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**Abstract**

In advanced countries, including Japan, the number of workers with postgraduate degrees is increasing. These highly educated workers are important contributors to innovation. This paper, using published data from the Employment Status Survey, estimates standard wage functions to investigate the effects of postgraduate degree on productivity and the rate of return on postgraduate education. According to the analysis, wage premium for postgraduates relative to undergraduates is about 20% in Japan, which is comparable to the figures found in the United States and the United Kingdom. The premium is larger for female employees. Wage reduction after age 60 is smaller, and retirement age is higher for workers with postgraduate education. Considering the trend toward advanced technology and the growing demand for human capital, postgraduate education is becoming important to vitalize the Japanese economy. At the same time, expansion of postgraduate education may contribute to narrowing the wage gap between male and female workers and increasing labor force participation of elderly people.

*Keywords*: postgraduate education, wage premium, wage function

*JEL classifications*：I20, J31



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## 1. Introduction

In advanced countries, including Japan, the number of workers with postgraduate degrees is increasing rapidly. These highly educated workers are important contributors to innovation. However, the "highly educated working poor" is a group that is often reported by the mass media and is regarded as a social problem in Japan. Considering the trend toward a knowledge-based economy, the effect of investments in advanced education, especially postgraduate education, on human capital productivity is an important policy interest.

According to the School Basic Survey, conducted annually by the Ministry of Education, Culture, Sports, Science and Technology (MEXT), the numbers of new postgraduates with MA and Ph.D. degrees who obtained jobs in 2011 were about 54,000 and 10,000, respectively (see Table 1), an increase of more than 3% per annum during the last ten years. This growth rate is higher than the figure for undergraduates (0.9% per annum). A large number of postgraduates obtained jobs in manufacturing, information and communications, and medical service industries (see Table 2), which are characterized as industries of rapid technological progress. Professional and engineering jobs are the dominant occupations for postgraduates. However, a large number of people with Ph.D. degrees obtained jobs in the education services sector, indicating that these people are working as professors or teachers. According to the Employment Status Survey (Ministry of Internal Affairs and Communications), in 2007, the share of workers with postgraduate educations to the total number of workers was only 2.0%, but this share is higher for younger cohorts. For example, among workers aged 25 to 39, the share of postgraduate education to total workers is 3.3%, and the share of workers with education higher than a bachelor's degree exceeds 10% (see Table 3, column (5)).

Workers with postgraduate degrees are important contributors to innovation. According to the Inventor Survey, conducted by the Research Institute of Economy, Trade and Industry (RIETI), 28.6% of the important patents and 12.9% of the triadic patents (patents filed in Japan and the EPO and granted by the USPTO) are filed by Ph.D. holders (Nagaoka and Tsukada, 2007; Nagaoka, 2010). Although these figures are lower than the comparable figures in the U.S. and Europe, it should be noted that the number of Ph.D. holders in Japan is small. Jones (2009, 2010) noted that the educational burden on recent cohorts of

innovators has increased due to the increase in the stock of knowledge, and the age at first invention has been increasing over time. To produce significant innovations, a significant investment in higher education is required.

An estimation of the effect of postgraduate education is lacking because official labor statistics in Japan did not differentiate between undergraduates and postgraduates until very recently. However, this situation is gradually changing. The Basic Survey on Wage Structure (Ministry of Health, Labour and Welfare), which examines starting salaries, made a distinction between postgraduate and undergraduate education in its 2005 Survey. According to the 2011 results, the average starting wages of postgraduates are higher than the wages of undergraduates by 14% for male employees and 20% for female employees. The Employment Status Survey, used in this paper, introduced a questionnaire distinguishing postgraduates and undergraduates in its latest survey in 2007.

Based upon this background, this paper investigates the effects of postgraduate education on workers' productivity in Japan. Specifically, this paper estimates simple wage functions by using published statistical data of the 2007 Employment Status Survey and calculates the rate of return on the investment in postgraduate education. The contribution of this paper is its focus on the effect of postgraduate education not only on the wages of working people, but also on labor participation and its calculation of the rate of return by incorporating both wages and labor participation rates.

The major results of the analysis can be summarized as follows.

(1) According to simple wage function estimations that use sex, age, education, and employment status as explanatory variables, the wage premium for postgraduate workers relative to undergraduate workers is approximately 20% in Japan, which is comparable to the figures found in the United States and the United Kingdom.

(2) Among employees, the postgraduate wage premium is larger for female employees than for male employees.

(3) The postgraduate wage premium is very large for male self-employed individuals.

(4) The wage reduction after age 60 is smaller and the retirement age is higher for workers with postgraduate educations. In other words, people with postgraduate educations earn higher wages and remain in the labor market longer.

(5) The private rate of return on the investment in postgraduate education is 10% or more.

The social rate of return, including the benefits from knowledge spillovers, may be much higher.

This paper is structured as follows. Section 2 briefly reviews the relevant studies on the postgraduate wage premium. Section 3 explains the method of analysis and the data used in this paper. Section 4 reports and interprets the results, and Section 5 concludes with policy implications.

