0.070** (0.035)
Cohort*Age61	-0.111* (0.057)	0.073** (0.029)	-0.009 (0.036)	-0.005 (0.035)
Cohort*Age62	-0.171*** (0.057)	0.051* (0.029)	0.033 (0.036)	0.060* (0.035)
Mar	0.110 (0.159)	-0.033 (0.080)	0.011 (0.099)	-0.142 (0.098)
Unhealthy	-0.067* (0.041)	0.070*** (0.020)	0.010 (0.025)	0.002 (0.025)
Constant	0.765*** (0.131)	0.059 (0.066)	0.014 (0.081)	0.133 (0.081)

Notes: N=915. * significant at 10%; ** significant at 5%; *** significant at 1%. Standard errors in parentheses.

Table 2. 6 Impact of Revisions on Receipt of Pension

	(1) Whether receiving the Welfare Pension	(2) Logarithm of the Welfare Pension
Age60	0.405*** (0.052)	1.702*** (0.206)
Age61	0.484*** (0.052)	1.927*** (0.206)
Cohort*Age60	-0.018 (0.085)	-0.429 (0.335)
Cohort*Age61	0.032 (0.085)	0.328 (0.335)
Constant	0.089*** (0.021)	0.333*** (0.081)

Notes: N=410.* significant at 10%; ** significant at 5%; *** significant at 1%.

Standard errors in parentheses.

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Chapter 3 How Employment Affects Subjective Well-Being among Older Adults

3.1 Introduction

In recent years, with the improvement of living conditions and the decline in birth rate, aging has become an important social issue. Many countries worldwide are facing a rapidly aging population, which leads to a shrinking number of workforces and a growing social security solvency problem. To address this problem, countries have implemented various elderly employment promotion policies. In Japan, owing to its rapidly aging population, the government implemented the Elderly Employment Stabilization Law (EESL) ¹ and the Pension Reform Act in 2006 to increase the employment of older people. However, when promoting the employment of older adults, it is important to consider changes in individual well-being. This study assesses the effect of employment on the well-being of older adults in Japan.

Does being employed make individuals happier? According to neoclassical economics, individuals maximize utility by choosing particular combinations of consumption and leisure. Individuals gain utility directly from leisure, while work hours has a negative effect on utility (Borjas, 2010). However, with the increase in work hours, additional wages increase consumption, which leads to an increase in individual utility. Therefore, although work hours itself has adverse effects on utility, the increase in wages results in positive utility for individuals. However, when household income is controlled for, this effect is expected to disappear, and the employment itself could have adverse effects on utility.

This study examines the effect of continued employment after mandatory retirement on the subjective well-being of older adults. More specifically, the study examines the impact of 2006 EESL revisions on the continued employment of older adults, and consequently on their well-being. One hypothesis is that employment

provides not only pecuniary benefits but also spiritual reward to people through social contact, and individual identity. However, when perceived as being involuntary, employment may decrease the well-being of older adults and is likely to decrease free time and increase physical and mental stress.

This study is related to the extensive literature concerning the impact of retirement on the subjective well-being of older adults, in which empirical evidence is mixed, and either adverse, positive, or no effects are found. Some studies suggest that retirement has a positive impact on subjective well-being (Charles, 2004, Gorry et al., 2015 for the United States; Johnston and Lee, 2009 for England; Latif, 2011 for Canada; Horner, 2014 for sixteen countries of Western Europe and the United States). Charles (2004) finds that the results for OLS and FE indicate that retirement has a negative impact on the well-being in the United States, while the results for IV suggest a positive impact. Horner (2014) uses international data from Western Europe and the U.S. and also finds a positive effect. However, some studies suggest that retirement does not affect subjective well-being. Fonseca et al. (2014) and Coe and Zamarro (2011) find that retirement has a negative effect on well-being based on Europe data, but the negative effect disappears when applying the IV approach to control for endogeneity, and the effect of retirement is not significant. Kesavayuth et al. (2016) use United Kingdom data and find that different from the FE results, the IV coefficients are statistically insignificant, and the effect of retirement on life satisfaction is not found for male older adults. Kapteyn et al. (2013) show that retirement has a negative influence on life satisfaction in Europe. After controlling for endogeneity, however, the IV coefficients demonstrate that there was no effect. Furthermore, Bonsang and Klein (2012) use the German data and finds that retirement has a positive effect on satisfaction with free time, a negative effect on household income, and the average effect on life satisfaction is negligible.

Although the literature above all addresses the endogeneity of retirement decisions by exploiting retirement policy changes or pension eligibility age, the results still turn out to be mixed. The mixed results may be due to differences in the definition of retirement. Alternatively, it may be due to differences in statutory retirement ages, post-

retirement earnings, and social awareness, such as the socially acceptable retirement age or social norms across countries.

However, many literatures find that the results change after controlling for endogeneity with the instrumental variables approach (Charles, 2004; Gorry et al., 2015; Horner, 2014; Fonseca et al., 2014; Coe and Zamarro, 2011; Kesavayuth et al., 2016; Bonsang and Klein, 2012; Kapteyn et al., 2013). This implies that endogeneity exists between employment and well-being in a wide range of countries. Shiba et al. (2017) find that people who transitioned to retirement had significantly higher depression symptoms than those who continued to work in Japan. However, the study may not have considered the bias introduced by the reverse causality problem.

The main contributions of this study are as follows. First, it addresses the endogeneity of employment decisions in Japan. People with idiosyncratic low levels of well-being or those facing transitory shocks that adversely affect well-being might disproportionately select into retirement (Charles, 2004). However, to our knowledge, none of the previous studies in Japan have addressed this causal problem, and most of them have only examined the correlation. Second, when examining the well-being of older adults, it is vital to determine not only the effects of employment itself, but also the heterogeneous effects of different types of employment, such as regular and non-regular employment.

This study uses subjective well-being measures that are available in the Japanese General Social Surveys (JGSS). The probit ordinary least squares (POLS) results indicate that employment increases satisfaction in household budget situation. However, the effects disappear after using the POLS with instrumental variables (IV-POLS) approach. Furthermore, this study finds that the effect of employment on well-being differs depending on the employment status (i.e., being a regular or non-regular employee). However, the differences disappear after controlling for household income.

The rest of this chapter is structured as follows. Chapter 3.2 describes the institutional setting in Japan. Chapter 3.3 discusses the data and descriptive statistics, while Chapter 3.4 explains the identification strategies. Chapter 3.5 presents the empirical results, which are further discussed in Chapter 3.6. Finally, Chapter 3.7

provides the conclusions.

3.2 Institutional Setting and International Comparison

Description and International Comparison of Employment among Older Adults in Japan

This subsection provides background information on Japan's macroeconomic situation in relation to changes in the employment rate for men aged 60–64 years before and after the 2006 revision of the EESL. From 2004 to 2005, the employment rate for men aged 60–64 years was around 65.5%. However, after implementation of the revised EESL and pension policies in 2006, the employment rate continued to increase, rising to 72.5% in 2008, followed by a slight decline from 2008 to 2010 due to the financial crisis. However, the employment rate continued to rise again after 2011, with the latest data showing that the employment rate for men aged 60–64 years reached 81.1% in 2018.

Figures 3.2 and 3.3 provide a comparison of the employment rate of older adults in Japan with those of the main Organisation for Economic Co-operation and Development (OECD) countries. Japan ranks first in terms of employment rate for men in both the 60–64 and over 65 years age groups, as compared with those of internationally representative OECD countries or the average of OECD countries from 2000 to 2018. One may wonder why the employment of older adults in Japan is the highest. In the next two sections, this study provides two possible reasons. Considering Japan's characteristics and its international representativeness, using Japan as the research subject can provide deeper understanding of the impact of employment on the well-being of older adults.

The 2006 Elderly Employment Stabilization Law and Pension Revisions in Japan

According to the White Paper on the Aged Society², in the 1980s, Japan's population

ageing rate was lower than that of the other main developed countries and regions. However, after 1990, the ageing rate accelerated, and Japan transformed from an ‘ageing society’ (over 7% in 1970) to an ‘aged society’ (over 14% in 1994) in the space of 24 years. Against this background, the Japanese government implemented the revisions in relation to pensions and employment of older people.

The Pension Reform Act, reversed in 1994, had gradually raised the eligibility age from 60 to 65 for the fixed rate part of the ‘specially provided pension’³ for men by one year every two years from 2001. The revision for women applied five years later than for men, starting from 2006. As shown in Figure 3.4, for example, if a man was born in 1941 or 1942, he can start receiving the basic portion when he is 61 years old in 2002 or 2003, respectively. However, at this time, the mandatory retirement age was still 60, and there was a gap between the pension eligibility age and the mandatory retirement age. To close the gap, the EESL revision was implemented in 2006. According to this revision, companies were required to take at least one of the following measures: 1) increase the mandatory retirement age to the pension eligibility age; 2) set up a formal rule for employment extension (*kinmu enchō*) or reemployment (*saikoyō*); or 3) abolish the mandatory retirement age.

Figure 3.4 summarises how each revision applies to each cohort. The figure shows the timing of each cohort’s eligibility age for the basic proportion part of their pension (under the 1994 pension revision). The parts within the dotted line are the cohort affected by 2006 EESL, under which companies are obliged to employ or make an effort to employ older adults. As mentioned above, there is a five-year gap between the 1994 pension revision (implemented in 2001) and the 2006 EESL revision (implemented in 2006). We can see that the eligibility age for receiving the wage proportion part of the pension gradually increased for the cohort born after 1941, while the 2006 EESL only protected the cohort born after 1946. Put it more simply, for older men born from 1941 to 1944, although the pension eligibility age is 61 or 62, no employment protection is offered after the mandatory retirement age of 60. While the men born after 1946 are protected by the 2006 EESL revision, which obliges companies to employ them. Thus, this study will compare those two groups to examine the effect

of 2006 EESL revisions.

In Japan, many empirical studies have examined the effects of the 2006 revision of EESL. Regardless of the data source and method, all studies indicate that this law has effectively increased the employment rate of older adults (Yamamoto, 2008; Kondo and Shigeoka, 2017). Yamamoto (2008) estimates the impact of the EESL using the Japan Household Panel Survey data and employs a difference in difference and a triple difference model. His results show that the employment rate of those aged 60–62 years rose by 12.4% to 15.3%. Kondo and Shigeoka (2017), using microdata from the Labour Force Survey, estimate the impact by comparing cohorts affected by the 2006 revision (such as those born in 1946) with those who were unaffected (those born in 1945). They show that due to the revision, the employment rate rose by 2.4% to 3.2%. Furthermore, the impact of pension revisions on employment is slightly larger when combined with the 2006 EESL revision.

An International Comparison of Older Adults' Work Motivation

According to the 2015 International Comparative Study on the Lives and Attitudes of the Elderly Survey⁴ conducted by the Japan Cabinet Office, 68.7% of 60-year-olds in Japan want to "continue working for pay in the future. This figure is higher than that of the United States (62%), Germany (50%), and Sweden (60.4%). Unlike other countries, Japanese people seems to have higher work motivation, and the same is true for older adults in Japan.

As mentioned above, because systems and public attitudes toward worker retirement vary from country to country, it is difficult to predict in advance the impact of employment promotion policies and revisions to the pension system in Japan on the well-being of older adults based on the results of previous studies for other countries. If older adults were forced to work because of the reduction in pension income, employment would have a negative impact on happiness. However, if employment brings not only monetary income but also spiritual satisfaction, it may lead to more happiness for older adults.

3.3 Data, Definitions, and Descriptive Statistics

Data Sources

The empirical analysis is based on individual-level data from the 2000 to 2012 JGSS, which is a representative survey of individuals in Japan. The population of the survey is males and females between the ages of 20 and 89 years old and the sample is selected by stratified two-stage sampling method. This dataset is ideal for the study because it has rich information about people's satisfaction with various aspects of life, including family life, income, and leisure. Moreover, the survey asks several detailed questions regarding employment status and demographics such as age, gender, marital status, and education, among others.

To investigate the effect of employment on the well-being of older adults, this study uses 2000–2012 individual-level data from the JGSS (see Figure 3.5). Since the survey was not implemented in some years, this study uses microdata for nine waves: yearly from 2000 to 2012 except for 2004, 2007, 2009 and 2011. Furthermore, given our interest, this study uses samples of men born between 1941 and 1950. This study also excluded observations with missing information on employment status, age, gender, and subjective well-being, leaving a sample of 792 individuals for the analysis.

Definitions

Dependent Variables: Life Satisfaction and Happiness

Based on new welfare economics, utility is used to illustrate individual choices when facing various goods, and it can never be measured with a cardinal number. However, in theory, ordinal utility is used as an index of preference, which is far from substantive and empirically measurable subjective well-being. Thus, in recent years, there has been

a trend in economics whereby utility is measured, and a large number of empirical analyses based on individual data have appeared.

According to psychologists, “happiness” is a momentary feeling of joy and pleasure, referred to in psychology as positive and negative affect, while overall contentment in life is usually called “life satisfaction” (Nettle, 2006). In terms of the connotation of happiness and life satisfaction, although slightly different, most economic scholars consider them to be the same or similar (Frey et al., 2010; Tomioka, 2006; Urakawa, 2011). Specifically, Bok (2010) documents that groups of people are found to respond quite similarly when asked how happy or satisfied they feel about their lives. Thus, researchers tend to use the terms interchangeably. Based on the above, this study also considers happiness and life satisfaction as interchangeable indicators, using happiness as a proxy indicator of overall life satisfaction.

