Essays on Wage Determination Factors and Individual Heterogeneity —Evidence from Japanese Panel Data—

Yawen Sun

Graduate School of Economics
Hitotsubashi University

2016

Acknowledgement

Over the past four years I have received support and encouragement from a great number of individuals. I would like to express my sincere gratitude to my advisor Professor Daiji Kawaguchi for the continuous support of my Ph.D study and related research, for his patience, motivation, and immense knowledge. His guidance helped me in all the time of research and writing of this dissertation. I also wish to thank Professor Takashi Oshio, for his insightful comments and encouragement. Without their continuing support and encouragement, I would never have completed this dissertation. In addition, advice and comments given by Professor Ryo Kambayashi, Associate Professor Yuko Ueno and Associate Professor Emiko Usui has been a great help in improving this dissertation. I would also like to thank the teachers who give practical comments at conferences.

I thank Panel Data Research Center at Keio University, Institute of Social and Economic Research at Osaka University and Professor Toshiaki Tachibanaki for permission to use their panel data to conduct my research and complete this dissertation.

Special thanks to my fellow mates and dormitory mates for the stimulating discussions, and for all the fun we have had in the last four years. Finally, I am deeply greatful to my family for their enduring emotional and financial support.

Contents

1 Chapter 1 Introduction

1.1 Overview

Verifying factors influencing wage level and changes has remained a key issue in labor economics. Since the Mincer (1974) earnings function based on human capital theory, many empirical studies have shown that years of schooling and labor market experience are major factors affecting wage determination in the United States and many other countries (Borjas 2012; Burusku 2006; Willis 1987).

Several studies analyzing the effects of returns of education, work experience, and job tenure on wages use the Mincer equation to address the issues of omitted variables and biased estimate heterogeneity (Altonji and Shakotko 1987; Abraham and Farber 1987; Marshall and Zarkin 1987). In the case of Japan, Tachibanaki and Taki (1990) pointed out that the problem of omitted variables or heterogeneity does not apply to tenure because Japan has almost no labor turnover; however, this trend has changed over the years. According to a 2013 labor analysis report by the Ministry of Health, Labour and Welfare, the labor turnover rate is increasing on an annual basis, especially among the younger age groups (20s and 30s). Over the years, people's way of working has changed especially after the collapse of the Japanese permanent employment system. This points to the need to address the problem of omitted variables and heterogeneity when discussing wage determination in Japan.

Many studies on wage determination use cross-sectional data, although this

creates a potential heterogeneity problem. This thesis investigates factors affecting wages using Japanese panel data. According to Hsiao (2003) and Baltagi (2013), panel data can eliminate potential sources of time-invariant unobservable individual heterogeneity, which cannot be controlled for using time-series and cross-sectional data.

There are several factors influencing wages, including family and social environment and habituation. Economists have investigated the influences of behavioral factors on economic decision-making. In this thesis, we investigate the effects of two behavioral factors, smoking and marriage, on wages. In addition, we use two methods to measure the Big Five personality traits as potential unobservable individual heterogeneity to discuss the validity of unstable variables in economic empirical analyses. Recent studies, particularly in the field of economic behavior, use unstable variables such as time discount rate, risk aversion rate, locus of control, and other personality traits as proxy variables for individual unobservable heterogeneity.

The results revealed that individual unobservable heterogeneity affects wage determination through two behavioral factors, smoking and intra-household specialization. In addition, it is important to carefully interpret estimation results when using unstable variables such as the Big-Five personality traits as a proxy variable of individual unobservable heterogeneity.

1.2 Summary of Chapters

In Chapters 2 and 3, we use Japanese panel data to verify factors contributing the wage disparity between smokers and nonsmokers and between males who have full-time housewives and those are single or whose wives also have full-time or part-time jobs (hereinafter other males).

Specifically, in Chapter 2, we present our research of smoking behavior. As is widely known, smoking is known to have negative effects on health, and to discourage the practice, governments frequently implement policies such as tax increases or restrictions on public smoking. To evaluate these policies, it is necessary to grasp a clearer understanding of the economic benefits and costs of reducing the number of smokers. By conducting panel data analysis while controlling for unobserved heterogeneity, Chapter 2 shows that smoking is not the main factor causing observed wage differentials between smokers and nonsmokers in Japan.

As for the relationship between smoking and wages, we find that male smokers receive lower hourly wages than male nonsmokers. Smoking behavior generally depends on environmental, congenital, or social factors. These factors, however, do not only affect smoking behavior but also the wages of these individuals. To isolate the effect of smoking on wages, we control for individual heterogeneity using panel data to verify the existence of such an effect.

Using tax change as an instrumental variable in the fixed effects model and several robustness checks, the results show that smoking has no statistically significant effect on wage rate. This suggests that smoking does not directly affect

wages; rather, unobserved individual heterogeneity (other factors influencing both smoking and wages) leads to wage differences between smokers and nonsmokers. Nevertheless, smoking can affect wages in the long run through health problems. The nine-year panel data used in this research, however, is insufficient to capture the long-term indirect health effects. Thus, future research should consider analyzing indirect health effects using panel data spread across a wider time frame.

In Chapter 3, we attempt to answer the research question "Do wedding bells bring wealth?" In Japan, it is commonly believed that marriage can increase men's income level and a cursory view of the data suggests that this may hold true, particularly if the man's spouse is a full-time housewife. Further, Becker (1991) argues that women hold a comparative advantage over men in housework; thus, focusing on their jobs after marriage can result in a male wage premium. Using Japanese panel data, this chapter investigates the relationship between marital status and wage rate for men and finds that when unobserved heterogeneity is properly controlled for, marital status and intra-household specialization have no effect on men's wage. To isolate the effect of intra-household specialization, we use the interaction terms of marital status and wife's working status as dummy variables. While the results for the ordinary least squares estimation show that a man who has a full-time housewife earns higher wages than other males, the fixed effects model finds no such effect.