## 2. Literature review

There have been numerous studies on the returns of education. In advanced countries, the average estimate of the gross rate of return of a year of additional education ranges between 5% and 10% (see survey articles such as Card (1999, 2001); Blundell et al. (1999); Meghir and Rivkin (2011)). In Japan, Kawaguchi (2011) conducted a comprehensive analysis of the wage structure and found that the rate of return for an additional education of a year for highly educated workers was approximately 10% when their tenure was relatively short, but the rates monotonically increased as the tenure increased. However, most previous studies have not distinguished between undergraduate and postgraduate education.

Studies on the effect of postgraduate education on wages have been very limited, but there are several exceptions in the U.S. and the UK. Jaeger and Page (1996), using the U.S. Current Population Survey (CPS) data, found that postgraduate degrees are valued by the labor market. Specifically, MA degree holders earn 5.5%-15.5% more and Ph.D. degree holders earn 8.3%-10.3% more than holders of bachelor's degrees. By sex, the wage premium of a postgraduate degree is larger for females than for males. Card's (1999) representative survey on the relationship between education and wages indicated that the wages of workers with MA and Ph.D. degrees were approximately 20% and 30% higher, respectively, than were those of workers with undergraduate educations. Deere and Vesovic (2006) used data from the U.S. Census and found that the hourly wage for workers with postgraduate educations was approximately 30% higher than the wage for workers with

college educations in 2000. Song et al. (2008) used the U.S. scientist and engineer statistics data system, collected by the NSF for 1993, and found that the sorting effect produced a substantial downward bias in estimated returns on graduate education. Furthermore, these authors found that correcting for the sorting effect raised estimated annualized returns on a master's or doctoral degree from approximately 5% to 7.3% and 12.8%, respectively.

In the UK, Walker and Zhu (2011) used data from the Labour Force Surveys to demonstrate that males (females) with MA degrees earned 12% (17%) more than those with undergraduate degrees and that males (females) with Ph.D. degrees earned 4% (7%) more than those with MA degrees. It is interesting to note that the postgraduate wage premium is larger for females than for males.

Lindley and Machin (2011) analyzed the change in the number of workers with postgraduate qualifications and their relative wages in the U.S. and the UK. They reported that in the U.S., the postgraduate/undergraduate wage differential rose from zero in 1963 to a gap of 0.28 log points by 2009, whereas in the UK, the postgraduate/undergraduate wage gap increased from 0.05 log points in 1996 to 0.12 log points in 2009. These authors argued that postgraduates and undergraduate workers were imperfect substitutes in production and that the principal beneficiaries of technological change (the computer revolution) have been skilled workers with postgraduate qualifications, not all graduates.

In Japan, to the best of our knowledge, the postgraduate wage premium has not been studied empirically. An exception is Shimizu and Higuchi's (2008) study, which analyzed MBA qualifications and wages using an original survey of MBA holders in Japan. According to their analysis, MBA acquisition in foreign countries increased wages more than 50%, but MBA acquisition in Japanese universities did not have a significant effect on wages.

To summarize, in the U.S. and the UK, significant effects on wages due to postgraduate education have been identified, and these effects have increased over time. These recent studies suggest that it is important to distinguish between undergraduate and postgraduate education in empirical analyses of the relationship between education and labor market outcomes.

## 3. Data and Methodology

As described in the introduction, the Employment Status Survey (Ministry of Internal Affairs and Communications) introduced a revised questionnaire that distinguished postgraduates from undergraduates in the 2007 survey. The aim of the Employment Status Survey is to obtain basic data on the actual conditions of the employment structure at both national and regional levels by surveying the labor force in Japan. The survey was conducted every three years from 1956 to 1982 and every five years since 1982. The 2007 survey was conducted on October 1, 2007 among household members 15 years or older, including approximately 450,000 households and one million people. Survey items included sex, age, education, employment status, type of employment, industry, occupation, days worked per year, regularity of work, working hours per week, and annual income earned in workers' main jobs. Employee income is defined as the gross earnings, inclusive of tax, gained during the previous year from wages, salaries, various allowances, and bonuses. The income of self-employed workers is defined as revenue gained during the previous year from business, namely gross sales less necessary associated expenses. Income from financial assets and earnings from side jobs are not included in the annual income for the survey. In this paper, "annual income" and "wages" are used interchangeably.

Most of the survey items are categorical variables. For example, age groups are categorized in 5-year intervals: 15-19, 20-24, 25-29...75-79, 80-84, and 85 or older. Educational attainment is grouped into 6 classes: 1) primary school or junior high school, 2) senior high school, 3) vocational school, 4) junior college, 5) college or university, and 6) graduate school. Unfortunately, MA degrees and doctoral degrees are not treated separately. Annual income is categorized into 15 classes: 1) less than 500,000 yen, 2) 500,000 to 990,000 yen, 3) 1 to 1.49 million yen, 4) 1.5 to 1.99 million yen, 5) 2 to 2.49 million yen ... 13) 9 to 9.99 million yen, 14) 10 to 14.99 million yen, and 15) 15 million yen or more.