Furthermore, this study uses satisfaction in family life, household budget situation, and leisure activities, and happiness as the outcome variables, for which respondents were asked how they would describe their satisfaction on a 5-point scale, ranging from satisfaction to dissatisfaction. For the analysis, this study reorders the answer by defining “dissatisfaction” as “1” and “satisfaction” as “5.”

Employment

There are two ways of defining employment: (1) being employed by a company and (2) either being employed in a company or being self-employed. This study adopts the first definition because employees are the target of the 2006 EESL and pension revisions, and they are the group most directly affected by the revisions.

Regular and Non-Regular Workers

Even in the state of employment, different employment statuses may have different effects on well-being. Regarding regular and non-regular employment, this study considers non-regular workers as temporary, daily, or part-time workers; those

dispatched from temporary employment; contract employees; and temporary employees (shokutaku). Otherwise, they are considered regular workers.

Control Variables: Equivalent Income

According to the life cycle model, the effect of retirement on the satisfaction with free time is positive, while it is negative on the satisfaction with household income. The latter effect should disappear if the control for household income and the overall effect become positive. Furthermore, Frey et al. (2010) state that it is important to distinguish between two quite different aspects of a job: a) intrinsic features, which relate to the conduct of the work itself, and b) extrinsic features, which refer to the work conditions. Moreover, some researchers argue that intrinsic features more effectively satisfy innate needs than extrinsic features do and thus, contribute more to individuals' subjective well-being (Ryan et al., 1996). In order to analyze the impact of the job itself, it is necessary to exclude the impact of the income that accompanies the increase of work time. Therefore, this study does not control for the income variable in the first step of the analysis. However, in the second step, this study controls for the equivalent income⁵ to isolate the effect of work itself, as further discussed in results chapter.

Descriptive Statistics

Table 3.1 presents the summary statistics for all variables used in the analysis. The sample consists of 792 observations. First, regarding the individual characteristics, our sample comprises individuals aged 58–62 years with mean age of 59.84 years. In addition, since this study uses a dummy variable indicating "60 61 or 62 years old" and a dummy variable indicating "born after 1946" to examine the effect of the 2006 EESL and pension revisions, the table also shows the statistics of these variables. The mean values of the two dummy variables are 54.2 and 49.1, respectively, which are around 50%, indicating that the sample sizes of the control and treatment groups in the first stage of analysis are almost equal.

Moreover, the vast majority (91.2%) have a partner. The treatment variables of interest are employed individuals, regular employees, and non-regular employees. About 59.3% of the individuals are employed: 50.9% are regular and 8.4% are non-regular employees. In addition, the mean for all satisfaction items is above 3. These individuals are more satisfied in terms of overall happiness and family life, which have scores above 3.5, while fewer individuals report satisfaction with leisure activities and household budget situation, which have scores less than 3.5.

Table 3.2 provides the descriptive statistics by employment status. It shows that regular workers are slightly more satisfied with their leisure activities, family life, and household situation, as well as happier than the other two groups. However, that difference is not pronounced. As for worker demographics, a higher percentage of non-regular employees are over 60 years old, which is consistent with the actual situation. Furthermore, there is a small heterogeneity among the three groups with respect to the other control variables.

3.4 Identification Strategy

Employment/Non-Employment, Employment Status, and Subjective Well-Being

This study investigates the effect of employment on the subjective well-being of older adults. The traditional approach consists of estimating the following equation using OLS:

$$SWB_i = \alpha' L_i + \beta' X_i + \varepsilon_i \quad (3.1)$$

SWB_i represents a set of outcome variables that measure subjective well-being, such as satisfaction in family life, household budget situation, and leisure activities, and overall well-being. L_i is a binary variable denoting a salaried worker, and X denotes a set of predetermined variables, including marital status, health status, and year dummies.

However, since the choice of employment might be endogenous to subjective well-being, the estimation results do not necessarily imply causality. Specifically, there is an effect of employment on happiness and an opposite effect of happiness on employment. Moreover, both employment and happiness may be influenced by unobserved factors. Thus, it is crucial to control for endogeneity in employment. This study uses instrumental variables (IV) with probit ordinary least squares (POLS), in which this study uses a linear model to estimate the effect of policy modifications on employment and the probability of being employed in the first step and then uses these estimates to control for the endogeneity in the subjective well-being equation (estimated by POLS). This method is similar to previous literature in the United States and the European Union (Charles, 2004; Bonsang et al., 2012; Fonseca et al., 2014).

The instruments need to meet the assumption that they are relevant to employment but have no impact on subjective well-being. Previous literature has shown the significant positive impact of the 2006 EESL and pension revisions on the employment of older people (Yamada, 2007; Kondo and Shigeoka, 2017). For the first equation, this study estimates the probability of being employed by exploiting the 2006 EESL and pension revisions as sources of exogenous variations in employment as follows⁶:

$$L_i = \alpha + \beta cohort_i + \gamma age_i + \delta(age_i \cdot cohort_i) + \theta X_i + \varepsilon_i \quad (3.2)$$

Since the 2006 EESL revision and the social security revision in Japan are inextricably linked, one way to examine the effect of the two revisions simultaneously is to investigate them by cohort. In order to identify the effect of the 2006 EESL and pension revisions, this study uses a difference in difference approach, a method used in other studies that estimate the effects of this type of policy. This study defines older men born between 1941 and 1945 as the control group and older men born between 1946 and 1950 as the treatment group. We then compare the pre-retirement and post-retirement (age 60-62) status of both groups. Figure 3.4 shows the age at which each amendment applies to each cohort. At age 60, both the control and treatment groups are the same in that they could not receive the basic proportion part of the pension. However,

the treatment group is protected by the 2006 EESL, and firms are obligated to keep them employed. At age 61, the control group born from 1941 to 1942 is not protected by the 2006 EESL revision, but could receive a pension. However, the opposite is true for those in the treatment group. In addition, their situation at age 62 is the same as at age 61. Therefore, the coefficient δ in Eq. (3.2) captures the effect of the EESL and pension revision in 2006.

In Eq. (3.2), L_i represents employment status (i.e., employed or not, or a regular or non-regular worker). cohort_i is a dummy variable indicating whether individual i belongs to the treatment group. cohort_i equals 1 if individual i was born from 1946 to 1950, and zero if he was born from 1941 to 1945. age_i is a dummy variable indicating an individual's age; it equals 1 if individual i was 60, 61 or 62 years old and zero otherwise. X_i represents characteristics such as “self-reported health status” and “marital status,” with the “self-reported health status” equal to 1 if individual i was unhealthy, and zero otherwise, while “marital status” is equal to 1 if individual i was married and zero otherwise. Furthermore, this study controlled for the effect of the city size of residential area on the probability of employment by setting “large city” to 1 for government ordinance-designated cities.⁷ We then use the predicted value of the probability of employment in the second-stage estimation model as follows:

$$SWB_i = \alpha + \beta \tilde{L}_i + \theta X_i + \varepsilon_i \quad (3.3)$$

In practice, Eq. (3.3) and Eq. (3.2) are estimated using the instrumental variable method. Here, the dependent variable, SWB_i , is one of the three outcome variables that measure individuals' subjective well-being. $\tilde{L}_i$ denotes the values predicted from the first stage. β captures the estimated effect of employment on the individuals' well-being.

As mentioned above, in the analysis of the effect of employment on subjective well-being, this study uses the IV-POLS approach, in which adopts a linear model in the first step. However, we cannot apply the instrumental variable method when the endogenous variable is the employment status, which includes three alternatives: non-

employment, regular employment and non-regular employment. In such a case, in the first stage, we estimate the following equation using a multinomial logit:

$$CF_i = \alpha + \beta cohort_i + \gamma age_i + \delta(age_i \cdot cohort_i) + \theta X_i + \varepsilon_i \quad (3.4)$$

where CF is an indicator variable for the three employment statuses discussed above, and the other explanatory variables are the same as in Eq. (3.2). Next, following Dubin and McFadden (1984), we obtain a set of correction terms to be added as controls to the equation for job satisfaction by the following equation:

$$E(\varepsilon_i | CF_i = i) = \sum_{j \neq i}^m \left(\frac{\widehat{P}_j \ln \widehat{P}_j}{1 - \widehat{P}_j} + \ln \widehat{P}_i \right) \quad (3.5)$$

where P denotes estimated probabilities from Eq. (3.4).

Finally, we estimate the following POLS with a correction term:

$$SWB_i = \alpha + \beta \cdot CF_i + \lambda \cdot E(\varepsilon_i / CF_i) + \theta X_i + \varepsilon_i \quad (3.6)$$

where the parameter of the correction term, λ , captures the correlation of the unobserved variables between Eq. (3.4) and Eq. (3.6). If λ is statistically significant, it means that the correlation between them cannot be ignored.

Probit Ordinary Least Squares

POLS, as an alternative to the ordered response model, has more advantages, such as requiring less computations and being more easily generalized into complex models. Moreover, it allows better handling of economic issues such as endogeneity and simultaneous equations. Furthermore, in most cases, it yields roughly the same results as the ordered probit. (Van Raage et al., 2004)

The specific calculation steps for the POLS method are as follows. The frequency

and the cumulated frequencies for each category of the dependent variable $p_1, p_2, p_3, \dots, p_k$ are first calculated. Next, the corresponding Z-values of the standard normal distribution are determined based on the cumulated frequencies, and then the boundaries are calculated.

$$N(\mu_1) = p_1, N(\mu_2) = p_1 + p_2, \dots (3.7)$$

Taking the expectation of a standard normally distributed variable under the condition that it is in the interval between those two Z-values, the following equation is derived:

$$E(u|\mu_{i-1} < u_i \leq \mu_i) = \frac{n(\mu_{j-1}) - n(\mu_j)}{N(\mu_j) - N(\mu_{j-1})} (3.8)$$

3.5 Results

The Effect of Employment on Subjective Well-Being

Table 3.3 reports the results from the estimation of Eq. (3.1) by POLS. There is a significant positive effect of employment on satisfaction in household budget situation, and no significant effect on satisfaction in leisure activities and family life, and overall happiness. However, as previously mentioned, with POLS regression methods, the results may be biased due to endogeneity issues. People with idiosyncratic low levels of well-being or those facing transitory shocks that adversely affect well-being might disproportionately select into retirement (Charles, 2004). Thus, this can lead to biased upwards, and employment appears to increase the well-being of older adults.

Tables 3.3 and 3.4 report the results from the estimation of Eq. (3.2) and Eq. (3.3), respectively. As shown in Table 3.4, the 2006 EESL and pension revisions have a positive effect on the employment of older people, consistent with the results of Yamada (2008) and Kondo and Shigeoka (2017). This means that the IV is effective (see the

table for the F-value). Meanwhile, after controlling for endogeneity, the positive effects on satisfaction in household budget situation disappear. In particular, the estimated coefficient for happiness is positive but not statistically significant. Similarly, the coefficients of employment on satisfaction with leisure activities, family life, and household budget situation are negative, but not statistically significant.

The IV estimates on satisfaction in household budget situation are typically different from those of POLS, which suggests bias in the POLS estimates. As mentioned previously, older adults with higher well-being levels are more likely to continue working after mandatory retirement age. Thus, a simple POLS may produce an upward bias, and the results may only represent a correlation rather than an inherently causal relationship. The findings are in line with, for example, Fonseca et al. (2014) regarding retirement in Europe.

The Effect of Regular or Non-Regular Employment on Subjective Well-Being

We have so far examined the impact of being employed on subjective well-being. However, the employment status could potentially contribute to subjective well-being. While regular employment is more attractive than non-regular employment in terms of receiving higher wages, non-regular employment has the advantage of more flexible working hours than regular employment. In particular, it should be noted that unlike ordinary workers, the older people may not be able to work long hours due to physical reasons, and thus non-regular employment may be more suitable for them. Therefore, this study will further explore whether the impact of employment on well-being differs depending on the type of employment.

The estimated treatment effects in Table 3.6 show that the 2006 EESL and pension revisions have a positive impact on employment, which is consistent with the results in Table 3.4. The estimated effect of regular employment on satisfaction with household budget situation is positive, indicating that regular employment increases income of older adults, making them more satisfied with their household budget situation. In contrast, the results show that the impact of non-regular employment on house-life

satisfaction and overall happiness are negative.

It should be noted that so far this paper has focused on the overall effect of employment, which includes the increase in income from employment. Differences in the effects of regular and non-regular employment also reflect differences in wages, job content, and other factors, but in particular, differences in income due to employment status may cause differences in well-being. Therefore, in this study, we will control for the effect of differences in income by employment status by adding equivalent income as an explanatory variable. The results are shown in Table 3.8. There, when controlling for household income, only satisfaction with leisure activities is statistically significant at the 10% level, and the other outcomes do not differ statistically significantly among employment statuses.