Thus, this research suggests that it is not a wife's work status but unobservable individual heterogeneity that causes wage differentials between men with a spouse who is a full-time housewife and other males. In other words, there are various

unobserved characteristics that can influence both marital status and higher wages for men, for example, competence and attractiveness are values and appreciated by both a boss and a potential spouse. Interestingly, a wife's working status does not depend on the man's wage rate. Thus, future work should attempt to clarify the factors of unobservable individual heterogeneity that affect men's wages and the relationship between marriage and wage rate for women.

In Chapters 2 and 3, we find that wage differences between smokers and non-smokers and between married males who have full-time housewives and other males can be ascribed to individual unobservable differences, even after controlling for years of schooling, work experience and job tenure effects.

Chapter 4 focuses on the Big Five personality traits—Extraversion, Agreeableness, Conscientiousness, Neuroticism, and Openness to experience—to test the validity of unstable factors when using proxy variables of individual unobservable heterogeneity in economic empirical analyses; this is an established method to measure personality in the field of psychology.

We use two datasets that include 10-item and 44-item inventories to measure the Big-Five personality traits. In general, the procedure to measure personality includes the 44-item questionnaire, which is time consuming yet commonly used in psychology studies, while the 10-item questionnaire has been recently developed and saves time for researchers and respondents. Both procedures are certified as sufficient to measure personality traits in psychology analyses. However, this does not mean that both approaches provide similar results in economic analyses. In Chapter 4, we estimate the Mincer equation with personality traits to compare

the effect of personality on wages between the Big-Five variables estimated using 10 and from 44-item questionnaires. The results show that Agreeableness differ between both questionnaire types. To evaluate the factors underpinning these differences, we estimate the effect of each item on the outcome variables. We use the first principle component obtained by conducting the principle component analysis, instead of the Big-Five scores derived by adding up the scores for each item, to evaluate the appropriateness of weight given to each item's response. However, the results still show differences for Agreeableness between the 10 and 44-item questionnaires, suggesting that the differences are generated from those in the expressions of each item between the two questionnaires. In this case, if questionnaires demonstrate different nuances, then the personality traits estimated using them may capture varying personality traits. The main implication of this finding is that short questions save time for respondents and researchers and have a consistent effect on economic outcomes in comparison to widely used and time-consuming questions; however, this is applicable to "some' personality traits, not all. When using short questions in economic empirical researches, it is important to pay careful attention to the expression of each item in the questionnaire, particularly those based on Agreeableness.

In sum, we evaluated two behavioral factors that may affect wage determination and found that wage differences appeared owing to individual unobservable heterogeneity, even if we control for years of schooling or work experience. Next, we attempt to check the validity of the unstable variables, or the Big Five personality traits used as proxy variables of unobservable individual heterogeneity. Our

results highlight the need to exercise precaution when interpreting estimates for personality traits, which also depends on the type of questionnaire used.

We recommend further research on the mechanisms underlying the relationship between wages and smoking, marital status, and individual unobservable heterogeneity. In addition, it is necessary to have long-term panel data to verify the factors affecting wage determination in Japan.

The remainder of this thesis is organized as follows. Chapter 2 summarizes the analysis of the effects of smoking on wage determination. Chapter 3 discusses the relationship between intra-household specialization and wages. Chapter 4 presents the analysis of the Big-Five personality traits. Chapter 5 offers concluding remarks.

References

[1] Abraham, K.G. and H.S. Farber (1987) "Job Duration, Sniority, and Earnings." *American Economic Review.* 77, 278 − 297.

[2] Altonji, J.G. and R.A. Shakotko (1987) "Do Wages Rise with Job Seniority?." *Review of Economic Studies.* 54, 437 − 459.

[3] Baltagi, B. H. (2013) *Econometric Analysis of Panel Data.* fifth Edition. Wiley Press.

[4] Becker, G. S. (1991) *A Treatise on the Family.* Cambridge. MA: Harvard University Press.

[5] Borjas, G.J. (2012) *Labor Economics.* sixth Edition. McGraw-Hill Education Press.

[6] Burusku, B. (2006) "Training and Lifetime Income." *American Economic Review.* 96, 832 − 46.

[7] Hsiao, C. (2003) *Analysis of Panel Data.* second Edition. Cambridge University Press.

[8] Marshall, R.C. and G.A. Zarkin (1987) "The Effect of Job Tenure on Wage Offers." *Journal of Labor Economics.* 5, 301 − 324.

[9] Mincer, J. (1974), *Schooling, Experience and Earnings.* NBER and Columbia Press.

[10] Tachibanaki, T. and A. Taki (1990) "Wage Determination in Japan: A Theoretical and Empirical Investigation." H. Konig (Eds.) *Economics of Wage Determination.* 39 − 64, Springer-Verlag Press.

[11] The Ministry of Health, Labour and Welfare (2013). "Heisei 25 Nen Ban Rōdō Keizai no Bunseki" (The 2013th Analysis of Labor Economy). The Ministry of Health, Labour and Welfare webpage). http://www.mhlw.go.jp/wp/hakusyo/roudou/13/13-1.html (accessed November 12, 2015).

[12] Willis, R. (1987) "Wage Determinants: A Survey and Reinterpretation of Human Capital Earnings Functions." O. Ashenfelter and R. Layard (Eds.) *Handbook of Labor Economics.* 1, 525 − 602.

2 Chapter 2 Smoking and Wage Rates

2.1 Introduction

This chapter aims to verify the effect of smoking on hourly wages using Japanese panel data to determine whether encouraging people to quit smoking is an effective way to increase productivity. As we can find wage disparities between smokers and nonsmokers, there are many economic studies into the effects of smoking on labor outcomes from the 1990s. This chapter mainly focuses on the effect of smoking on wages in Japan to evaluate causes behind wage disparities between smokers and nonsmokers, and discuss the relationship between quitting smoking and productivity.