In this paper, we use the cell-level data taken from the published tables of the 2007 survey on the number of people engaged in work by age, employment status, type of employment, annual income, sex, and education. The central values of the annual income classes are

converted to logarithmic form and used in the analysis.[1]

Using this data set, first, we observe the unadjusted wages of postgraduate workers by sex and employment types (all workers, regular employees, and self-employed).[2] Then, we estimate standard wage functions to explain the log annual income. Because we can use only published cell-level data, the available explanatory variables are limited. Specifically, in addition to education dummies, sex, age, and type of employment are used as explanatory variables. In the Employment Status Survey, "regular employees" are defined as "persons who are called 'regular employees' at their workplace." Education and age groups are used as dummy variables. Technically, educational attainment can be converted into years of education, and age can be converted into a continuous variable by using the central value of the age classes. However, in Japan, Kawaguchi's (2011) comprehensive study of the Japanese wage structure noted that educational attainment should be included as discrete dummy variables rather than a single index of the years of education. Furthermore, that study suggested that the discontinuity in the wage profile at age 60 due to mandatory retirement should be considered when choosing model specifications.

Because the focus of this study is the differences between workers with postgraduate and undergraduate educations, undergraduate education is used as the reference group. As a result, the estimated coefficient for the postgraduate education dummy is the postgraduate wage premium relative to the undergraduate wage. For the age classes, ages 20-24 to ages 80-84 are used in the analysis, and the 20-24 age group is used as the reference group. Regarding sex and employment type, male employees and regular employees are used as the reference groups. Specifically, a dummy for female employees and dummies for non-regular employees and self-employed workers are used in the regressions. A weighted least square (WLS) estimation is employed in which the number of workers in each cell — 15 income classes * sex * 13 age classes * 6 education categories * 3 employment types — is used as the

[1] "Less than 500,000 yen" and "15 million yen or more" are treated as 500,000 yen and 15 million yen, respectively. Because the share of "15 million yen or more" is relatively large among postgraduate workers, the estimated postgraduate wage premium may understate the true premium.

[2] Non-regular employees include part-time workers, temporary workers, temporary agency workers, and contract employees. Persons engaged in work include the "executive of company or corporation" and "family workers." However, we do not include these types of workers in this study because the annual income of these groups by sex, age, and education are not published.

weight. To summarize, the baseline equation to be estimated is expressed below (equation (1)). The average figures of the variables by workers with undergraduate and postgraduate educations are shown in Table 4.

$$\ln(w) = ß_0 + ß_1 \text{ female dummy} + ß_2 \text{ age dummies} + ß_3 \text{ education dummies} + ß_4 \text{ employment type dummies} + \varepsilon \quad (1)$$

Next, we observe the labor participation rates of people with postgraduate educations by sex and age classes in comparison with people with only an undergraduate education. Then, we calculate the discounted present value of lifetime earnings and the rate of return on investment in postgraduate education by considering both the wages and the labor participation rates by sex and age groups.

## 4. Observations and empirical results

According to the published statistics of the Employment Status Survey in 2007, the average annual income was 5,238,000 yen and 6,777,000 yen for workers with undergraduate and postgraduate educations, respectively. Focusing only on regular employees, the figures are 5,726,000 yen and 7,119,000 yen for undergraduate and postgraduate educations, respectively, indicating that the average wage level of postgraduate workers was 24.3% higher than the wage level of undergraduate workers. By sex, the wage levels of postgraduate male and female workers were 21.9% and 36.6% higher than the corresponding wages for workers with an undergraduate education (see Table 5). When the sample is limited to only regular employees, the figures are 18.9% for male employees and 36.4% for female employees, indicating that the postgraduate wage premium is still larger for female employees.

Table 6 presents the estimation results of the wage functions. The baseline result shows that the postgraduate wage premium is 18.2% (log points), on average (column (1) of Table 6). Column (2) of the table shows the interaction term of postgraduate education with the

female dummy added as a right-side variable. The coefficient for the interaction term is positive and highly significant, indicating a larger postgraduate wage premium for female workers. Columns (3) and (4) show the results of separate estimations for male and female employees. In this specification, the estimated postgraduate wage premium is 21.5% for male employees and 23.2% for female employees. These figures are larger than those in column (1), and the male-female differential is smaller than in column (2). The major reason for these differences is that the effects of age on wages differ significantly by sex. That is, the average age-wage profile for male and female workers is different in Japan because a large number of females work part time and are often not within the seniority wage system. However, the wage differential between male and female workers is smaller for those with postgraduate educations than for those with undergraduate educations. This fact suggests that the increase in the number of female postgraduates with specialized skills may contribute to narrowing the wage gap between male and female workers.