3.6 Discussion

This study examines the causal effect of employment on subjective well-being. Many foreign literatures use the pension eligibility age as an instrumental variable. In Japan, the pension eligibility age varies across cohorts, thus allowing it to be used as an instrumental variable as well as in other countries. However, policy revisions such as the Japanese pension system and labor laws have brought about new changes in recent years. More specifically, the 2006 EESL revisions promote the employment of older people, leading to the fact that some older people will continue to work after the mandatory retirement age. What are the consequences of such a change? This paper focuses on these recent revisions and examines the impact of continued employment on the well-being of older people.

The POLS results indicate that employment increases satisfaction in household budget situation. However, the effects disappear after using the IV approach to control for endogeneity. As discussed in section 3.1, endogeneity issues due to reverse causality and omitted variables may bias the results. The results are consistent with Fonseca et al. (2014), Coe and Zamarro (2011), Kesavayuth et al. (2016) and Kapteyn et al. (2013),

who find no effect of retirement on subjective well-being after controlling for endogeneity using IV.

Furthermore, this study finds that the effect of employment on subjective well-being differs depending on the employment status (i.e., regular or non-regular employees). However, the differences disappear after controlling for equivalent income.

The following can explain why employment has no impact on the subjective well-being of older adults after controlling for household income. According to neoclassical economics, after controlling for household income, labor itself could have adverse effects on utility. However, according to the new happiness economics, individuals derive utility not only from income and leisure but also from highly valued social relations, from self-determination, and through their own competence (Frey et al., 2008). Employment provides not only pecuniary benefits but also a spiritual reward to people through social contact, individual identity, and occupational attachment. Therefore, the reason behind the absence of any effect of employment on happiness is that the negative effect of reduced leisure time and the positive effect of psychological rewards cancel each other out.

When controlling for household income, we could not identify any statistically significant differences in well-being between those in regular and non-regular employment, except for satisfaction with leisure activities. The reasons for the no difference might be as follows. In general, non-regular workers are not required to work full time, which allow them more leisure time and has a positive effect on their utility. Moreover, their work hours are more flexible. It is important to note that unlike other age groups, older adults are physically weaker, so flexible working hours might be more suitable for their physical situation. According to a survey of the Japan Institute for Labour Policy and Training,⁸ about 37.4% of male seniors aged 60–64 prefer to work only for a short time after the age of 65, instead of working full time. In summary, although regular employment gives workers higher wages, non-regular employment requires fewer working hours, which allows workers to adjust their working hours to their circumstances. Therefore, almost no differences were found. Only with regard to the satisfaction of leisure activities, we find a weak positive effect on the satisfaction

of workers in non-regular employment. This may be because a certain amount of work better enables them to make the most of their leisure time and increase their satisfaction with leisure activities.

3.7 Conclusion

This study investigated the effect of employment on the subjective well-being of older adults and examined whether the effect depends on job characteristics (i.e., regular and non-regular employment). It used the 2006 EESL and pension revisions as the sources of exogenous variables in employment and explored the impact of employment on the well-being of older adults.

The study sheds light on the above-mentioned issues by specifically exploring the situation of older adults in Japan. This study's topic has become an increasingly important policy concern for rapidly developing and aging Asian countries. Specifically, if employment reduces the subjective well-being of older adults, this implies significant policy cost. However, if employment has a positive or no effect on the welfare of older adults, this might make elderly employment policies or pension revisions easier to implement.

The POLS results indicate that employment increases satisfaction in household budget situation. However, the effects disappear after applying the IV approach. Furthermore, this study finds that the effect of employment on well-being differs depending on the employment status (i.e., regular or non-regular employment). However, the differences disappear after controlling for household income. As stated previously, the 2006 EESL and pension revisions offer three choices for individuals and companies, and they choose according to their situation. Therefore, the revisions have no consequence on the subjective well-being of older adults in Japan. With regard to employment promotion policies for older workers, the government should allow greater flexibility to provide individuals and companies with a wide range of employment options, such as formal or regular and non-regular or part-time statuses, so that older

adults can work according to their situation and companies can also adjust to their needs.

Notes

1 The Act on Special Measures Concerning Promotion of Employment of Middle-aged and Aged Persons of 1971 was revised many times. In 1986, the name was changed to the “Elderly Employment Stabilization Law.” Companies were obliged to make an effort not to set the retirement age younger than the age of 60. After that, with the 1994 amendment, enterprises were prohibited from setting the age of retirement before the age of 60 from 1998. Then, after the 2000 amendment, employers were obliged to make an effort to employ older adults until they reach the age of 65. In 2004, the Japanese government revised the EESL again and implemented the revision in 2006.

2 Cabinet Office, Government of Japan: Aged Society White Paper data (Heisei 29th edition).

3 The amendment of the law in 1985 gradually increased the eligibility age of welfare pension insurance from 60 to 65 years. To raise the age of starting payment smoothly, the ‘specially provided pension’ system of employees’ old-age pension was established. Specifically, the system has two parts: a fixed rate part and a remuneration-based proportional part. The fixed rate part is determined by the number of months the person has paid the contribution., while the remuneration-based proportional part is based on both number of months the person has contributed and earnings before retirement.

4 Japan Cabinet Office: Survey on 2015 International Comparative Study on the Lives and Attitudes of elderly (2015).

5 According to the economic theory, the effect of employment on well-being contains both the effect of increased work hours and increased income. We need to separate the effects of these two components, that is, to take into account income when estimating the effect of work hours. Even though income as a control variable might not be a completely exogenous variable for happiness, as in this study, we need to control for it. Here, we use the equivalent income of the household income, which includes the income of other family members, to reduce the endogeneity between individual income

and well-being.

6 The government-designated city system requirements stipulated by Article 252-19 of the Japan Local Self-Governing Law are "a city with a population of 500,000 or more" and "designated by government ordinance." In addition to the population, the ability to carry out financial affairs and others are also essential conditions. Now there are 20 government ordinance-designated cities in Japan in 2021.

7 The detailed descriptions of the method and data are as follows. First, we suggest that the 2006 EESL and pension revisions are appropriate as instrumental variables. An effective instrument needs actually to impact the relevant variables, and there has been some literature demonstrating that the 2006 EESL and pension revisions have a promotional effect on the employment of older adults (Kondo and Shigeoka, 2017; Yamamoto, 2008). On the other hand, Chapter 2 suggests that the 2013 EESL revisions do not significantly impact the employment of older adults. Second, we consider the JGSS data appropriate for this study, even though it is cross-sectional. The JGSS has multifaceted and long-term data on individual life satisfaction and well-being. Moreover, some foreign studies indicate that the results obtained using OLS or FE are similar. (Charles, 2004; Latif, 2011). The effect of fixed effects on the results might not be significant. Furthermore, the Japanese government-administered questionnaire data for older adults mainly focuses on mental health. In the KHPS used in Chapter 2, the survey on happiness has only been available since 2011. It is only in recent years after subjective well-being has gradually attracted widespread attention that the well-being item has been added to some questionnaires. If such panel data become available in the future, it would be more desirable for analysis.

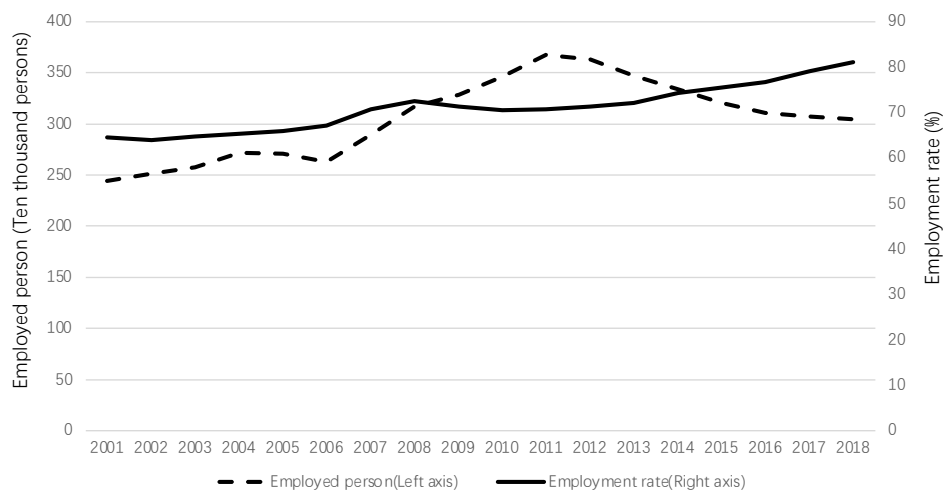
8 JILPT: Survey on Employment Life after Age 60.

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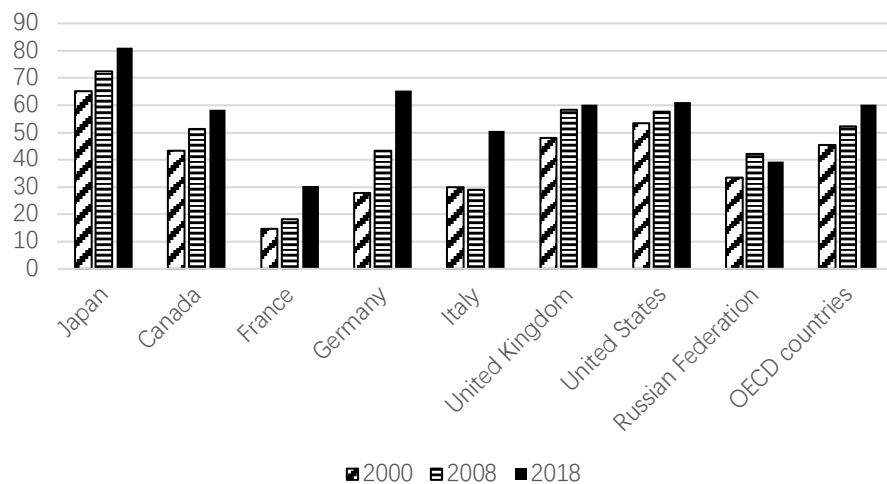
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Figure 3. 1 The Employment Number and Rates of Older Adults (Men Aged 60 to 64)



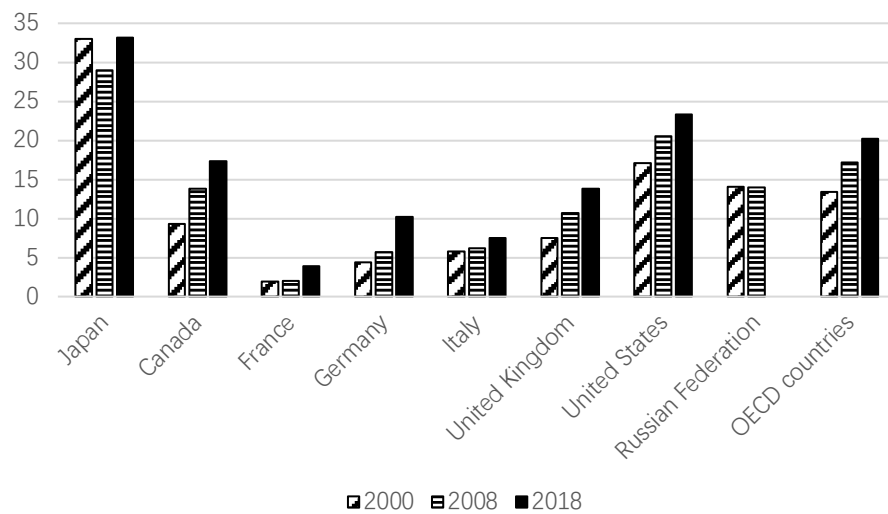
Source: Ministry of Internal Affairs and Communications: Labor force survey (long term time series data).

Figure 3. 2 The Employment Rates of Older Adults (Men Aged 60 to 64) across Countries



Source: OECD.Statistics <https://stats.oecd.org>.

Figure 3. 3 The Employment Rates of Older Adults (Men Aged above 65) across Countries



Source: OECD.Statistics <https://stats.oecd.org>.

Figure 3. 4 The 2006 EESL and the 1994 Pension Revisions

Age		60	61	62	63	64
Cohort born	Born before 1941.4.1	fixed rate part of pension starts				
	1941.4.2~1943.4.1		fixed rate part of pension starts			
	1943.4.2~1945.4.1			fixed rate part of pension starts		
	1945.4.2~1947.4.1				fixed rate part of pension starts	
	1947.4.2~1949.4.1					fixed rate part of pension starts
	1949.4.2~1953.4.1					
	Cohort affected by 2006 EESL revision					

Note: 1941.4.2 represents 2 April 1941.

Figure 3. 5 Sample Consist of Cohorts and Questionnaire Waves

Survey Year		2000	2001	2002	2003	2005	2006	2008	2010	2012
Survey Month		10-11	10-11	10-11	10-11	8-11	10-12	10-12	2-4	2-4
control group	1941.4-	59	60	61	62					
	1942.4-	58	59	60	61					
	1943.4-		58	59	60	62				
	1944.4-			58	59	61	62			
	1945.4-				58	60	61			
treatment group	1946.4-					59	60	62		
	1947.4-					58	59	61	62	
	1948.4-						58	60	61	
	1949.4-							59	60	62
	1950.4-							58	59	61

Note: The values in the table are the ages of the individuals.