Smoking not only directly affects health, but also leads to some economic costs. Since the 1960s, there have been many studies into the effects of smoking on health, demonstrating its negative effects.[1] In addition to being a major cause of rising healthcare costs, it also degrades labor productivity through its negative effect on workers' health, for example, through absenteeism and lost future incomes from health-related early retirement.[2] Furthermore, decreasing levels of nicotine in the blood lowers smokers' concentration, leading them to increase their smoking during working hours to compensate. Nicotine is also highly addictive, thus extending its negative impact on smokers' health.

[1] Smoking is a major cause of lung cancer, cardiac arrests, brain deficiencies, and stroke (Hackshaw, Law and Wald 1997; Benowitz 2008; Barik and Wonnacott 2009; Benowitz 2010).

[2] For example, Ault et al. (1991). The World Bank (1999) noted other costs such as depressed enjoyment and difficulty in quitting smoking.

As knowledge of the negative effects of smoking are widely known, governments have implemented policies to reduce the economic costs of smoking, such as increasing taxes on cigarettes, confining smokers to smoking areas expected to encourage smokers to quit, and preventing nonsmokers from secondhand smoke exposure.[3] It is therefore necessary to estimate the economic cost of smoking and the economic benefits of reduced smoking using a cost-benefit analysis of smoking (The World Bank 1999: Chapter 6).

According to previous studies, there are two themes (smoking and absent days, smoking and wage levels) in cost-benefit evaluations of smoking. In this chapter, we focus on smoking and wage levels to verify the effect of smoking on average hourly wages. Research into this topic in the 1990s showed that smokers have statistically significant lower wage levels than nonsmokers (Levin et al. 1997), whereas research in the 2000s showed no wage differences between smokers and nonsmokers (Lye and Hirschberg 2004; Yuda 2011). In this study, we used Japanese panel data to control for considerable individual time-invariant endogeneity to evaluate causes behind wage differences between smokers and nonsmokers. Additionally, we estimated the fixed effect instrumental (FE-IV) estimation to control for individual time-variant endogeneity using the tax increases on cigarettes. Furthermore, we checked the robustness of the results with some additional analysis.

Our results indicate that no smoking effect on hourly wages exists for both

[3] For example, the national tobacco tax, the cigarette special tax, the municipal tobacco tax, and the no street smoking ordinance.

men and women. Males have a statistically significant 9.4% wage difference between smokers and nonsmokers in the ordinary least squares (OLS) model, but it disappears in the fixed effect (FE) model. This result indicates that wages do not change when men quit smoking. Females have no statistically significant results both in the OLS and FE models. If FE estimates are the result of the smoking effect on wages, we believe that there are no statistically significant smoking effect on wages, and that wage differences among smokers and nonsmokers come from other factors aside from smoking. FE-IV estimates also show the same results as in OLS and FE estimates. In some additional estimates: the model adding occupation information, firm size, and employment status show similar results providing robustness to the OLS and FE estimates. To consider estimation bias in OLS estimates, we confirm that males have a lower bias and females have upper bias.

The remainder of this chapter is organized as follows. Section 2.2 summarizes the literature, Section 2.3 introduces the data and presents descriptive statistics, Section 2.4 explains the method and discusses the main results, and Section 2.5 shows the results of the robustness check. Section 2.6 concludes.

2.2 Literature Review

There has been considerable research into workers and smoking around the US and Europe. Those studies are divisible into two groups: studies about the relationship between smoking and absent days, and those between smoking and

wages.

The former set of studies shows that smoking does affect absenteeism. Ault et al. (1991), using US panel data (Panel Study of Income Dynamics), proves that unobservable individual differences between smokers and nonsmokers cause smokers have longer absent days than nonsmokers. Leigh (1995) uses the same data to note that the effect of smoking on the absenteeism rate reduces when controlling for individual heterogeneities. Bush and Wooden (1995) used Australian panel data to show that smoking does affect absence, but the amount of cigarettes smoked does not (National Health Survey).

Studies of the relationship between smoking and wages have two opposite results in terms of whether there is an effect from smoking on wages. Levin et al. (1997) find that male smokers have four to eight percent points lower wage rates than male nonsmokers in the US, using two-year panel data (National Longitudinal Survey of Youth) by estimating the first difference (FD) model to control for unobservable heterogeneity among siblings. On the other hand, Lye and Hirschberg (2004) showed that smoking does not statistically significant coefficient on the inverse mils ratio in a sample selection model using Australian cross-sectional data (Australian National Health Survey). In addition, Yuda (2011) used several years of US cross-sectional data to analyze an instrumental variable model and treatment effect model using the tax raise policy as an instrument variable, demonstrating that one cause determining smoking behavior is increased taxes on tobacco, and found no wage differences between both male and female smokers

and nonsmokers in the US.[4]

As prior studies used different data sets with different strategies to control for heterogeneity, there is no consistent result in terms of the effects of smoking on wage levels. There are several factors causing smoking behavior: an environmental factor, such as relationship with family or friends, an inherent factor such as ability or taste, and socio economic factors. These factors also happen to affect wage levels. For example, those with less willpower and a tendency to work slower tend to smoke more, and heterogeneity is a considerable problem in estimates of the effect of smoking on hourly wage levels. As those with weaker willpower do not show up in the general data, OLS model estimates with no controls will overestimate the negative effect of smoking on wages. It is important to control for omitted variable bias from unobservable individual heterogeneity. In this chapter, we use nine-year panel data to control for heterogeneity and verify the effect of smoking on wages under several different assumptions.

In Japan, there are some studies into tobacco tax policy, policies to encourage smokers to quit (Institute for Health Economics and Policy 2010), and the powerful addiction to smoking shown by the rational addiction model (Uemura and Noda 2011).[5] However, there are no studies about smoking and wages in Japan, to the best of our knowledge. Therefore, this chapter provides an analysis focused on whether smoking behavior causes wage differences between smokers and nonsmokers in Japan.