Table 7 shows the postgraduate wage premium estimated by type of employment. The wage premium is very large for male self-employed workers. There are various types of self-employment, from owners of traditional small shops to highly qualified specialists, such as physicians and lawyers or entrepreneurs of innovative firms. Self-employment with a postgraduate education seems to be quite different from self-employment among those with only an undergraduate education.

Next, we compare the age-wage profile of postgraduates and undergraduates based on the regression results presented above. Figure 1 and Figure 2 show the wage profiles of regular employees and male self-employed workers, respectively. When we examine the wage profile of regular employees, undergraduate-degree workers' wages drop abruptly just after age 60, which is a well-known phenomenon in the Japanese labor market. In contrast, interestingly, the drop in wages after age 60 among workers with postgraduate educations is very small. Despite the policy efforts to extend the compulsory retirement age, most Japanese firms have not extended the formal retirement age, but they re-employ elderly workers at significantly reduced wages. However, the productivity level of workers with postgraduate educations seems to be maintained, possibly because their high skills do not depreciate rapidly and they actively engage in specialized jobs. The wage profiles of male

self-employed workers also differ significantly between undergraduates and postgraduates. The wages of self-employed workers with undergraduate educations differ with age, increasing slowly during their 30s and 40s and gradually decreasing after their 50s. In contrast, the wages of self-employed workers with postgraduate qualifications increase rapidly until age 50, and the level continues to be far higher than the wage level for workers with only an undergraduate education. This difference is because a large number of self-employed workers with postgraduate educations are highly skilled.

It may be argued that the slow decline in wages of postgraduates after age 60 may be a result of the selection mechanism in which relatively low-wage workers tend to retire, leaving only high-wage earners in the labor market. To verify this possibility, Figure 3 shows the labor participation rates by age groups.[3] The labor participation rate of older people with postgraduate educations is more than 10 percentage points higher than the rate for both males and females with only undergraduate educations, and the average retirement age of people with postgraduate educations is relatively high.[4] In the case of individuals with MA degrees, the average time for entering the labor market is 2 years later than for the undergraduates, but the age of retirement is also more than 2 years later. Therefore, the lifetime working years are longer for postgraduate workers than for those with only undergraduate degrees. This fact suggests that the intellectual skills and knowledge of postgraduate workers depreciate slowly.[5]

Based on these observations and estimation results, we now calculate the rate of return on investment in postgraduate education. In calculating the discounted present value of lifetime income, some assumptions should be made. First, postgraduate education is assumed to be an MA course. This is a rather strong assumption, but the ratio of MA degrees to the total

[3] In calculating the labor participation rates by age groups, individuals attending school are included in the denominator.

[4] Shimizutani and Oshio (2010) indicate that in Japan, the likelihood of exiting the labor force is lower for highly educated older males, and educational attainment is not related to the work status of females. However, the data used in their study do not distinguish between postgraduate and undergraduate education.

[5] Another possibility is the better health status of highly educated people. The strong positive relationship between education and health is a stylized empirical regularity (see, for example, Eide and Showalter (2011) and Cutler and Lleras-Muney (2012)). In Japan, an analysis using the Japanese Study of Aging and Retirement (JSTAR), conducted by the Research Institute of Economy, Trade and Industry (RIETI), indicates a positive relationship between education and health among older people (Ichimura et al., 2009).

number of new postgraduates obtaining jobs has been approximately 84% in recent years (see Table 1). Second, we assume the discount rate to be 3% per year.

Additional lifetime earnings produced by postgraduate education depend both on income levels and labor participation rates throughout life. Therefore, we first calculate annual income multiplied by labor participation rates by age groups to obtain the discounted present value of the lifetime income. According to this calculation, the lifetime earnings of male workers with postgraduate educations are approximately 35 million yen (28.8%) higher than the lifetime earnings of workers with only undergraduate educations (see Table 8). This difference is 28 million yen (50.3%) for female workers. With the assumption that annual school expenses and living expenses are 3 million yen, the rate of return on investment in postgraduate education is approximately 12% for men and about 10% for women (see Table 8, column (3)). In this calculation, the opportunity cost is set as the average first two years of income earned by new undergraduate workers (2.78 million yen for men and 2.57 million yen for women). These figures are conservative because the assumption of 3 million yen for annual school and living expenses may be somewhat high.[6] If we assume these annual expenses to be 1.5 million yen, the estimated rate of return will be higher: 16% for men and 13% for women (Table 8 (4)). These figures are the private rate of return on investment. The social rate of return may be much higher because knowledge and innovations generated by high-level human capital have positive spillover effects.[7]

Several reservations should be noted in the analysis of this paper. First, we do not use individual-level micro data, and we rely on cell-based published statistics from the Employment Status Survey. As a result, we have limited control over individual workers' characteristics. However, because the sample size is large, we believe that the estimated postgraduate wage premium using micro data does not differ significantly. Second, because the income data from the survey is multiple-choice style and the share of "15 million yen or

[6] In Japan, the annual cost of a private university for postgraduate education (science and engineering courses) is approximately 1.2 to 1.8 million yen in the first year and approximately 0.9 to 1.5 million yen in the second year. In the case of national universities, the figures are approximately 0.8 million yen in the first year and approximately 0.5 million yen in the second year.