Table 3. 1 Summary Statistics

Variable	Obs.	Mean	Std. dev.	Min	Max
<i><u>Outcome Variables</u></i>					
Leisure Activities Satisfaction	792	3.399	1.001	1	5
Family Life Satisfaction	792	3.745	0.969	1	5
Household Budget Situation Satisfaction	792	3.120	1.119	1	5
Happiness	792	3.846	0.943	1	5
<i><u>Treatment Variable</u></i>					
Employment	792	0.593	0.492	0	1
Regular employee	792	0.509	0.500	0	1
Non-regular employee	792	0.0846	0.278	0	1
<i><u>Control Variable</u></i>					
Age	792	59.84	1.400	58	62
Age $\geq$ 60	792	0.542	0.499	0	1
Cohort $\geq$ 1946	792	0.491	0.500	0	1
Marital status	792	0.912	0.284	0	1
Unhealth	792	0.509	0.500	0	1
Large town	792	0.198	0.399	0	1
Equivalent income	558	419.7	282.5	0	2,300

Notes: Data Source: JGSS 2000,2001,2002,2003,2005,2006,2008,2010,2012 waves.

Equivalent income in 10,000 yen.

Table 3. 2 Summary Statistics of Different Employment Statuses

	Not working		Regular employee		Non-regular employee	
	Mean	Std. dev.	Mean	Std. dev.	Mean	Std. dev.
Leisure Activities Satisfaction	3.354	1.044	3.432	0.981	3.418	0.907
Family Life Satisfaction	3.711	0.996	3.821	0.924	3.448	1.049
Household Budget Situation Satisfaction	3.006	1.187	3.246	1.075	2.910	0.949
Happiness	3.755	0.995	3.983	0.856	3.463	1.035
Age $\geq$ 60	0.652	0.477	0.404	0.491	0.836	0.373
Cohort $\geq$ 1946	0.422	0.495	0.533	0.499	0.567	0.499
Marital status	0.894	0.308	0.933	0.250	0.866	0.344
Unhealth	0.528	0.500	0.491	0.501	0.522	0.503
Large town	0.189	0.392	0.206	0.405	0.194	0.398
Equivalent income	342.298	258.973	495.971	287.190	297.581	213.202

Notes: Data Source: JGSS 2000,2001,2002,2003,2005,2006,2008,2010,2012 waves.

Equivalent income in 10,000 yen.

Table 3. 3 Effect of Employment on Subjective Well-Being: POLS Estimates

	(1) Leisure Activities Satisfaction	(2) Family Life Satisfaction	(3) Household Budget Situation Satisfaction	(4) Happiness
Employment	0.043 (0.069)	0.002 (0.064)	0.150** (0.069)	0.070 (0.063)
Age	-2.853 (2.401)	-0.342 (2.267)	-1.093 (2.464)	-1.233 (2.284)
Age2	2.409 (2.004)	0.304 (1.891)	0.941 (2.056)	1.002 (1.907)
Marital status	0.276** (0.119)	0.840*** (0.124)	0.444*** (0.109)	0.832*** (0.123)
Unhealth	-0.461*** (0.065)	-0.477*** (0.062)	-0.401*** (0.066)	-0.496*** (0.063)
Large town	0.008 (0.085)	0.118 (0.078)	0.086 (0.086)	0.147* (0.080)
Constant	84.417 (71.895)	8.874 (67.945)	31.211 (73.751)	37.249 (68.376)
Survey year	Yes	Yes	Yes	Yes
Survey month	Yes	Yes	Yes	Yes
Observations	792	792	792	792
R-squared	0.102	0.186	0.110	0.173

Notes: * significant at 10%; ** significant at 5%; *** significant at 1%. Robust standard errors in parentheses.

Table 3. 4 Effect of 2006 EESL and Pension Revisions (First Stage)

First stage (Reg)	Employment
Age $\geq$ 60	-0.271*** (0.057)
Cohort	0.026 (0.086)
Age $\geq$ 60*Cohort	0.192** (0.079)
Marital status	0.087 (0.062)
Unhealth	-0.027 (0.034)
Largetown	0.033 (0.043)
Constant	0.588*** (0.071)
Survey month	Yes
Inst.F-Stat	14.2626
Observations	792
R-squared	0.062

Notes: * significant at 10%; ** significant at 5%; *** significant at 1%. Robust standard errors in parentheses.

Table 3. 5 Effect of Employment on Subjective Well-Being: IV-POLS Estimates

	(1) Leisure Activities Satisfaction	(2) Family Life Satisfaction	(3) Household Budget Situation Satisfaction	(4) Happiness
Employment	-0.062 (0.297)	-0.190 (0.287)	-0.103 (0.299)	0.445 (0.291)
Marital status	0.281** (0.123)	0.855*** (0.126)	0.462*** (0.114)	0.799*** (0.130)
Unhealth	-0.465*** (0.066)	-0.477*** (0.063)	-0.419*** (0.067)	-0.480*** (0.064)
Largetown	0.021 (0.085)	0.139* (0.078)	0.095 (0.086)	0.140* (0.081)
Constant	-0.139 (0.201)	-0.681*** (0.201)	-0.353* (0.196)	-0.856*** (0.205)
Survey month	Yes	Yes	Yes	Yes
Observations	792	792	792	792
R-squared	0.090	0.169	0.084	0.131

Notes: * significant at 10%; ** significant at 5%; *** significant at 1%. Robust standard errors in parentheses.

Table 3. 6 Effect of 2006 EESL and Pension Revisions (First Stage Mlogit)

First stage (Mlogit)	(1)	(2)
	Regular employee	Non-Regular employee
Age $\geq$ 60	-1.332*** (0.259)	0.205 (0.517)
Cohort	0.164 (0.399)	-0.507 (1.055)
Cohort*Age $\geq$ 60	0.704* (0.363)	1.721** (0.794)
Marital status	0.520* (0.273)	-0.153 (0.417)
Unhealth	-0.159 (0.158)	0.048 (0.280)
Largetown	0.176 (0.204)	0.002 (0.340)
Constant	0.172 (0.316)	-1.985*** (0.560)
Survey month	Yes	Yes
Observations	792	792

Notes: * significant at 10%; ** significant at 5%; *** significant at 1%. Robust standard errors in parentheses.

Table 3. 7 Effect of Employment Status on Subjective Well-Being: Two-stage Procedure POLS Estimates

	(1) Leisure Activities	(2) Family Life Satisfaction	(3) Household Budget	(4) Happiness
	(1)	(2)	(3)	(4)
Regular employee	0.027 (0.072)	0.037 (0.066)	0.182** (0.072)	0.132** (0.065)
Non-regular employee	0.041 (0.113)	-0.268** (0.118)	-0.115 (0.109)	-0.257** (0.120)
Marital status	0.276** (0.126)	0.845*** (0.126)	0.465*** (0.113)	0.796*** (0.126)
Unhealth	-0.463*** (0.067)	-0.474*** (0.063)	-0.419*** (0.067)	-0.482*** (0.063)
Large town	0.017 (0.085)	0.137* (0.078)	0.095 (0.085)	0.146* (0.080)
mills2	0.005 (0.050)	-0.020 (0.046)	-0.036 (0.049)	0.012 (0.046)
mills3	0.008 (0.024)	-0.001 (0.021)	0.001 (0.023)	-0.006 (0.020)
Constant	-0.090 (0.406)	-0.856** (0.370)	-0.603 (0.399)	-0.674* (0.378)
Survey month	Yes	Yes	Yes	Yes
Observations	792	792	792	792
R-squared	0.092	0.184	0.104	0.181

Notes: * significant at 10%; ** significant at 5%; *** significant at 1%. Robust standard errors in parentheses.

Table 3. 8 Effect of Employment Status on Subjective Well-Being: Two-stage Procedure POLS Estimates (Control for Equivalent Income)

	(1) Leisure Activities Satisfaction	(2) Family Life Satisfaction	(3) Household Budget Situation Satisfaction	(4) Happiness
Regular employee	0.029 (0.089)	0.008 (0.082)	0.096 (0.085)	0.085 (0.079)
Non-regular employee	0.231* (0.130)	-0.202 (0.139)	-0.015 (0.124)	-0.127 (0.136)
Marital status	0.139 (0.156)	0.806*** (0.159)	0.375*** (0.133)	0.768*** (0.158)
Unhealth	-0.462*** (0.078)	-0.491*** (0.074)	-0.433*** (0.074)	-0.487*** (0.072)
Large town	0.004 (0.106)	0.100 (0.095)	0.077 (0.098)	0.014 (0.095)
mills2	0.010 (0.044)	0.014 (0.041)	-0.025 (0.040)	0.031 (0.041)
mills3	0.001 (0.003)	0.001 (0.003)	0.002 (0.003)	0.002 (0.003)
Equivalent income	0.000 (0.000)	0.000*** (0.000)	0.001*** (0.000)	0.001*** (0.000)
Constant	-0.053 (0.266)	-0.770*** (0.256)	-0.869*** (0.234)	-0.759*** (0.256)
Survey month	Yes	Yes	Yes	Yes
Observations	558	558	558	558
R-squared	0.093	0.197	0.210	0.228

Notes: * significant at 10%; ** significant at 5%; *** significant at 1%. Robust standard errors in parentheses.

Chapter 4 Aging Workforce, Productivity, and Wages in Japan

4.1 Introduction

Lower fertility rates and rising life expectancies have contributed to population aging in many industrialized countries in recent years. Among them, Japan's population continues to age rapidly at a rate unlike any other country in the world. Furthermore, Japan recently surpassed other countries as the world's fastest aging country.

According to the 2019 Revision of World Population Prospects, Japan's population aging rate was lower than that of other developed countries and regions in the 1980s. However, after 1990, in 24 years, the aging rate accelerated, and Japan transformed from an "aging society" (over 7% in 1970) to an "aged society" (over 14% in 1994). Since the 20th century, Japan's aging rate has risen further, increasing to 28.4% in 2019, the highest in the world.

Population aging leads to a decline in the potential labor supply in the economy and an aging workforce. Hence, issues concerning the effect of the aging of the workforce or changes in firms' age structure on firms' productivity have received widespread attention. This study examines the effect of the age structure of employees on labor productivity and wages in Japan. Moreover, we also compare the age-productivity profiles and age-wage profiles at the company level to determine whether older workers are rewarded according to their productivity.

Two main clusters exist in the associated hypotheses: The first cluster of hypotheses concerns the relationship between aging and productivity. According to medical studies (Shock, 1962; Welford, 1977), workers' abilities deteriorate with age. Skirbekk (2004) conducted a review of the empirical literature and found that individual performance tends to deteriorate through later stages in adulthood. In contrast, human

capital theory (Ben-Porath, 1967; Mincer, 1974; Becker, 1975) argues that individual employees can improve or accumulate skills through training and education. Thus, as workers become older, the accumulated skills lead to increased productivity. A similar hypothesis is supported by the “Horndal effect,” as discussed by Lundberg (1961). Based on the experience of the Horndal steel plant in central Sweden, the hypothesis indicates that an aging workforce is compatible with rapid increases in labor productivity through a learning-by-doing effect (Malmberg et al., 2008).

The second cluster of hypotheses concerns the relationship between age, productivity profile, and age–wage profile. The dominant hypothesis is the theory of “delayed payment contracts” (Lazear, 1979; Harris and Holmstrom, 1982; Carmichael, 1983; Malcolmson, 1984; Hutchens, 1989). Lazear’s model of delayed payment contracts states that both parties are paid to agree to a long-term wage stream that pays workers less than their value of the marginal product (VMPs) when young and more than the VMPs when old. However, this payment schedule is founded and based on the bedrock requirement of mandatory retirement, that is, the date at which the contract is terminated, and the worker is no longer entitled to receive a wage greater than his VMP (Lazear, 1979). Therefore, the aging workforce may provide firms with an incentive to reduce the wages of older employees or terminate them after they reach the statutory retirement age.

This study relates to the extensive literature concerning the effect of firms’ age structure on firms’ productivity. Several empirical studies have shown that older employees have a detrimental impact on firm productivity (Haltiwanger et al., 1999 for the United States; Ilmakunnas and Maliranta, 2007 for Finland; Grund and Westergaard-Nielsen, 2008 for Denmark; Lallemand and Rycx, 2009 for Belgium).

However, many more recent studies have found that older employees have no impact or a positive impact on firm productivity (e.g., Hellerstein et al., 1999 for the United States; Aubert and Crépon, 2003 for France; Malmberg et al., 2008 for Sweden; Van Ours and Stoeldraijer, 2011 for the Netherlands; Cardoso et al., 2011 for Portugal; Malmberg et al., 2013 for Austria; Borsch-Supan and Weiss, 2016 for Germany; Kim, 2019 for Korea; and Lee et al., 2020 for Japan and Korea (industry-level analysis)).

Some of these studies find that after using fixed-effects models (FE), instrumental variables models (IV), or generalized method of moments (GMM), different results are obtained from ordinary least squares (OLS). Moreover, the negative impact of older workers' employment effects disappears.