[4] Using categorical data of wages.

[5] Ishii and Kawai (2006), Kawai (2012), Yuda (2012) and Yuda (2013) showed that raising tobacco prices and tax leads people to quit smoking or to moderate smoking frequencies.

To summarize this study offers several contributions. Our study uses nine-year panel data to control for unobservable individual heterogeneity, which is difficult using cross-sectional data or two-year panel data. Additionally, we use non-categorized wage data and use Japan as the study context.

2.3 Data and Descriptive Statistics

2.3.1 Data

The data for this analysis is from the Keio University Household Panel Survey (KHPS) from 2004 to 2012.[6] This data contains basic individual information such as working status, years of working experience, tenure, education, and data related to daily habits and health. Considering Japanese regulations to stabilize employment specifies retirement ages, the sample data includes only working people, except students, from 20 to 59 years old. We removed any data with missing values.[7]

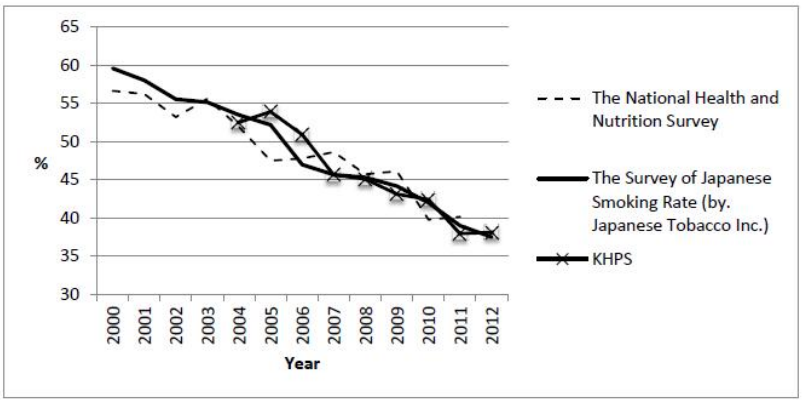
Figures 1 and 2 compare the smoking rates for people over 20 years old from two official tobacco data sets (The National Health and Nutrition Survey by Health, Labour and Welfare Ministry and The Survey of Japanese Smoking Rate by Japan Tobacco Inc.) and KHPS by sex. These figures demonstrate the validity of the data for this research. According to the graphs of the official data

[6] See http://www.gcoe-econbus.keio.ac.jp/post-8.html for more detail about the data.

[7] We control for wage difference by age because wage levels decrease significantly for those in their 60s in Japan. Additionally, we exclude students to eliminate part-time student income.

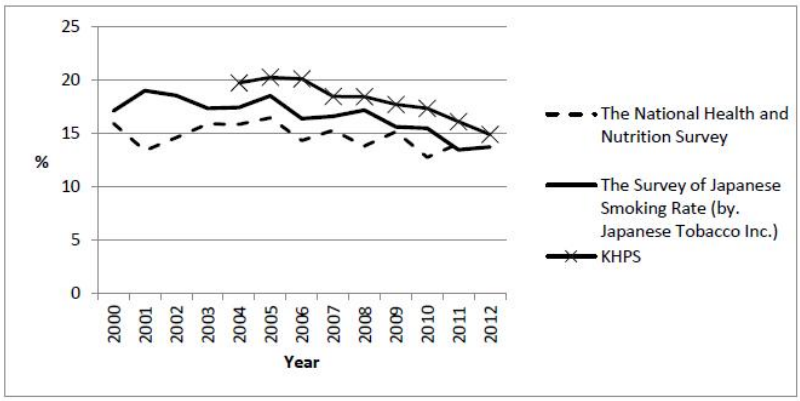
sets, male smokers declined year by year, starting at 60% at the start of the year 2000 and reaching at 45% at the end of 2000. The recent figure is 30%. Female smokers fluctuate between 13% and 20%. The KHPS data also moved in a similar direction, showing a decrease among male smokers to around 38% and to around 15% female smokers. This indicates that KHPS is valid for this research.

Figure 1 Change in the Rate of Smoking Population (Males)



Sorce: The National Health and Nutrition Survey,
The Survy of Japanese Smoking Rate, KHPS 2004-2012.

Figure 2 Change in the Rate of Smoking Population (Females)



Sorce: The National Health and Nutrition Survey,
The Survy of Japanese Smoking Rate, KHPS 2004-2012.

2.3.2 Descriptive Statistics

We use the following definition for average hourly wages, in line with previous studies:

$$hwage = \frac{Annual\ earnings}{Hour \times 52(weeks)}$$

where $Annual\ earnings$ is the annual amount calculated from regular payment and bonus information in the questionnaire, $Hour$ means working hours per week, including overtime hours.[8]

[8] We use monthly income multiplied 12 months for people who answered that they received weekly or monthly income, and daily income multiplied by the number of monthly working days and 12 months for those receiving daily income, and use annual income for people paid annually. There are two questionnaires about income:“an annual income including tax” or“highest amount of monthly, daily, hourly, and annually income if you have more than two jobs” Here, we use the latter.

We use an historical questionnaire (15 to 68 years old) to calculate years of education, experience, and tenure.[9] Table 1 summarizes the other variables. We define smokers in this chapter as people who were smokers when they answered the survey, and nonsmokers as those people who do not smoke at the time they completed the survey, which includes those who are previous smokers but quit at the time they answered the survey.

Table 2 describes the average values by smoking status for men and women, which shows that both male and female smokers have a lower average hourly wage. The average hourly wage for male smokers is about 2,332 JPY and 2,776 JPY for male nonsmokers, meaning that male smokers have 920,000 JPY average lower annual income than male nonsmokers.[10] On the other hand, the average hourly wage for female smokers is 1,390 JPY and 1,423 JPY for female nonsmokers, resulting in an average income difference between female smokers and nonsmokers is 70,000 JPY, significantly less than for men. This implies that smoking may have a negative effect on wages for men but not for women, though nonsmokers seem to have higher wage levels than smokers for all years for both genders in nearly all years, as reported in Table 3.