[7] See, for example, Moretti (2004) and Falck et al. (2011). In contrast, government support for postgraduate education decreases the social rate of return relative to private returns.

more" is relatively large among postgraduate workers, the postgraduate wage premium in this study may be underestimated. However, the possibility of underestimation strengthens the results of this paper because the wage premium and the rate of return on postgraduate education are statistically and economically significant. Third, because the analysis in this paper uses cross-sectional data for the single year of 2007, the existence of a postgraduate wage premium does not necessarily imply a causal relationship. The observed wage premium may result from 1) the effects of postgraduate education on upgraded human capital, 2) the signal effect, and 3) the selection effect. The analysis in this paper does not disentangle these competing explanations. Fourth, although the 2007 Employment Status Survey is innovative in distinguishing between postgraduate and undergraduate educational attainment, the differences between MA and Ph.D. degrees remains unclear. Finally, as indicated by Cameiro and Lee (2011) in the U.S., due to the increase in the ratio of students who continue to universities, the quality of average undergraduate students may be declining. As a result, the estimated postgraduate wage premium may reflect the relative decline in the quality of workers with only an undergraduate education.

## 5. Conclusion

Using published data from the Employment Status Survey in 2007, this paper estimates standard wage functions to investigate the effects of postgraduate qualifications on wages and calculates the rate of return on postgraduate education.

The major results of the analysis can be summarized as follows.

(1) According to the WLS regressions, in which sex, age, education, and employment status are used as explanatory variables, the wage premium for workers with postgraduate degrees relative to those with undergraduate degrees is approximately 20% in Japan, which is comparable to the figures found in the U.S. and the UK.

(2) The postgraduate wage premium is larger for female employees than for male employees.

(3) The postgraduate wage premium is very large for male self-employed workers.

(4) Wage reduction after age 60 is smaller and retirement age is higher for workers with a

postgraduate education. In other words, people with postgraduate educations earn higher wages and remain in the labor market longer.

(5) The private rate of return on investment in postgraduate education is 10% or more. The social rate of return, including benefits from knowledge spillovers, may be much higher.

Policy implications based on the analysis in this paper are as follows.

(1) Given the trend toward advanced technology and the growing demand for high-level human capital, postgraduate educations are important to revitalize the Japanese economy.

(2) The expansion of postgraduate education may contribute to narrowing the wage gap between male and female workers and increasing the labor force participation of elderly people in the long run.

(3) When analyzing the economic effects of education and comparing wage levels among firms or institutions, it is desirable to distinguish between undergraduate and postgraduate education.

The future of the postgraduate wage premium depends on both the supply of postgraduates and the demand for high-skilled labor. Because the trend toward advanced technology is expected to continue, the postgraduate wage premium may increase further if the increase in the supply of postgraduate degrees does not catch up to the increase in demand for postgraduate workers.

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Table 1 The number of new postgraduates who obtained jobs in 2011

| | MA | Ph.D. |
|---|---|---|
| 2001 | 39,496 | 7,454 |
| 2002 | 43,137 | 7,697 |
| 2003 | 43,301 | 7,896 |
| 2004 | 45,217 | 8,531 |
| 2005 | 48,200 | 8,723 |
| 2006 | 50,618 | 9,149 |
| 2007 | 53,437 | 9,872 |
| 2008 | 55,264 | 10,239 |
| 2009 | 55,024 | 10,537 |
| 2010 | 52,052 | 9,772 |
| 2011 | 54,004 | 10,150 |
| Annual Growth | 3.2% | 3.1% |

(Source) The School Basic Survey (Ministry of Education, Culture, Sports, Science and Technology (MEXT)).

Table 2 The number of new postgraduates by industry

| | MA | Ph.D. |
|---|---|---|
| Total | 54,186 | 10,160 |
| Agriculture & Forestry | 181 | 21 |
| Fishery | 16 | 3 |
| Mining | 100 | 3 |
| Construction | 2,257 | 87 |
| Manufacturing | 22,710 | 1,392 |
| Electricity, Gas & Water Supply | 1,144 | 30 |
| Information & Communication | 5,408 | 246 |
| Transportation | 1,026 | 18 |
| Wholesale & Retail | 1,687 | 65 |
| Finance & Insurance | 987 | 44 |
| Real Estate | 250 | 15 |
| Professional & Techinical Services | 3,317 | 1,211 |
| Accomodations & Restaurants | 161 | 3 |
| Personal Services & Amusement Services | 272 | 4 |
| Education | 5,026 | 3,657 |
| Health Care & Welfare | 3,680 | 2,674 |
| Compound Services | 261 | 16 |
| Services N.E.C. | 1,563 | 141 |
| Government | 3,125 | 319 |
| Industries Unable to Classify | 1,015 | 211 |

(Source) The School Basic Survey in 2011 (MEXT).