Furthermore, as with the above hypotheses, some studies have focused on comparing age-productivity and age-wage profiles. However, the evidence in this case is ambiguous. Some studies (Crépon *et al.*, 2002; Japan: Kawaguchi *et al.*, 2006; Ilmakunnas and Maliranta, 2007; Dostie, 2011; Naganuma and Nishioka, 2014) find that the upward slope of the age-wage profile is greater than that of the age-productivity profile. This indicates that the findings are consistent with Lazear's (1979) theory of a "delayed payment contract." In contrast, some research suggests that the age-wage profile is not significantly different from the age-productivity profile (Hellerstein and Neumark, 1995; Hellerstein *et al.*, 1999; Aubert and Crépon, 2003; Van Ours and Stoeldraijer, 2011; Malmberg *et al.*, 2013). Moreover, according to Cardoso *et al.* (2011), the contribution of older workers to firm-level productivity exceeds their contribution to wage costs, implying that the upward slope of the age-wage profile is greater than that of the age-productivity profile.

This study contributes to the literature in the following three ways. First, this study focuses on the Japanese case of the impact of an aging workforce on firm performance. Japan has a rapidly aging population and is now the most aged country in the world. However, the impact of firm-level aging on productivity in such an aging country has been largely unexplored. Second, using firm-level panel data, this study accounts for both time-invariant and time-variant heterogeneity across firms. We examine the differences in estimation results between OLS estimation and firm fixed effects models, which were not examined in previous studies due to data limitations. Finally, this study not only analyzes single firms, but also considers the transfer of elderly workers within a group of firms using data from consolidated firms.

The main results of this study are as follows. The OLS results demonstrate that labor productivity is negatively related to the share of workers aged over 50 or over 60. However, after controlling for unobservable heterogeneity and productivity shocks, the

negative effects disappear. Moreover, the age-productivity profile is shown to be basically flat, while the age-wage profile is shown to be increasing up to middle age and flat after that. This means that compared to the middle-aged reference group, the relative wages of the older workforce group are consistent with their relative productivity. Thus, there is no evidence that older people are overpaid.

In addition to the above baseline findings, the following conclusions were drawn from this study: We find that the company's history is one of possible explanatory factors for the difference between the OLS and FE results. Moreover, the results of the consolidated companies show that companies do not allocate older people with low productivity to branches. Finally, we find different results for manufacturing and non-manufacturing samples. The results for the manufacturing sector are consistent with those for the overall sample. However, the age-productivity profile for the non-manufacturing sector is flat, and the age-wage profile declines after middle age. Older people in the non-manufacturing sector were not less productive. However, they have lower wages compared to the middle-aged reference group, indicating their underpayment.

4.2 The Theoretical Framework

We follow the existing literature in deriving the theoretical model (Crépon et al. 2002; Mahlberg et al. 2013). First, we express a firm's output in terms of the Cobb-Douglas production function, as shown in Eq. (4.1) below:

$$Y_i = AK_i^\alpha L_i^{*\beta} \quad (4.1)$$

where firm i 's output (Y_i) is determined by its capital input (K_i), total labor input (L_i^*), and technology level (A_i). As in previous literature, we partition the total labor input of company i into the weighted sum of distinct kinds (k), with L_{ik} denoting the quantity of type k workers in firm i , with λ_{ik} denoting the individual productivity:

$$L_i^* = \sum_{k=0}^m \lambda_{ik} L_{ik} = \lambda_{i0} L_{i0} + \sum_{k=1}^m \lambda_{ik} L_{ik} = \lambda_{i0} L_i (1 + \sum_{k=1}^m \frac{(\lambda_{ik} - \lambda_{i0})}{\lambda_{i0}} \left(\frac{L_{ik}}{L_i} \right)) \quad (4.2)$$

We separate labor force types into different age groups to determine the difference in productivity of employees in group k compared to the reference group, as in Eq. (4.2), where L_{i0} and λ_{i0} denote labor input and productivity for the reference group, and L_{ik} and λ_{ik} denote labor input and productivity for age group k , respectively. The variable of importance to us, the relative productivity difference between age groups k and reference age groups ($\gamma_{ik} = \frac{(\lambda_{ik} - \lambda_{i0})}{\lambda_{i0}}$), can be obtained by further arranging Eq. (4.2). Then, taking the logarithm of Eq. (4.2), we obtain Eq. (4.3):

$$\ln(L_i^*) = \ln(\lambda_{i0}) + \ln(L_i) + \ln\left(1 + \sum_{k=1}^m \gamma_{ik} \left(\frac{L_{ik}}{L_i}\right)\right) \quad (4.3)$$

We assume that differences in productivity between groups are consistent across firms ($\gamma_{ik} = \gamma_k$) and constant returns to scale. Taking the logarithm of Eq. (4.1) and replacing $\ln(L_i^*)$ in Eq. (4.1) by using Eq. (4.3), the following equation can be obtained:

$$\ln(Y_i) = \alpha \ln(K_i) + (1 - \alpha) \ln(\lambda_{i0}) + (1 - \alpha) \ln(L_i) + (1 - \alpha) \ln\left(1 + \sum_{k=1}^m \gamma_k \left(\frac{L_{ik}}{L_i}\right)\right) + \ln(A) \quad (4.4)$$

After subtracting $\ln(L_i)$ from both sides, denoting $\ln(\lambda_{i0})$ as the constant term c , and applying the approximation $\ln(1 + x) \approx x$, we can express the production function per head as follows:

$$\ln\left(\frac{Y_i}{L_i}\right) = c + \alpha \ln\left(\frac{K_i}{L_i}\right) + (1 - \alpha) \sum_{k=1}^m \gamma_k \left(\frac{L_{ik}}{L_i}\right) + \sum_{j=1}^n \delta_j X_{ij} + u_i \quad (4.5)$$

Output per employee $\frac{Y_i}{L_i}$ can be produced by capital intensity $\frac{K_i}{L_i}$, the share of

different types of labor $\frac{L_{ik}}{L_i}$ and firm-specific characteristic X_{ij} . The parameter $(1 - \alpha)$ captures the relative productivity differentials γ_k .

Similarly, we can derive the labor cost function using the same method as the productivity function above, as follows:

$$\ln\left(\frac{w_i}{L_i}\right) = c + \alpha \ln\left(\frac{K_i}{L_i}\right) + (1 - \alpha) \sum_{k=1}^m \gamma_k \left(\frac{L_{ik}}{L_i}\right) + \sum_{j=1}^n \delta_j X_{ij} + u_i \quad (4.6)$$

4.3 Data

Data Sources

To examine the effect of the age structure of employees on labor productivity and wages, we use matching data from two surveys covering 2004 to 2016. One is the Toyo Keizai Corporate Social Responsibility (CSR) Survey, which collects information on a firm's age structure. The other is the Nikkei NEEDS-Financial QUEST (NEEDS-FQ), which was conducted by Nikkei Inc. and contains the firm's financial information. Both are representative surveys of listed companies in Japan.

A brief introduction to the two databases and the matching method is given below. The CSR data survey targets listed companies and some large non-listed companies. Moreover, the survey respondents in NEEDS-FQ are mainly listed companies on the Japanese Stock Exchange (including the Japanese Association of Securities Dealers Automated Quotations, JASDAQ), as well as some non-listed companies. We match the two databases by applying a standard listed company security code, providing complete panel data for analysis.

The CSR and NEED-FQ data are especially suitable for this study, as we can create long-term panel data by combining the two datasets. The CSR data contains rich information on the composition of various types of workers in the firms, such as the number of workers of all ages, the number of female workers, and the number of temporary workers. All these factors are necessary for the analysis. Moreover, NEED-

FQ includes information about the company's sales and profits, which are proxies for productivity in the analysis. It also includes basic information about the firms' characteristics, such as fixed assets, registration year, and industry. Additionally, the two databases are ideal because their survey respondents are mainly large, listed companies, which could better represent the Japanese situation.

There are no standardized regulations for the fiscal year of Japanese listed companies, which might result in differences in the values of the number of employees in the two surveys. In this study, however, the number of employees in the firm is a crucial variable, and accurate data is required for reliable results. Thus, to ensure the accuracy of the data and the validity of the analysis, we compared the main values from the above two databases and removed partially deviating samples. More specifically, we compared the number of employees from the NEEDS-FQ database with the same item (obtained by summing the number of employees in each age group) from the CSR database and removed the samples where the two values deviated by more than 25%. After limiting the data sample, 3559 of the 4572 observations in Table 4.1 have the same values, and the remaining observations are restricted to no more than 25% deviation between the two values. Thus, even though the analysis data originated from two databases, we can guarantee the accuracy of the data.

Definitions

We use two indicators, sales and profit, as indices of labor productivity. Although the value-added could be used as a measure of productivity, unlike in Europe and the US, this is not usually available in Japanese databases. In fact, the NEEDS-FQ database lacks value-added data after 2014, making it difficult to use it for analysis. Sales and profits are also ideal measures of productivity, which are often used in the literature. Thus, we take the same approach as in the previous literature and use firms' sales (Haltiwanger et al. 1999; Cardoso et al. 2011) and profit (Ilmakunnas and Maliranta, 2007) as dependent variables.

Regarding age classification, we first follow the literature (Malmberg et al., 2013;

Lee et al., 2020) in categorizing age into three groups: under 30, 30 to 49, and above 50 years. This classification was adopted as the baseline analysis. We then divided the age group into four categories: under 30, 30 to 49, 50 to 59, and over 60 years. In both cases, we used the proportion of workers aged 30 to 39 years as the reference group.

As capital input in the production function, we used fixed assets per employee as a control variable. This variable has been applied in numerous previous studies (Van Ours and Stoeldraijer, 2011; Malmberg et al., 2013; Kim, 2019 (tangible fixed assets)). Similarly, we control for the number of employees as the labor input in the production function.

Moreover, we control for tenure (defined as the time spent working in the current firm) and its square. As stated in the previous literature, aging may affect productivity levels for various reasons. On the one hand, older workers are considered more reliable and more skilled than average workers. On the other hand, older workers have higher healthcare costs and lower flexibility in accepting new assignments and may be less suitable for training (Barth et al., 1993). To separate the effects of tenure, the previous literature controls for it, and the results are referred to as pure age effects (Malmberg et al., 2013). Additionally, we control for the share of female workers, the share of temporary workers¹, industry dummies, and year dummies².

Descriptive Statistics

Table 4.1 presents the summary statistics of the variables considered in this study. The first to third columns of Table 4.1 show the descriptive statistics (mean values and standard deviations) of variables for the overall sample, manufacturing sample, and non-manufacturing sample, respectively.

As the second and third columns of Table 4.1 show, the differences between the outcomes of manufacturing and non-manufacturing, such as the logarithm of sales, logarithm of profits, and logarithm of wages, is slight. Concerning the number of employees, the number of workers in manufacturing is slightly higher than that in non-manufacturing businesses. Moreover, there is no considerable variation in the value of

fixed assets between the manufacturing and non-manufacturing sectors. This could be because of the inclusion of some industries, such as real estate, in the non-manufacturing sector. The share of female workers and temporary workers is somewhat higher in the non-manufacturing sector than in the manufacturing sector, which is consistent with the actual situation. Additionally, considering age composition, which is our main interest, between manufacturing and non-manufacturing industries, a small heterogeneity exists.

Figure 4.1 shows the association between a firm's average age and productivity and the relationship between a firm's average age and labor costs. The average age of the firm, which is the horizontal coordinate of the figure, is literally defined as the average determined from the age of the firm's workforce. The vertical coordinates of the firm's sales, profits, and wage costs are presented in panels A, B, and C, respectively. The fitted line in Panel A shows a slight upward convexity. In contrast, the fitted line in Panel B is almost flat, indicating that the relationship between the average age of firms and productivity may not be clear. Furthermore, the fitted line in Panel C is hump-shaped, with firms' labor costs possibly increasing more sharply with average age and decreasing less sharply after that.

4.4 Methodology

This study examines the effect of the age structure of employees on labor productivity and wages in Japan. We first estimate the basic models of production and the wage function model using OLS. However, the results may be biased due to unobserved firm characteristics. Much of the previous literature criticizes pooled OLS estimators of productivity models for their potential "heterogeneity bias" (Aubert and Crépon, 2003). Firm productivity might be strongly influenced by firm-specific, time-invariant factors, not measured in surveys. Hence, these estimators may be biased because unobserved firm characteristics may influence a firm's productivity and age structure simultaneously (Garnero et al., 2014). To control for firm heterogeneity in the

estimation of the productivity and wage equation, we estimate the following fixed-effect model:

$$\ln\left(\frac{Y_{it}}{L_{it}}\right) = c + \alpha \ln\left(\frac{K_{it-1}}{L_{it-1}}\right) + (1 - \alpha) \sum_{k=1}^m \gamma_k p_{ikt-1} + \delta X_{it-1} + \eta \ln L_{it-1} + \theta_i + \sigma_t + u_{it} \quad (4.7)$$

The dependent variable in Eq. (4.7) $\ln\left(\frac{Y_i}{L_i}\right)$ represents a set of outcome variables measuring productivity or labor cost, such as the logarithm of sales per employee, logarithm of profit per employee, and logarithm of wages per employee. Furthermore, the independent variables are as follows: $\ln\left(\frac{K_i}{L_i}\right)$ denotes fixed assets per employee, and $\ln L_i$ denotes the total number of employees. p_k is a vector of the share of various types of workers, and γ_k is the associated parameter to be estimated. X_{it-1} consists of a set of predetermined variables described in the section on Data Sources, including tenure and its square. Moreover, θ_i is the firm fixed effect, controlling for unobserved time-invariant heterogeneity across firms. σ_t denotes the time effects, and u_{it} is the error term. Finally, to avoid reverse causality, we use one-period lagged explanatory variables in the model, as in Mahlberg et al. (2013). The main variable of interest was the proportion of older workers.