In terms of other variables, nonsmokers have more years of education and labor market experience, and a higher marriage rate only for females. Table 2 shows

[9] In the first year of the survey (2004), the questionnaire has only historical data for those from 18 to 68 years of age. They added historical data for 15 to 17 year olds in the following year (2005). We combine both as one historical data set from 15 to 68 years old.

[10] Suppose a person works eight hours per day per week. We calculate the average wage differences by multiplying wage differences between smokers and nonsmokers (about 444 JPY for males and 33 JPY for females) by eight hours, five days, and 52 weeks.

Table 1 Variable Explanation

Explained variable	
Hourly wages (JPY)	Individual hourly wages (JPY).
Explanatory variables	
Smoking dummy	Equal to 1 if people smoked and 0 if people did not smoke during the survey years. Past smokers report 0.
Individual attributes	
Ages	Subtract year of birth from survey years.
Marriage dummy	Equal to 1 if married and 0 otherwise.
Children dummy	Equal to 1 if people have children and 0 otherwise.
Educational attributes	
Schooling years	Calculated from historical questions (from 15 to 68 years old).
Junior high school	Equal to 1 if people graduated junior high school and 0 otherwise.
High school	Equal to 1 if people graduated high school and 0 otherwise.
Vocational school	Equal to 1 if people graduated vocational school and 0 otherwise.
University	Equal to 1 if people graduated university and 0 otherwise.
Graduate school	Equal to 1 if people graduated graduate school and 0 otherwise.
Working attributes	
Actual work experience	Calculated from history records (15-68 years old).
Job tenure	Tenure from first survey year and add or change length from labor turnover information in each survey year.
Regular worker dummy	Equal to 1 if working status is a regular worker and 0 otherwise.
Labor turnover dummy	Equal to 1 if people changed jobs since the previous year.
Area attributes, Years dummy	
Big city dummy	Equal to 1 if the city is the one of 14 big cities.
Years dummy, 2005-2010	Equal to 1 for each year. Reference group is 2004 in estimation equations.
Others	
Daily number of cigarettes	Mean number of cigarettes smoked per day (from 2004 to 2012).
Daily number of cigarettes 2004	Mean number of cigarettes smoked per day (at 2004).
Daily number of cigarettes 2007	Mean number of cigarettes smoked per day (at 2007).

Table 2 Descriptive Statistics of Male and Female by Smoking Status (Average)

	Male		Female	
	Smoker	Nonsmoker	Smoker	Nonsmoker
Explained variable				
Hourly wages (JPY)	2331.828	2776.26	1390.181	1423.448
Individual attributions				
Ages	43.675	44.813	41.588	43.433
Marriage dummy	0.764	0.785	0.592	0.713
Children dummy	0.706	0.719	0.551	0.662
Educational attributions				
Schooling years	12.946	14.11	12.242	13.16
Junior high school	0.054	0.038	0.066	0.023
High school	0.529	0.392	0.617	0.461
Vocational school	0.081	0.068	0.18	0.271
University	0.279	0.402	0.075	0.164
Graduate school	0.016	0.058	0.001	0.005
Working attributions				
Actual work experiences	23.756	24.024	18.374	18.73
Job tenure	11.997	12.971	5.688	6.884
Regular worker dummy	0.908	0.918	0.344	0.382
Labor turnover dummy	0.045	0.041	0.085	0.06
Area attributions, Years dummy				
Big city dummy	0.271	0.289	0.296	0.26
Smoking attributions				
Daily number of cigarettes	19.606		13.698	
Daily number of cigarettes 2004	19.649		12.068	
Daily number of cigarettes 2007	18.832		13.134	
N	4,283	5,056	1,357	6,141

Nonsmokers include past smokers (smoked in the past and quit smoking).

Table 3 Hourly Wages (JPY) from 2004 to 2012

	Male		Female	
Year	Smoker	Nonsmoker	Smoker	Nonsmoker
2004	2111.723	2329.490	1393.807	1547.689
2005	2607.132	2812.702	1351.125	1412.363
2006	2261.202	2868.314	1415.711	1391.230
2007	2408.139	3116.226	1270.360	1504.287
2008	2265.278	2820.181	1334.748	1422.150
2009	2368.896	2899.370	1715.166	1435.322
2010	2305.656	2689.370	1516.641	1349.897
2011	2483.135	2846.842	1216.455	1353.476
2012	2218.352	2600.107	1309.344	1362.252
Total	2331.828	2776.260	1390.181	1423.448

that both male and female nonsmokers have about one additional year of education on average than smokers. This seems to lead to more junior high school and high school graduates and fewer university and graduate school graduates in the smoking group. Additionally, both nonsmoking males and females have one additional year of labor market experience and longer tenure. Other variables have observable differences, except that female nonsmokers have about 12% more married respondents and about 10% more with children than nonsmokers, potentially indicating that females tend to quit smoking more than males due to marriage and children. Furthermore, females have lower income after marriage or having a child. We address this by adding dummy variables for marriage and children in our estimates.[11]

Table 4 provides the transition matrix showing the validity of this data for the

[11] Kawaguchi (2008) illustrate that females have about an 8% marriage penalty and about a 4% birth penalty.

fixed effect (FE) model, which requires changes in smoking behavior for a comparative analysis of wage level transitions. In Table 4, 6.81% of males changed their smoking status from smokers to nonsmokers, and 3.27% of males changed from nonsmokers to smokers. Women show 10.51% changing from smokers to nonsmokers, and 1.55% moving from nonsmokers to smokers. Both males and females have observable status changes, so we have determined that this transition rate is sufficient for an FE model.