Table 3 The share of workers with postgraduate qualifications by age group

| Age Groups | (1) Engaged in Work (thousands) | (2) University Graduates | (3) Graduate School Graduates | (4) (3)/(1) | (5) (3)/[(2)+(3)] |
|---|---|---|---|---|---|
| 20-24 | 4003.9 | 890.4 | 21.8 | 0.5% | 2.4% |
| 25-29 | 6196 | 2051.5 | 236.2 | 3.8% | 10.3% |
| 30-34 | 7221 | 1995.4 | 248.3 | 3.4% | 11.1% |
| 35-39 | 7379.1 | 1815.6 | 211.3 | 2.9% | 10.4% |
| 40-44 | 6711.4 | 1681.6 | 151.9 | 2.3% | 8.3% |
| 45-49 | 6442 | 1704.2 | 130 | 2.0% | 7.1% |
| 50-54 | 6495 | 1563.1 | 96.8 | 1.5% | 5.8% |
| 55-59 | 7735.7 | 1373.3 | 84.1 | 1.1% | 5.8% |
| 60-64 | 4761.6 | 713 | 51.2 | 1.1% | 6.7% |
| 65-69 | 2934.3 | 323.7 | 23.8 | 0.8% | 6.8% |
| 70-74 | 1675.9 | 165.5 | 10.7 | 0.6% | 6.1% |
| 75-79 | 861.8 | 79.9 | 5.5 | 0.6% | 6.4% |
| 80-84 | 364.2 | 31.6 | 1.2 | 0.3% | 3.7% |
| 85- | 129 | 9.5 | 0.3 | 0.2% | 3.1% |
| Total | 63374.5 | 14398.5 | 1273.1 | 2.0% | 8.1% |

(Source) The Employment Status Survey in 2007 (Ministry of Internal Affairs and Communications).

Table 4 Sample distribution by education

| | (1) All Workers | (2) Undergraduates | (3) Postgraduates |
|---|---|---|---|
| Log Income | 14.792 | 15.237 | 15.534 |
| Female | 0.408 | 0.253 | 0.152 |
| Junior highschool | 0.109 | | |
| Senior highschool | 0.425 | | |
| Vocational school | 0.121 | | |
| Junior college | 0.088 | | |
| University | 0.235 | | |
| Graduate school | 0.021 | | |
| 25-29 | 0.101 | 0.143 | 0.186 |
| 30-34 | 0.117 | 0.139 | 0.195 |
| 35-39 | 0.119 | 0.126 | 0.166 |
| 40-44 | 0.108 | 0.117 | 0.119 |
| 45-49 | 0.104 | 0.118 | 0.102 |
| 50-54 | 0.104 | 0.109 | 0.076 |
| 55-59 | 0.123 | 0.095 | 0.066 |
| 60-64 | 0.074 | 0.049 | 0.040 |
| 65-69 | 0.044 | 0.023 | 0.018 |
| 70-74 | 0.024 | 0.011 | 0.008 |
| 75-79 | 0.012 | 0.005 | 0.004 |
| 80-84 | 0.005 | 0.002 | 0.001 |
| Self-employed | 0.105 | 0.065 | 0.048 |
| Non-regular employee | 0.343 | 0.230 | 0.149 |

(Note) The figures are calculated from the Employment Status Survey in 2007.

Table 5 Postgraduate wage premium relative to workers with only undergraduate education

| | Male | Female | All |
|---|---|---|---|
| All workers | 21.9% | 36.6% | 29.4% |
| Regular employees | 18.9% | 36.4% | 24.3% |
| Self-employed | 53.8% | 31.1% | 55.7% |

(Note) The figures are calculated from the Employment Status Survey in 2007.