While fixed-effects estimation appropriately controls for heterogeneity across firms, it does not deal with the potential endogeneity of the explanatory variables. To address these endogeneity issues, we estimate our model using the GMM. This approach is generally used in research on the impact of labor heterogeneity on productivity and wages (Cardoso et al., 2011; Van Ours and Stoeldraijer, 2011; Garnero et al. 2014; Kim, 2019). The model instruments the first-differenced age structure variables with their lagged levels. Following Garnero et al. (2014), we use the first and second lags as instrumental variables. Several statistical tests were conducted to confirm the validity of the results. We use the Cragg-Donald Wald F statistic to test whether the correlation between the instrumental variables and the endogenous variables is low, that is, whether the instruments are weak. The second test is the

Kleibergen-Paap rk LM statistic, given the null hypothesis that the equation is under-identified. Moreover, we conduct an overidentification test and use the Hansen J statistic, with the null hypothesis that the instruments are uncorrelated with the error term.

4.5 Results

The Effect of Age Structure on Productivity and Wages in All Industries

Tables 4.2 and 4.3 show the effect of age structure on productivity and wages in all industries. Table 4.2 shows the OLS, FE, and GMM estimates for the three age groups.³ In the productivity analysis, the OLS estimates in Columns 1 and 4 show that, relative to the reference age group (workers aged 30 to 49), a higher share of workers aged over 50 is negatively related to the firm's sales and profit. However, the FE estimates in Columns 2 and 5 and the GMM estimates in Column 3 demonstrate that the negative effects disappear. The estimated coefficients are statistically insignificant in these columns. The results indicate that a relative increase in the share of workers aged over 50 years does not have a negative impact on the firm's productivity.

Table 4.3 shows the OLS, FE, and GMM estimates for the four age groups. Similarly, from the OLS estimates in columns 1 and 4, we find a significant negative relationship between the share of workers aged over 60 and the firm's sales or profit. As with the results in Table 4.2, the negative effects disappear after applying the FE and GMM methods. Specifically, the FE results in column 2 and GMM results in column 3 show that a relative increase in the share of older workers aged over 60 does not have a negative impact on firms' sales. Moreover, the results of the profit analysis in column 5 show a positive impact at the 10% level of significance.

In addition to the analysis of the age-productivity profiles, we examine the age-wage profiles at the company level to see whether there are any similarities or differences. Regarding the labor cost function, column 7 of Table 4.2 or Table 4.3 (FE estimates) shows that relative to the reference age group, the share of younger workers

aged under 30 is negatively related to the firms' wage costs. The coefficient for older workers is insignificant. The results indicate that compared to the reference age group, companies pay lower wages to younger workers but relatively the same amount to older workers.

Let us summarize the results of the productivity and labor cost functions above. According to the OLS results, the age-productivity and age-wage profiles are hump-shaped. However, the FE and GMM estimates show that younger workers, despite being paid less, are not less productive than the middle-aged group. Additionally, older workers are not less productive, and their wages do not differ significantly from those of the reference group. Thus, the age-productivity profile is shown to be basically flat, while the age-wage profile is shown to be increasing up to middle age and flat after that. This suggests that when compared to the middle-aged reference group, the wages of older workers are commensurate with their productivity and that they are not overpaid.

Differences between OLS and FE Estimates

In this subsection, we examine the possible factors that may cause the OLS and FE results to differ. As mentioned in the Methodology section, "heterogeneity bias," which occurs in pooled OLS estimators of productivity models, has been criticized in earlier studies (Aubert and Crépon, 2003). Firm productivity might be strongly influenced by firm-specific, time-invariant factors that are not measured in surveys. Hence, these estimators may be biased because unobserved firm characteristics may influence a firm's productivity and age structure simultaneously (Garnero et al., 2014). However, the previous literature, while finding differences between OLS and FE results, does not explore the exact time-invariant firm characteristics.

The registered year of the firms are considered to be one potentially important factor. The possible explanatory factors for the difference between the OLS and FE results are firm time-invariant variables. Thus, this study uses a proxy variable for firm age, year of firm registration. Figure 4.2 shows the density distribution of firms' registration years. The sample includes several companies established in both the pre- and post-war

periods.

Table 4.4 shows the OLS regression results after controlling for the different firm characteristic variables. The dependent variables in Columns 1 to 2 are the logarithm of sales and, in Columns 3 to 4, are the logarithms of profits. Columns 1 and 3 repeat the results in Table 4.3, controlling only the industry and year dummies. Columns 2 and 4 show the results, including controls for the firm-registered year.

We find that, after controlling for the registered year, the negative impact of the older workers' share on firms' sales vanishes, and the negative effects on firms' profits are also reduced. Thus, the firm's registered year is one of factors that impact both productivity and company age structure, and the absence of controls for these factors may be partly responsible for the differences in OLS and FE results.

The Results of Consolidated Companies: Are Low-Productivity Older People Being Transferred?

So far, using nonconsolidated company data, we find that the share of older people has no negative impact on the company's productivity. However, firms with multiple affiliates may choose to retain more productive older workers and transfer their less productive workers to their affiliates. To prove whether this possibility exists, we also examine the situation of consolidated companies. Here, we analyze consolidated accounts' data on sales and profits.⁴

Table 4.5 shows the effect of age structure on the productivity of consolidated companies. The share of older workers' coefficients is statistically insignificant in the productivity function. The results find no decrease in productivity among older people compared to the middle-aged reference group, which is the same as the results of the sole companies in the first subsection of the Results section.

Manufacturing and Non-Manufacturing Sectors

Manufacturing and non-manufacturing sectors in Japan differ in many aspects, including the various skills demanded by workers (physical or mental) and the wage-

setting mechanisms. We examine the manufacturing and non-manufacturing subsamples separately and find different results.⁵

Columns 1 to 3 of Table 4.6 show the results for the manufacturing sector, which are consistent with those for the overall sample. Compared to the middle-aged reference group, older adults are not less productive, and no significant wage differences are found. The age-productivity profile is presented as basically flat, whereas the age-wage profile is represented as rising until middle age, then flat.

As shown in Columns 4 to 6, the age-productivity profile for the non-manufacturing sector is similar to that of the manufacturing sector, which is also flat. However, the age-wage profile for the non-manufacturing sector declines after middle age. Even in the non-manufacturing sector, despite the productivity of older people not being lower than that of the middle-aged reference group, their relative wages are lower, indicating that they are underpaid.

Robustness

In this subsection, we check the robustness of our results. Specifically, considering the reliability of the data on the number of employees, we limit our sample to companies that have the same value of the number of employees in the two databases and re-estimate the same analysis. As described in the third section “Data,” of the 4572 samples, 3599 have the same number of employees, and the remaining samples have a deviation of no more than 25%. As a robustness test, we retained only samples with the same values.⁶

Table 4.8 presents the estimation results using an alternative sample, wherein columns 1 to 3 show all samples, columns 3 to 6 show the results for the manufacturing sector, and columns 7 to 9 for the non-manufacturing sector. We find similar results to those in the fourth section under the Results section for manufacturing and non-manufacturing, respectively. Therefore, the estimation results of the productivity function for the entire sample remain stable. There was no decrease in productivity among older people compared to the middle-aged reference group in either the total,

manufacturing, or non-manufacturing samples.

Furthermore, the results show that the share of people aged 50 and over has a negative impact on the labor cost of companies. However, this may reflect the effects of changes in the sample composition. Evidently, the proportion of non-manufacturing samples increases in the robustness check.⁷ Consequently, the results for the non-manufacturing sector would have a greater effect on the results for the entire sample, which is the reason for the change in the results of the labor cost function. Thus, the results are similar even when the sample is changed, indicating the robustness of our findings.

4.6 Discussion

The results of the study contribute valuable insight to the field as follows. First, we analyze the production functions for all industries. The OLS results indicate a negative relationship between the employment share of older employees and labor productivity. However, the effects disappear after applying the FE and GMM methods. In other words, employing older people has no significant negative effect on firm productivity. Moreover, employing people over the age of 60 has a positive effect on a company's profit at the 10% level of significance.

These results are in line with the findings of Malmberg et al. (2008), Van Ours and Stoeldraijer (2011), Cardoso et al. (2011), Börsch-Supan and Weiss (2016), and Kim (2019). They find that the results for FE, IV, or GMM are different from those for OLS and that the negative impact of the employment share of older workers disappears after controlling for firm fixed effects. As discussed in the Methodology and Results sections, failure to control for time variables or time-invariant firm factors may lead to biased OLS results that differ from those of the FE, IV, or GMM results.

The fact that the relative productivity of older workers does not decline can be attributed to the human resource management strategies adopted by firms to mitigate such a decline. For instance, Göbel and Zwick (2013) suggest that the relative

productivity contributions of old workers are significantly higher in establishments providing specific human resource measures for old employees. In Japan as well, Higuchi and Yamamoto (2002) find that employment in the late 50s and later age groups is more likely to be maintained in establishments that implement employment management strategies targeted at easing working conditions and circumstances for older employees. In other words, they suggest that flexible work arrangements by firms maintain the productivity of older employees.

We also compared the age-productivity profile with the age-wage profile. The OLS results show that the age-productivity and age-wage profiles are hump-shaped, which is consistent with previous literature findings in Japan (Kawaguchi et al., 2006). However, the FE and GMM estimations show that the age-productivity profile is basically flat, while the age-wage profile increases until middle age and remains flat thereafter, consistent with Lazear's hypothesis (Lazear, 1979). Therefore, relative to the reference group, older people's wages remain consistent with their productivity, and there is no evidence that older people are overpaid.

Second, we analyze the impact of firm time-invariant characteristics that may lead to a difference in the OLS and FE results. After controlling for registered year, we find that the older worker share has no negative impact on the firm's sales and has a minor negative effect on the firm's profit. The results indicate that the year of registration of the firm affect both the productivity and age structure of the firm, which might explain why the OLS and FE results differ. Although determining the direction of the effect may be a little challenging, the firm-registered year might be a potential factor affecting both the age structure and the performance of the company.

Third, we examine the age structure of the workforce and labor productivity in consolidated companies. The results show that similar to the findings of sole company data, employing older employees had no detrimental influence on the firm's productivity. We could not find any evidence that companies employ highly productive older workers in the main company while transferring less productive older workers to subsidiaries.

Finally, we find that the age-productivity profiles are similar for the manufacturing

and non-manufacturing industries, but the age-wage profiles are different. The age-wage profile of the manufacturing sector rises until middle age and then levels off, while the age-wage profile of the non-manufacturing sector tends to decline after middle age. The results suggest that incentives for long-term contracts with workers differ between manufacturing and non-manufacturing companies. In the manufacturing sector, firms are highly motivated to commit to long-term contracts for workers to remain with the firm, while in the non-manufacturing sector, such motivation tends to be low.

4.7 Conclusion

In this study, we examine the effect of the age structure of employees on labor productivity and wages in Japan based on a panel dataset of listed companies covering the period 2004–2016. We compare the age-productivity profiles and age-wage profiles at the company level to investigate whether older workers are rewarded according to their productivity.

The results are summarized as follows. First, the age-productivity profile is shown to be basically flat, and the age-wage profile is shown to be increasing up to middle age and flat thereafter. This means that relative to the middle-aged reference group, older people's wages are consistent with their productivity. There is no evidence that older people are overpaid. Second, we find that time-invariant firm characteristics, such as registration year, could partially explain the difference between the OLS and FE results. Third, we find that even in consolidated companies, the share of older people does not have a negative impact on a firm's productivity. There is no evidence that companies transfer older people with low productivity to branches. Finally, we find that the manufacturing sector's results are consistent with those of the overall sample. On the other hand, the age-productivity profile for the non-manufacturing sector is flat, and the age-wage profile declines after middle age. In the non-manufacturing sector, older workers are not less productive but have lower wages compared to the middle-aged

reference group, indicating their underpayment.

The aging of Japan's population has accelerated in recent years because of a decline in the fertility rate and an increase in average life expectancy. The number of births in Japan has fallen sharply after the coronavirus disease 2019, further exacerbating the aging of the population. Moreover, the aging of the labor force has progressed significantly. However, we find that the relative productivity of older workers is not lower than that of prime-age workers. The fact that the employment of older workers does not adversely affect firms' productivity can support the implementation of government measures to promote the employment of older workers in production. However, to arrive at this conclusion, we need to clarify two points in the future. First, many workers in Japan work part-time or on fixed-term contracts after the mandatory retirement age of 60. Although we conducted our analysis using the ratio of temporary employees combined with other age groups to consider the increase in non-regular employment among older workers, future studies need to explicitly analyze the impact on productivity using data showing the ratio of non-regular employees aged 60 and above. Second, a German study has shown that several specific human resource measures for old employees affect their relative productivity (Göbel and Zwick, 2013). Therefore, we need to clarify why relative productivity does not decline with age in Japan and how firms are reacting in this regard.

Notes

1 As temporary workers are not included in the number of employees according to the definition in the Annual Securities Report, we calculate the share of temporary workers based on the following formula: $\text{share of temporary workers} = \frac{\text{temporary workers}}{\text{employees number} + \text{workers}}$.