Table 4 Transition Matrix

		T + 1				Total		
		Nonsmoker 0		Smoker 1				
		Male	Female	Male	Female	Male	Female	
T	Nonsmoker 0	3,701	4,510	125	71	3,826	4,581	N
		96.73	98.45	3.27	1.55	100	100	%
	Smoker 1	224	109	3,063	928	3,287	1,037	N
		6.81	10.51	93.19	89.49	100	100	%
	Total	3,925	4,619	3,188	999	7,113	5,618	N
		55.18	82.22	44.82	17.78	100	100	%

2.4 Smoking and Wage Rate

2.4.1 Empirical Methodology

Following Levine, Gustafson, and Velenchik (1997), we use the following Mincer equation for the OLS model estimation:

$$\ln(hwage_i) = \alpha + \beta_1 Smoking_i + X_i\beta_2 + u_i (1)$$

where $\ln(hwage_i)$ is the log of hourly wage for individual i at time t; $Smoking$ is a dummy variable equal to one if people answered "smoke" or "sometimes smoke" to the question "Do you smoke?," and equal to zero for people who have already quit. We expect β_1 to be negative if smoking is a factor in lowering wage levels. The variable X is a vector of individual attributes such as years of education; working experience and its square; tenure and its square; and the other dummy variables of marriage, children, and big city that potentially affect wages. The random variable u is an error term for individual i.

2.4.2 Problem and Solution

As many considerable factors can determine wages, it is important to handle unobservable individual heterogeneity. In other words, if $Smoking_i$ correlates with u_i in equation (1), β_1 will be a biased estimate. For example, suppose people have different degrees of attainment by personality, and personality is one factor

determining wages, the effect of smoking on wages will appear in β_1 because of unobservable personality data, and β_1 will have a downward bias. This bias, called omitted variable bias, causes uncertainty in estimates of the effect of smoking on wages, leading to an overvaluation or undervaluation of policies, such as those designed to encourage smokers to quit.

We use the panel data to solve this problem. In line with Kitamura (2005) and Wooldridge (2010), we estimate the following equation:

$$\ln(hwage_{it}) = \alpha + \beta_1 Smoking_{it} + X_{it}\beta_2 + \beta_3 d_t + c_i + v_{it} \quad (2)$$

where c_i is a time-invariance factor and indicates individual unobservable heterogeneity in a part of u_i in equation (1). The variable d_t is a year dummy considering macro effects such as the effect of prices on wages, using 2004 as the reference year. The FE model uses differences by subtracting each variable's mean from each variable as in the following:

$$\{\ln(hwage_{it}) - \ln\overline{(hwage_i)}\} = \beta_1\{Smoking_{it} - \overline{Smoking_i)}\} + \{X_{it} - \overline{X_i}\} + \{v_{it} - \overline{v_i}\} \quad (3)$$

where $\ln\overline{(hwage_i)}$, $\overline{Smoking_i}$, and $\overline{v_i}$ are the mean values of each variable for individual i. We will find the effect of smoking on wages by controlling for individual unobservable heterogeneity. In addition, we conduct an F-test and Hausman test to examine the validity of FE estimates (equation (3)).

2.4.3 Empirical Results and Discussion

Tables 5 and 6 summarize the results for males and females, respectively. The results in Table 7 indicate that the FE estimates are the reasonable results. The results (1) in Tables 5 and 6 are OLS estimates, and results (2) are FE estimates.

There are no wage differences by smoking status for males. The OLS estimate in Table 5 shows that smoking males have a 9.4% lower hourly wage than non-smoking males. This result is similar to those of Levine et al. (1997), we reported 8%. However, the FE estimate shows no statistically significant wage differences between smokers and nonsmokers, demonstrating that wage differences between smokers and nonsmokers come from individual unobservable heterogeneity, with no causal relationship between smoking and wages. In other words, there is no evidence confirming that wages increase when people quit smoking.

Females have similar results to males, with no wage differences by smoking status. In Table 6, the OLS estimate shows that smokers have a 3.7% higher hourly wage than nonsmokers and the FE estimate shows that smokers have a 4.4% lower hourly wage than nonsmokers if they quit smoking, and both estimates are statistically nonsignificant. In other words, wage differences for females come from factors other than smoking status.

In terms of the other variables, we found that work experience affects hourly wages for both males and females and marriage and having children affects hourly wages only for females. Tables 5 and 6 show that males have a 10.4% higher hourly wage if they have an additional year of work experience, and females

Table 5 Results of Male

	(1)	(2)	(3)	(3)'	(4)	(4)'
Model	OLS	FE	FEIV 1	FEIV 2 1st	FEIV 2	FEIV 2 1st
Explained Variable	log wage	log wage	log wage	Smoking	log wage	Smoking
Smoking	-0.094	-0.020	-0.016		-0.158	
	(0.022)***	(0.027)	(0.235)		(0.186)	
Education	0.042					
	(0.005)***					
Experience	0.018	0.104	0.241	0.029	0.063	0.024
	(0.005)***	(0.040)***	(0.062)***	(0.026)	(0.061)	(0.025)
$(Experience)^2$	-0.036	-0.148	-0.143	-0.012	-0.153	-0.017
	(0.010)***	(0.013)***	(0.019)***	(0.008)	(0.022)***	(0.009)*
Tenure	0.018	0.004	0.003	0.002	0.006	-0.002
	(0.003)***	(0.004)	(0.005)	(0.002)	(0.006)	(0.002)
$(Tenure)^2$	0.004	0.035	0.026	-0.007	0.034	0.005
	(0.009)	(0.012)***	(0.016)	(0.007)	(0.019)*	(0.007)
Married	0.166	-0.045	-0.106	-0.043	0.037	-0.019
	(0.038)***	(0.045)	(0.056)*	(0.023)*	(0.065)	(0.026)
Children	0.130	-0.006	-0.002	-0.014	-0.022	-0.003
	(0.032)***	(0.029)	(0.036)	(0.015)	(0.034)	(0.014)
Big city	0.042	0.023	0.000	0.002	-0.039	-0.035
	(0.025)*	(0.045)	(0.055)	(0.023)	(0.072)	(0.029)
IV†				-0.005		-0.002
				(0.001)***		(0.000)***
Constant term	6.370	6.040	3.103	0.441	7.002	0.205
	(0.081)***	(0.781)***	(1.297)**	(0.544)	(1.326)***	(0.538)
Years dummy	Yes	Yes	Yes	Yes	Yes	Yes
R^2	0.21	0.04		0.04		0.07
N	9,339	9,339	6,026	6,026	5,763	5,763