Table 6 Estimation results of the wage functions

| | (1) Male & Female | | (2) Male & Female | | (3) Male | | (4) Female | |
|---|---|---|---|---|---|---|---|---|
| | Coef. | | Coef. | | Coef. | | Coef. | |
| Female | −0.5952 | *** | −0.5971 | *** | | | | |
| | (−3414.60) | | (−3404.86) | | | | | |
| Junior hischool | −0.5272 | *** | −0.5270 | *** | −0.5130 | *** | −0.4955 | *** |
| | (−1741.57) | | (−1741.30) | | (−1452.64) | | (−923.86) | |
| Senior highschool | −0.3543 | *** | −0.3541 | *** | −0.3052 | *** | −0.3645 | *** |
| | (−1734.42) | | (−1733.17) | | (−1286.42) | | (−987.62) | |
| Vocational school | −0.2504 | *** | −0.2499 | *** | −0.2789 | *** | −0.2135 | *** |
| | (−897.35) | | (−895.53) | | (−766.46) | | (−497.75) | |
| Junior college | −0.2017 | *** | −0.2007 | *** | −0.1564 | *** | −0.2166 | *** |
| | (−629.96) | | (−626.71) | | (−266.50) | | (−515.48) | |
| Graduate school | 0.1816 | *** | 0.1595 | *** | 0.2151 | *** | 0.2319 | *** |
| | (324.15) | | (263.34) | | (361.50) | | (170.84) | |
| Graduate*Female | | | 0.1445 | *** | | | | |
| | | | (96.21) | | | | | |
| 25-29 | 0.1048 | *** | 0.1045 | *** | 0.1932 | *** | 0.1001 | *** |
| | (267.98) | | (267.24) | | (363.16) | | (185.16) | |
| 30-34 | 0.2126 | *** | 0.2122 | *** | 0.4144 | *** | 0.1140 | *** |
| | (559.12) | | (558.03) | | (809.90) | | (212.40) | |
| 35-39 | 0.3046 | *** | 0.3045 | *** | 0.5808 | *** | 0.1016 | *** |
| | (803.47) | | (803.22) | | (1137.79) | | (189.45) | |
| 40-44 | 0.3829 | *** | 0.3828 | *** | 0.7174 | *** | 0.1062 | *** |
| | (992.06) | | (991.81) | | (1373.94) | | (195.91) | |
| 45-49 | 0.4298 | *** | 0.4297 | *** | 0.7788 | *** | 0.1330 | *** |
| | (1103.17) | | (1102.85) | | (1473.47) | | (244.32) | |
| 50-54 | 0.4583 | *** | 0.4583 | *** | 0.8042 | *** | 0.1458 | *** |
| | (1174.39) | | (1174.5) | | (1525.66) | | (265.97) | |
| 55-59 | 0.4645 | *** | 0.4644 | *** | 0.7805 | *** | 0.1526 | *** |
| | (1218.88) | | (1218.81) | | (1529.74) | | (280.91) | |
| 60-64 | 0.2902 | *** | 0.2901 | *** | 0.4639 | *** | 0.0931 | *** |
| | (675.36) | | (675.16) | | (827.32) | | (146.05) | |
| 65-69 | 0.0877 | *** | 0.0876 | *** | 0.1951 | *** | −0.0150 | *** |
| | (176.34) | | (176.20) | | (308.25) | | (−19.53) | |
| 70-74 | 0.0455 | *** | 0.0455 | *** | 0.1207 | *** | 0.0492 | *** |
| | (74.56) | | (74.46) | | (160.48) | | (49.34) | |
| 75-79 | 0.0178 | *** | 0.0179 | *** | 0.0999 | *** | 0.0274 | *** |
| | (22.35) | | (22.39) | | (104.07) | | (20.29) | |
| 80-84 | 0.0094 | *** | 0.0094 | *** | 0.0466 | *** | 0.1249 | *** |
| | (8.12) | | (8.11) | | (33.72) | | (64.27) | |
| Self-employed | −0.7002 | *** | −0.7005 | *** | −0.5706 | *** | −0.9380 | *** |
| | (−2457.09) | | (−2458.17) | | (−1721.46) | | (−1822.65) | |
| Non-regular | −0.6412 | *** | −0.6411 | *** | −0.3952 | *** | −0.8226 | *** |
| | (−3469.41) | | (−3468.65) | | (−1508.10) | | (−3252.37) | |
| Adj R-squared | 0.4768 | | 0.4769 | | 0.3660 | | 0.3981 | |

(Notes) WLS estimates with t-values in parentheses. *** Significant at the 1% level. Male, university graduate, age 20-24, and regular employee are used as reference groups.

Table 7 Postgraduate wage premium by type of employment

| | (1) Male & female | | (2) Male | | (3) Female | |
|---|---|---|---|---|---|---|
| All workers | 0.182 | *** | 0.215 | *** | 0.232 | *** |
| | (324.15) | | (361.50) | | (170.84) | |
| Regular employees | 0.207 | *** | 0.224 | *** | 0.249 | *** |
| | (434.23) | | (478.34) | | (167.76) | |
| Self-employment | 0.445 | *** | 0.479 | *** | 0.232 | *** |
| | (126.86) | | (123.90) | | (28.91) | |

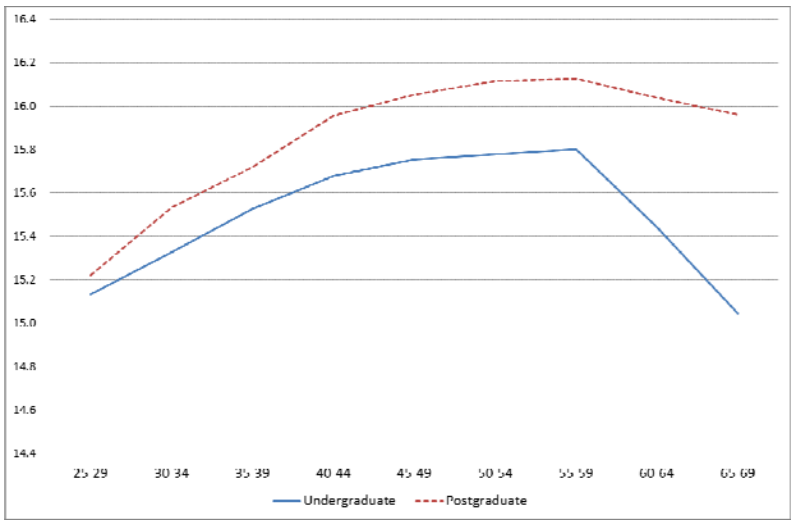
(Notes) WLS estimates with t-values in parentheses. *** Significant at the 1% level.