2 OLS and GMM estimates include sector dummies and year dummies. FE estimates only include year dummies.

3 The results of the GMM estimation presented in the table pass the statistical tests of under-identification, weak-identification, and over-identification. Unfortunately, the GMM analysis of the profit and wage equations does not pass all tests. However, the FE estimates for sales are similar to the GMM estimates. Both FE results in column 2 and GMM results in column 3 of Table 4.2 show that a relative increase in the share of older workers does not have a negative impact on firms' sales. Therefore, the FE results are robust.

4 The average wage data of companies with consolidated financial statements are of doubtful reliability because the securities reports, on which CSR data are based, are not required to submit materials for calculating accurate labor costs in the case of consolidated financial statements.

5 Unfortunately, however, the analysis of the sub-sample hardly passes all the above tests of the GMM; hence, the analysis of FE is applied in the manufacturing and non-manufacturing sub-samples.

6 Using values with a one-period lag as the regression variable would have resulted in the loss of some samples; hence, the final sample of 3196 is used for the robustness analysis.

7 In the results of first subsection of the Results section, the total sample of 4527 includes 2891 manufacturing samples and 1636 non-manufacturing samples. However, in the robustness checks, the 3196 samples include 1997 manufacturing samples and 1199 non-manufacturing samples.

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Table 4. 1 Descriptive Statistics of the Sample

	All firms		Manufacturing		Non-manufacturing	
	Mean	Std.dev	Mean	Std.dev	Mean	Std.dev
<i>Outcomes</i>						
Sales	116.8	203.5	76.51	55.53	188.0	318.1
Insales	4.266	0.882	4.157	0.593	4.458	1.214
Profit	20.24	22.62	17.29	16.74	25.45	29.65
Inprofit	2.639	0.879	2.550	0.785	2.796	1.005
Wage	6.489	1.55	6.535	1.193	6.409	2.031
Inwage	1.843	0.231	1.860	0.189	1.814	0.288
<i>Firm characteristics</i>						
Size	3,120	6,128	3,728	7,003	2,047	3,932
Insize	7.031	1.465	7.319	1.341	6.523	1.535
Fixedassets	99.01	331.6	59.58	99.04	168.7	528.6
Infixedassets	3.698	1.148	3.710	0.789	3.678	1.595
Tenure	14.90	4.403	16.31	3.135	12.41	5.157
Proportionoffemale	0.186	0.119	0.155	0.0915	0.242	0.139
Proportionoftemporary	0.150	0.186	0.116	0.119	0.211	0.255
ProportionofAgedunder30	0.206	0.0959	0.192	0.0709	0.231	0.125
ProportionofAged3039	0.297	0.0822	0.280	0.0659	0.326	0.0985
ProportionofAged4049	0.291	0.0823	0.302	0.0713	0.271	0.0956
ProportionofAged5059	0.184	0.0791	0.202	0.0667	0.151	0.0883
ProportionofAgedover60	0.0223	0.0312	0.0233	0.0324	0.0205	0.0288
N	4527		2891		1636	

Notes: Sales, Profit, Wage, Fixedassets are per employee, in 1 million yen. Size in million people. Tenure in year.

Table 4. 2 The Effect of Age Structure on Productivity and Wages in All Industries
(Three-district Age Groups)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
<i>Dependent variables</i>	lnsales			lnprofit		lnwage	
<i>Methods</i>	OLS	FE	GMM	OLS	FE	OLS	FE
L.ProportionofAgedunder30	-0.663*** (0.150)	-0.088 (0.156)	-0.330 (0.481)	-1.391*** (0.158)	-0.422 (0.288)	-0.491*** (0.035)	-0.112** (0.049)
L.ProportionofAgedover50	-0.274* (0.159)	0.049 (0.207)	-0.870 (0.965)	-0.982*** (0.171)	-0.145 (0.277)	-0.286*** (0.051)	-0.027 (0.062)
L.Proportionoffemale	-0.264*** (0.095)	0.281 (0.311)	0.312 (0.265)	0.153 (0.104)	0.375 (0.445)	-0.113*** (0.024)	-0.215*** (0.072)
L.Proportionoftemporary	0.076 (0.068)	0.128 (0.079)	0.156** (0.068)	0.478*** (0.064)	0.104 (0.111)	-0.131*** (0.015)	-0.002 (0.029)
L.Insize	0.219*** (0.084)	0.834** (0.399)	-0.779*** (0.235)	0.022 (0.077)	0.622 (0.479)	0.081*** (0.014)	0.082* (0.049)
L.(lnsize)^2	-1.145** (0.556)	-8.171*** (2.809)	1.356 (1.810)	-0.163 (0.522)	-7.896** (3.420)	-0.261*** (0.090)	-0.797** (0.366)
L.Infixedassets	0.626*** (0.176)	-0.373 (0.293)	-0.037 (0.257)	1.421*** (0.200)	-0.291 (0.404)	-0.175*** (0.051)	-0.059 (0.061)
L.(lnfixedassets)^2	-0.593 (0.503)	1.054 (0.828)	0.247 (0.720)	-2.867*** (0.564)	0.724 (1.131)	0.775*** (0.142)	0.217 (0.175)
L.Tenure	0.006 (0.015)	0.074*** (0.023)	0.043 (0.047)	-0.085*** (0.015)	0.032 (0.031)	0.008** (0.003)	0.003 (0.006)
L.(Tenure)^2	-0.000 (0.000)	-0.003*** (0.001)	-0.001 (0.001)	0.002*** (0.001)	-0.002* (0.001)	-0.000 (0.000)	0.000 (0.000)
Constant	8.255*** (1.417)	19.142*** (3.015)	-0.102** (0.044)	2.597 (1.701)	19.049*** (4.122)	15.978*** (0.435)	15.925*** (0.562)
Year dummy	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry dummy	Yes	-	Yes	Yes	-	Yes	-
Observations	4,527	4,527	3,542	4,527	4,527	4,527	4,527
R-squared	0.657	0.182	0.317	0.547	0.125	0.641	0.242
Number of firm		859			859		859
Underidentification test	-	-	48.891***	-	-	-	-
Weak identification test	-	-	25.289	-	-	-	-
Hansen J statistic	-	-	0.662	-	-	-	-

Notes: Robust standard errors in parentheses.

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

Reference categories: aged 30-49, male employees, regular employees.

OLS and GMM estimates include sector and year dummies. The FE estimates include only year dummies.

OLS, Fixed effects: explanatory variables are lagged 1 year.

GMM: explanatory variables are first-differenced variables instrumented with their lagged levels.

Table 4. 3 The Effect of Age Structure on Productivity and Wages in All Industries
(Four-district Age Groups)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
<i>Dependent variables</i>	lnsales			lnprofit		lnwage	
<i>Methods</i>	OLS	FE	GMM	OLS	FE	OLS	FE
L.ProportionofAgedunder30	-0.648*** (0.151)	-0.094 (0.156)	-0.230 (0.510)	-1.404*** (0.159)	-0.442 (0.288)	-0.497*** (0.036)	-0.112** (0.049)
L.ProportionofAged5059	-0.181 (0.183)	-0.008 (0.211)	-1.085 (0.959)	-1.065*** (0.192)	-0.329 (0.274)	-0.325*** (0.056)	-0.026 (0.062)
L.ProportionofAgedover60	-0.529* (0.301)	0.417 (0.403)	-1.507 (1.873)	-0.755** (0.333)	1.029* (0.598)	-0.177** (0.090)	-0.032 (0.128)
L.Proportionoffemale	-0.264*** (0.095)	0.278 (0.309)	0.378 (0.260)	0.153 (0.104)	0.366 (0.441)	-0.113*** (0.024)	-0.215*** (0.072)
L.Proportionoftemporary	0.067 (0.070)	0.133* (0.080)	0.147** (0.070)	0.486*** (0.066)	0.120 (0.112)	-0.128*** (0.015)	-0.002 (0.029)
L.Insize	0.218*** (0.084)	0.840** (0.399)	-0.734*** (0.230)	0.023 (0.077)	0.639 (0.475)	0.081*** (0.014)	0.082* (0.049)
L.(lnsize)^2	-1.146** (0.556)	-8.222*** (2.812)	1.016 (1.773)	-0.162 (0.522)	-8.060** (3.399)	-0.261*** (0.090)	-0.796** (0.366)
L.Infixedassets	0.621*** (0.175)	-0.378 (0.291)	-0.043 (0.254)	1.426*** (0.201)	-0.309 (0.402)	-0.173*** (0.050)	-0.059 (0.061)
L.(lnfixedassets)^2	-0.578 (0.502)	1.069 (0.823)	0.260 (0.709)	-2.880*** (0.564)	0.771 (1.130)	0.769*** (0.142)	0.217 (0.175)
L.Tenure	0.007 (0.015)	0.074*** (0.023)	0.045 (0.047)	-0.086*** (0.015)	0.031 (0.031)	0.008** (0.004)	0.003 (0.006)
L.(Tenure)^2	-0.000 (0.000)	-0.002*** (0.001)	-0.001 (0.001)	0.002*** (0.001)	-0.001 (0.001)	-0.000 (0.000)	0.000 (0.000)
Constant	8.282*** (1.415)	19.180*** (2.994)	-0.101** (0.046)	2.573 (1.702)	19.168*** (4.082)	15.967*** (0.435)	15.925*** (0.562)
Year dummy	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry dummy	Yes	-	Yes	Yes	-	Yes	-
Observations	4,527	4,527	3,542	4,527	4,527	4,527	4,527
R-squared	0.657	0.183	0.308	0.547	0.128	0.641	0.242
Number of firm		859			859		859
Underidentification test	-	-	83.384***	-	-	-	-
Weak identification test	-	-	24.833	-	-	-	-
Hansen J statistic	-	-	1.251	-	-	-	-

Notes: Robust standard errors in parentheses.

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

Reference categories: aged 30-49, male employees, regular employees.

OLS and GMM estimates include sector and year dummies. The FE estimates include only year dummies.

OLS, Fixed effects: explanatory variables are lagged 1 year.

GMM: explanatory variables are first-differenced variables instrumented with their lagged levels.

Table 4. 4 The OLS Regression Results after Controlling for Different Variables

	(1)	(2)	(3)	(4)
	Insales	Insales Registered year control	Inprofit	Inprofit Registered year control
L.ProportionofAgedunder30	-0.663*** (0.150)	-0.432*** (0.150)	-1.391*** (0.158)	-1.154*** (0.173)
L.ProportionofAgedover50	-0.274* (0.159)	-0.131 (0.159)	-0.982*** (0.171)	-0.794*** (0.181)
L.Proportionoffemale	-0.264*** (0.095)	-0.470*** (0.098)	0.153 (0.104)	0.245** (0.109)
L.Proportionoftemporary	0.076 (0.068)	0.092 (0.074)	0.478*** (0.064)	0.507*** (0.069)
L.Insize	0.219*** (0.084)	0.235*** (0.082)	0.022 (0.077)	0.056 (0.078)
L.(Insize)^2	-1.145** (0.556)	-1.252** (0.547)	-0.163 (0.522)	-0.405 (0.532)
L.Infixedassets	0.462*** (0.038)	0.478*** (0.042)	0.629*** (0.046)	0.656*** (0.049)
L.(Infixedassets)^2	-0.593 (0.503)	-0.749 (0.543)	-2.867*** (0.564)	-3.295*** (0.593)
L.Tenure	0.006 (0.015)	0.048*** (0.016)	-0.085*** (0.015)	-0.015 (0.017)
L.(Tenure)^2	-0.000 (0.000)	-0.002*** (0.000)	0.002*** (0.001)	0.000 (0.001)
Constant	1.959*** (0.326)	2.009*** (0.408)	2.947*** (0.343)	2.239*** (0.410)
Year dummy	Yes	Yes	Yes	Yes
Industry dummy	Yes	Yes	Yes	Yes
Registered year		Yes		Yes
Observations	4,527	4,527	4,527	4,527
R-squared	0.657	0.714	0.547	0.611

Notes: Robust standard errors in parentheses.

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

Table 4. 5 The Effect of Age Structure on Productivity and Wages in Consolidated Companies

	(1)	(2)
	Insales FE	Inprofit FE
L.ProportionofAgedunder30	0.057 (0.250)	0.165 (0.477)
L.ProportionofAgedover50	-0.137 (0.350)	0.107 (0.675)
L.Proportionoffemale	-0.472 (0.447)	-1.476** (0.675)
L.Proportionoftemporary	0.290* (0.174)	0.099 (0.184)
L.Insize	-0.261 (0.371)	0.195 (0.746)
L.(Insize)^2	0.649 (2.868)	-5.886 (6.439)
L.Infixedassets	0.362 (0.323)	0.940** (0.444)
L.(Infixedassets)^2	-0.929 (0.947)	-2.679** (1.210)
L.Tenure	-0.028 (0.033)	-0.097* (0.051)
L.(Tenure)^2	0.000 (0.001)	0.002 (0.002)
Constant	16.117*** (3.007)	10.714*** (4.056)
Year dummy	Yes	Yes
Observations	882	882
R-squared	0.256	0.158
Number of firm	228	228

Notes: Robust standard errors in parentheses.