* p<0.1; ** p<0.05; *** p<0.01. Standard error is noted in brackets.
FE is the fixed effect model, FEIV is the fixed effect IV model, and FEIV1st is the first stage of FEIV.
† We use the cross-term of the mean number of daily cigarette in 2004 and the annual tax amounts from 2004 to 2010 as the IV in the FEIV 1 model.We use the cross-term of the mean number of daily cigarettes in 2007 and annual tax amounts from 2007 to 2012 as the IV in the FEIV 1 model.

Table 6 Results of Female

	(1)	(2)	(3)	(3)'	(4)	(4)'
Model	OLS	FE	FEIV 1	FEIV 2 1st	FEIV 2	FEIV 2 1st
Explained Variable	log wage	log wage	log wage	Smoking	log wage	Smoking
Smoking	0.037	-0.043	-0.199		0.369	
	(0.029)	(0.039)	(0.388)		(0.315)	
Education	0.052					
	(0.006)***					
Experience	0.014	0.080	0.081	-0.012	0.105	-0.018
	(0.005)***	(0.014)***	(0.020)***	(0.007)*	(0.024)***	(0.008)**
$(Experience)^2$	-0.040	-0.078	-0.084	0.005	-0.083	0.013
	(0.012)***	(0.017)***	(0.024)***	(0.008)	(0.026)***	(0.009)
Tenure	0.021	0.005	0.002	0.001	0.007	0.006
	(0.004)***	(0.004)	(0.006)	(0.002)	(0.006)	(0.002)***
$(Tenure)^2$	0.018	0.018	0.052	-0.006	-0.018	-0.016
	(0.016)	(0.021)	(0.031)*	(0.010)	(0.030)	(0.010)
Married	-0.090	-0.073	-0.033	-0.064	-0.122	-0.041
	(0.041)**	(0.043)*	(0.061)	(0.019)***	(0.060)**	(0.019)**
Children	-0.032	0.072	0.035	-0.007	0.036	0.001
	(0.038)	(0.029)**	(0.036)	(0.012)	(0.033)	(0.011)
Big city	0.056	0.001	-0.001	0.041	-0.019	0.023
	(0.026)**	(0.050)	(0.068)	(0.022)*	(0.073)	(0.024)
IV†				-0.008		-0.002
				(0.001)***		(0.000)***
Constant term	6.198	5.980	5.973	0.567	5.472	0.497
	(0.098)***	(0.191)***	(0.330)***	(0.098)***	(0.382)***	(0.116)***
Years dummy	Yes	Yes	Yes	Yes	Yes	Yes
R^2	0.13	0.02		0.03		0.04
N	7,498	7,498	4,679	4,679	4,881	4,881

* p<0.1; ** p<0.05; *** p<0.01. Standard error is noted in brackets.
FE is the fixed effect model, FEIV is the fixed effect IV model, and FEIV1st is the first stage of FEIV.
† We use the cross-term of the mean number of daily cigarette in 2004 and the annual tax amounts from 2004 to 2010 as the IV in the FEIV 1 model.We use the cross-term of the mean number of daily cigarettes in 2007 and annual tax amounts from 2007 to 2012 as the IV in the FEIV 1 model.

have 8.0% higher wages with the same condition. Though the estimate for the marriage dummy variable is statistically nonsignificant, married males have 4.5% lower hourly wages than single males, suggesting that the marriage premium is due more to individual unobservable heterogeneity. It is interesting that the estimate becomes negative after controlling for individual heterogeneity.[12] Females have statistically significant results for the dummy variables of marriage and having children, indicating that marriage and birth do affect wage determinants for females. There are no other statistically significant results in Tables 5 and 6. The reason behind statistically nonsignificant results for job tenure is that the effect of work experience may involve the effect of tenure because of the low rate of labor turnover in this data: 4% for males and 6 8% for females, indicated in Table 2.[13]

Regarding the R-squared value, the OLS model has 0.21 of the R-squared value for males and 0.13 for females, indicating that our model explain 21% of the variance for males and 13% of the variance for females, and other unobserved factors account for about 80% of the variance. The R-squared results in the FE model have similar implications, indicating that of the wage determinants are of time-invariant individual heterogeneous type excluded in the FE model. Additionally, though the R-squared values in the FE model are lower than the results in the OLS model, years of working experience remains statistically significant, indicating that this is still predictor among wage determinants while holding other

[12] Cornwell and Rupert (1997) and Gray (1997) demonstrated that males have a positive effect from marriage on wages, while females have no effect.

[13]Rates for males and females in Table 2 are lower than the rates in the Survey on Employment Trends conducted by the Ministry of Health, Labour and Welfare. The official rate for males is 8.1% and 10.4% for females in 2010.

predictors in the model constant.

In the OLS estimates, males have a downward bias and females have an upward bias. The results in Table 5 show that the negative smoking effect on wages for males decreases from 9.4% in the OLS estimate to 2.0% in the FE estimate, though the FE estimate is not statistically significant. In other words, the difference in the negative smoking effect on wages is 7.4% when we controlled for individual unobservable heterogeneity, indicating downward bias in the OLS estimates for males. Similarly, Table 6 shows an upward bias in the OLS estimates for females.