Table 8 Discounted present value of lifetime income and the rate of return on investment in postgraduate education (thousand yen, %)

| | Male | Female |
|---|---|---|
| (1) Undergraduates | 122,979 | 54,951 |
| (2) Postgraduates | 158,408 | 82,577 |
| (3) Difference [(2)-(1)] | 35,430 | 27,626 |
| (4) Rate of return (a) | 11.8% | 9.6% |
| (5) Rate of return (b) | 16.0% | 13.1% |

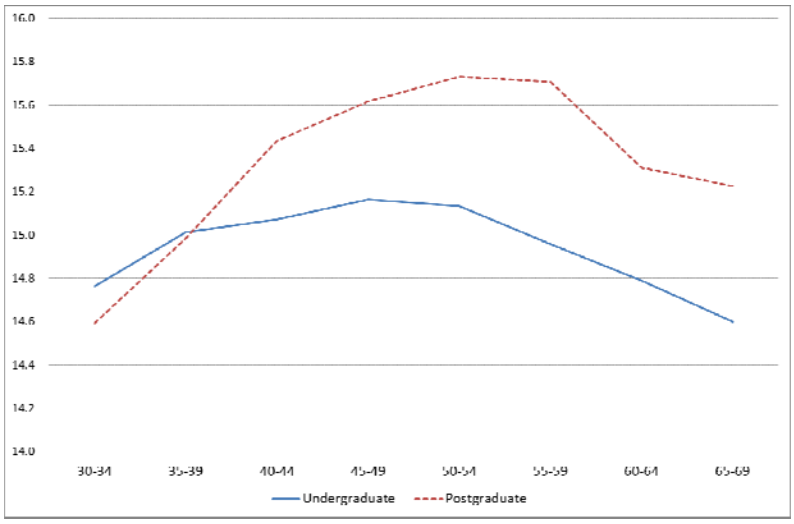
(Notes) The figures are estimated from the Employment Status Survey in 2007. Labor participation rates by sex and age classes are adjusted. Discount rate is assumed to be 3% per annum. The rate of return (a) and (b) assume annual school and living expenses to be 3 million yen and 1.5 million yen, respectively.

Figure 1 Age-wage profiles of regular employees



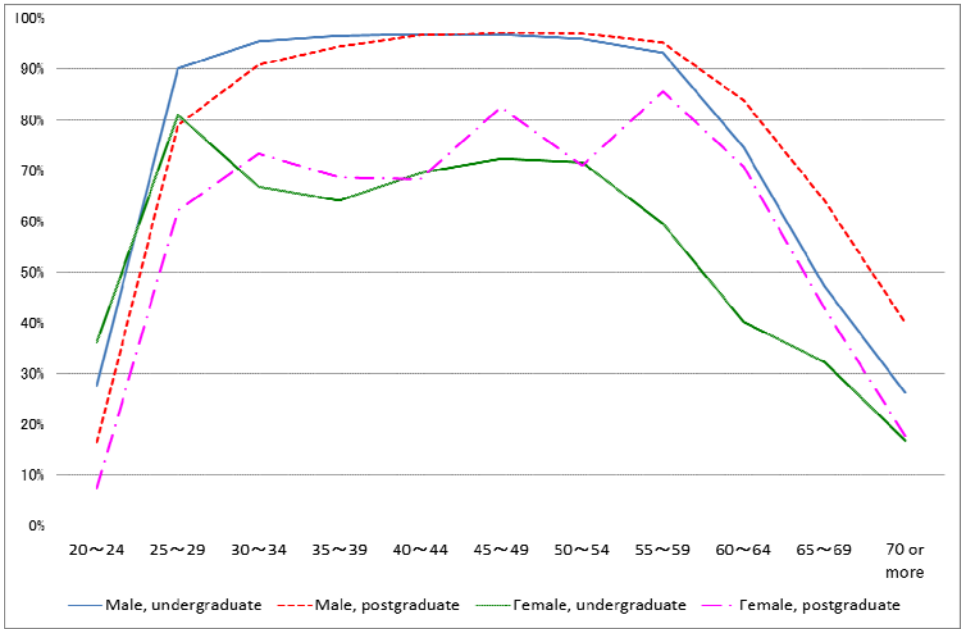

(Note) Estimation is made by cell data from the Employment Status Survey in 2007.

Figure 2 Age-wage profile of male self-employed workers




(Note) Estimation is made by cell data from the Employment Status Survey in 2007.

Figure 3 Labor participation rates by sex and education




(Note) Labor participation rates by age groups are calculated from the Employment Status Survey in 2007.