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

Table 4. 6 The Results of Manufacturing and Non-manufacturing Companies

	(1)	(2)	(3)	(4)	(5)	(6)
	Manufacturing			Non-manufacturing		
	Insales FE	Inprofit FE	Inwage FE	Insales FE	Inprofit FE	Inwage FE
L.ProportionofAgedunder30	-0.033 (0.220)	-0.619 (0.489)	-0.119* (0.063)	-0.036 (0.228)	-0.273 (0.325)	-0.102 (0.074)
L.ProportionofAgedover50	-0.272 (0.222)	-0.014 (0.336)	0.088 (0.074)	0.841** (0.379)	-0.068 (0.517)	-0.248** (0.099)
L.Proportionoffemale	-0.224 (0.462)	-0.229 (0.609)	-0.205* (0.124)	0.647 (0.408)	1.004 (0.659)	-0.210** (0.087)
L.Proportionoftemporary	0.110 (0.103)	-0.030 (0.189)	0.029 (0.040)	0.113 (0.127)	0.218* (0.123)	-0.033 (0.037)
L.Insize	0.840 (0.557)	-0.261 (0.406)	0.053 (0.069)	0.982* (0.529)	1.063 (0.739)	0.088 (0.075)
L.(Insize)^2	-7.833** (3.833)	-2.464 (2.709)	-0.513 (0.484)	-9.717** (3.977)	-10.549* (5.489)	-0.836 (0.610)
L.Infixedassets	-1.674** (0.785)	-0.025 (1.361)	-0.185 (0.126)	-0.177 (0.255)	-0.179 (0.464)	-0.028 (0.069)
L.(Infixedassets)^2	4.605** (2.250)	-0.321 (3.893)	0.598* (0.361)	0.615 (0.715)	0.598 (1.310)	0.124 (0.192)
L.Tenure	0.082* (0.044)	0.025 (0.062)	0.000 (0.009)	0.075*** (0.025)	0.089*** (0.033)	0.011 (0.009)
L.(Tenure)^2	-0.003** (0.001)	-0.001 (0.002)	0.000 (0.000)	-0.002*** (0.001)	-0.003** (0.001)	-0.000 (0.000)
Constant	30.808*** (6.414)	21.348* (11.607)	17.027*** (1.092)	16.570*** (3.247)	14.903*** (5.128)	15.577*** (0.663)
Year dummy	Yes	Yes	Yes	Yes	Yes	Yes
Observations	2,891	2,891	2,891	1,636	1,636	1,636
R-squared	0.224	0.173	0.334	0.174	0.094	0.144
Number of firm	503	503	503	356	356	356

Notes: Robust standard errors in parentheses.

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

Table 4. 7 Results of the Robustness Check

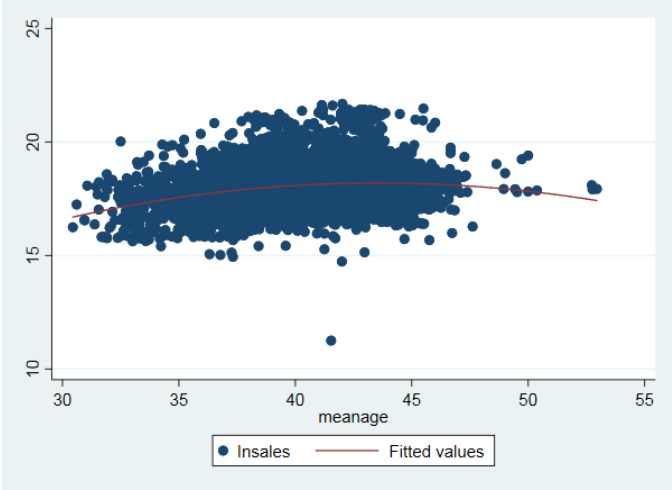
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	All firms			Manufacturing			Non-manufacturing		
	Insales FE	Inprofit FE	Inwage FE	Insales FE	Inprofit FE	Inwage FE	Insales FE	Inprofit FE	Inwage FE
L.ProportionofAgedunder30	0.022 (0.204)	-0.527 (0.412)	-0.157** (0.063)	-0.051 (0.296)	-0.856 (0.706)	-0.162** (0.069)	0.174 (0.310)	-0.196 (0.433)	-0.154 (0.099)
L.ProportionofAgedover50	-0.044 (0.242)	-0.424 (0.324)	-0.145** (0.063)	-0.428 (0.288)	-0.344 (0.373)	-0.046 (0.066)	0.509 (0.344)	-0.520 (0.599)	-0.306** (0.124)
L.Proportionoffemale	0.234 (0.327)	0.376 (0.512)	-0.246*** (0.074)	-0.031 (0.515)	0.302 (0.622)	-0.282** (0.117)	0.433 (0.394)	0.584 (0.796)	-0.185* (0.094)
L.Proportionoftemporary	0.269** (0.114)	0.243* (0.146)	0.022 (0.026)	0.129 (0.141)	0.037 (0.233)	0.021 (0.038)	0.382* (0.204)	0.496** (0.226)	0.033 (0.043)
L.Insize	1.151** (0.474)	0.990 (0.620)	0.096* (0.057)	1.054* (0.614)	0.035 (0.405)	0.029 (0.076)	1.129* (0.646)	1.446 (0.921)	0.120 (0.076)
L.(Insize)^2	-10.214*** (3.375)	-10.623** (4.463)	-0.991** (0.428)	-9.600** (4.296)	-4.635 (3.011)	-0.530 (0.533)	-9.607** (4.746)	-13.114* (6.728)	-0.983 (0.630)
L.Infixedassets	-0.730** (0.293)	-0.819* (0.474)	-0.114 (0.070)	-1.991** (0.819)	-0.392 (1.359)	-0.086 (0.133)	-0.354 (0.247)	-0.775 (0.505)	-0.111 (0.078)
L.(Infixedassets)^2	1.944** (0.831)	2.124 (1.346)	0.345* (0.199)	5.434** (2.354)	0.632 (3.863)	0.278 (0.387)	0.950 (0.713)	2.157 (1.484)	0.340 (0.217)
L.Tenure	0.087*** (0.024)	0.031 (0.036)	-0.001 (0.007)	0.096* (0.053)	-0.006 (0.078)	0.001 (0.011)	0.083*** (0.028)	0.095** (0.039)	0.004 (0.009)
L.(Tenure)^2	-0.003*** (0.001)	-0.002 (0.001)	0.000 (0.000)	-0.003** (0.001)	-0.001 (0.002)	0.000 (0.000)	-0.003*** (0.001)	-0.003** (0.001)	0.000 (0.000)
Year dummy	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Constant	21.368*** (2.585)	22.810*** (4.297)	16.550*** (0.610)	33.100*** (6.654)	24.099** (11.713)	16.515*** (1.118)	17.607*** (2.463)	19.240*** (4.668)	16.284*** (0.692)
Observations	3,196	3,196	3,196	1,997	1,997	1,997	1,199	1,199	1,199
R-squared	0.220	0.137	0.256	0.245	0.189	0.373	0.224	0.108	0.132
Number of firm	723	723	723	423	423	423	300	300	300

Notes: Robust standard errors in parentheses.

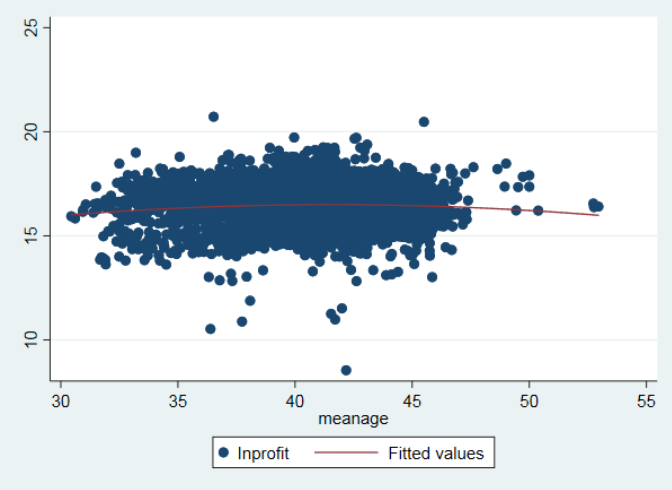
*** p<0.01, ** p<0.05, * p<0.1.

Figure 4. 1 Dot Plot of Average Age, Productivity, and Wage Costs of Firms

A. Logarithm of Firm Sales



B. Logarithm of Firm Profit



C. Logarithm of Firm Wage Costs

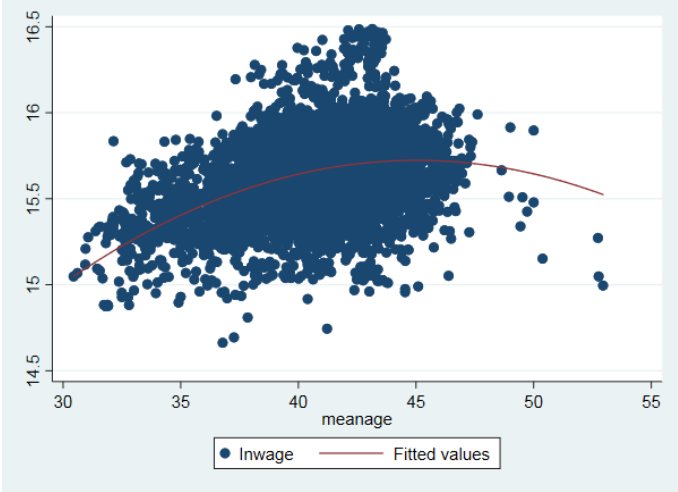
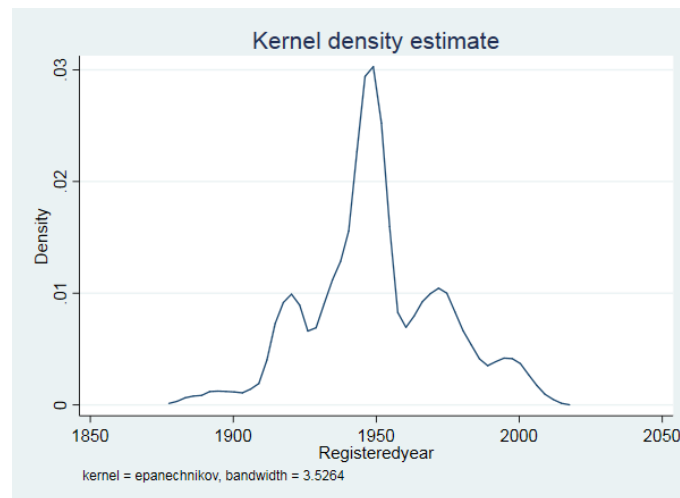


Figure 4. 2 Registered Year of the Firms



Chapter 5 Conclusion

The final chapter gives a brief review of the research in Chapters 2 to 4. It also summarizes the main findings of this doctoral dissertation and future research on these topics.

Chapter 2 examined labor supply responses to the increase in pension eligibility age and labor demand responses to changes in companies' discretion regarding continued employment. Since employment law revisions and social security revisions are inextricably linked, this study examined the combined effects of these revised laws. Specifically, using the Japan Household Panel Survey from 2008 to 2018, this study compared the unaffected cohort born between April 1949 and March 1953 with the revision-affected cohort born between April 1953 and January 1956 using a difference in differences model. The results showed that the revisions had almost no impact on the employment of older adults and their receipt of pensions. However, they did have significant positive effects on job transfers and retirement. Thus, although the revised law obligated companies to continue to employ older workers, it gave companies the option of placing older adults in affiliated companies, which encouraged older workers to retire.

Chapter 3 examined the effect of employment on the subjective well-being of older people, based on Japanese national survey data (Japanese General Social Surveys) from 2000 to 2012. To address the endogeneity problem of employment choice, this study estimated a probit ordinary least square (POLS) using the exogenous employment change due to the 2006 Elderly Employment Stabilization Law and pension revision as an instrumental variable (IV). While the POLS results showed that employment increases satisfaction with the household situation, the IV-POLS method showed that the effect disappears. Furthermore, the effect of employment on well-being depended on the type of employment (regular or non-regular), but the difference disappeared when household income was controlled. These results suggest that employment has

both positive and negative effects on subjective well-being, and the two cancel each other out.

In Chapter 4, using a panel data set of Japanese firms covering the period 2004-2016, we examined the effect of the age structure of employees on labor productivity and wages. The ordinary least squares results indicate a negative relationship between the employment share of older employees and labor productivity. However, the effects disappear after applying the fixed-effects model and generalized method of moments method. We further find that the share of older employees does not significantly affect firms' labor costs. Thus, there is no evidence of overpayment by older workers.

This thesis has some remaining issues to be addressed. In Chapter 2, since the 2013 revision of the Elderly Employment Stabilization Law was mainly targeted at men, the study analysed only the impact on men. However, as the aging population is expected to proceed rapidly in Japan in the future, it should be noted that promoting the employment of older female people is an important research and policy issue in order to secure the labour force. In Chapter 3, this study used cross-sectional data because of the limited availability of panel surveys on well-being conducted by the Japanese government. It would be desirable to use panel data for analyses in the future when they become available. In Chapter 4, this study found that the proportion of older employees in a company had no negative impact on productivity. In the future, however, it will be necessary to clarify why relative productivity does not decline with age in Japan and how companies are addressing this issue.