Although our results show no wage differences between smokers and non-smokers for both males and females, it is obvious that smoking has negative health consequences, and deteriorating health leads to low wage levels (Yuda 2010) and we therefore cannot dismiss the effect of smoking on wages through health effects. This study uses only nine years of data that is limited in terms of analyzing the effects of smoking as a mediator in health conditions if smoking takes a long time to yield negative health impacts.[14]

[14] According to the National Cancer Center Home Page "the relationship between smoking and death rate" and Juntendō University Respiratory Home Page "About Lung cancer," the longer people smoke, the higher their death rate becomes. Additionally, it is difficult to reduce the risk of death from by cancer, even with quitting smoking. For example, it takes 20 years to develop lung cancer.

Table 7 Test Results

Test	Null hypothesis
F-test	OLS estimates are more sufficient than FE estimates. (Coefficients of dummy variables for each individual are all zero)
Hausman test	Select FE estimates.

	Male		Female	
	OLS	FE	OLS	FE
Smoking	-0.094	-0.020	0.037	-0.043
	(0.022)***	(0.027)	(0.029)	(0.039)
R^2	0.21	0.04	0.13	0.02
N	9,339	9,339	7,498	7,498
F-test	F-ratio 4.36 Prob>F=0.0000		F-ratio 4.84 Prob>F=0.0000	
Hausman test	Prob>chi2=0.0000		Prob>chi2=0.0000	

* p<0.1; ** p<0.05; *** p<0.01. Standard error is noted in brackets.
OLS is a pooled estimate, FE is a fixed effect estimate.

	Male		Female	
	FEIV 1	FEIV 2	FEIV 1	FEIV 2
IV	-0.005	-0.002	-0.008	-0.002
	(0.001)***	(0.000)***	(0.001)***	(0.000)***
F-test	F-ratio 4.69 Prob>F=0.0000	F-ratio 4.42 Prob>F=0.0000	F-ratio 4.68 Prob>F=0.0000	F-ratio 5.07 Prob>F=0.0000

* p<0.1; ** p<0.05; *** p<0.01. Standard error is noted in brackets.
FEIV 1 is the IV related to the tax raise in 2006, FEIV 2 is the IV related to the tax raise in 2010.

2.4.4 Instrumental Variable Estimation

We discussed time-invariant individual unobservable heterogeneity earlier, though we discuss it here to estimate the Fixed Effect Instrumental variable estimation. We focus here on changes in individual attributes of time-variant individual unobservable heterogeneity from exogenous influences. For example, suppose one's spouse becomes unemployed, creating financial problems for the couple that means they cannot afford to buy tobacco. If this situation leads people to quit smoking and work more to support the family, it seems that quitting smoking raise one's wage levels. In this case, the FE estimates have upward bias, so we have underestimated the negative effect of smoking on wages. Hence, we use instrumental variable methods to control for time-variant individual unobservable heterogeneity.

We use tobacco tax increases as an instrumental variable because they are exogenous and not time-invariant. Moreover, tax increases do not affect wage determinations but suppress smoking behavior (Ishii and Kawai 2006; Kawai 2012; Yuda 2012; Yuda 2013), and more so if a person smoked a lot before the tax increase. We can thus eliminate bias from the coefficient β_1 of smoking in equation (3) using instrumental variables that control for changes in smoking behavior from higher taxes.

The data we use for this analysis covers 2004 to 2012, in which there were two tax increases: 2006 and 2010. Table 8 shows tax per cigarette after the tax increases. Amount of tax per one cigarette are 7.892 JPY from 2004 to 2006;

8.744 JPY from 2007 to 2010; 12.244 from 2011 to 2012 in this data.[15]

Table 8 Tax per Cigarette and Instrumental Variables

	After tax raise in 2003	After tax raise in 2006	After tax raise in 2010
Tax (JPY)	7.892	8.744	12.244
Difference (JPY)	0.852	3.5	
Data period	From 2004 to 2006	From 2007 to 2010	
IV 1	Daily number of cigarettes 2004 × 7.892 JPY (Tax amount after tax raise in 2003)	Daily number of cigarettes 2004 × 8.744 JPY (Tax amount after tax raise in 2006)	
Data period		From 2007 to 2010	From 2011 to 2012
IV 2		Daily number of cigarettes 2007 × 8.744 JPY (Tax amount after tax raise in 2006)	Daily number of cigarettes 2007 × 12.244 JPY (Tax amount after tax raise in 2010)

We develop two instrumental variables from the two tax increases and estimate them separately. The instrumental variable is a cross term of number of cigarettes smoked in the first year of the estimated data sets and amount of tax per cigarette.[16] This instrumental variable imposes a restraint on those who smoked more in the first year of the estimated data sets. Nonsmokers have no effect because they use zero cigarettes. Thus, we expect similar results as in previous studies (Ishii and Kawai 2006 etc.). Each instrumental variable is summarized in Table 8. We

[15] KHPS is conducted every January, and tax increases were in July of 2006 and October of 2010, so we determined the tax changes as occurring in 2007 and 2011 in this study.

[16] Regarding number of cigarettes smoked, the average daily number of cigarettes for males is 19.6 and 13.7 for females, as reported in Table 2. According to the National Health and Nutrition Survey, 2004 to 2011, the average daily number of cigarettes for males is around 17 to 20 and around 13 to 16 for females. This indicates that our sample data has a similar number of daily cigarettes compared to the national data.

use a subsample from 2004 to 2010, including the tax increase in 2006 for the IV1 model as a cross term of number of cigarettes smoked in 2004 and amount of tax per cigarette. Similarly, the sample data from 2007 to 2012 used in the IV2 model, which is a cross term of number of cigarettes in 2007 and amount of tax per cigarette. We estimate these separately because it is difficult to make one instrumental variable and estimate this in a single equation because the tax increases are for different amounts.

The results still show no causal relationship between smoking behavior and hourly wages for both males and females, as show in Tables 5 and 6 in (3) to (4). The results (3) to (3)' are estimates with IV1, and results (4) to (4)' are estimates with IV2. Additionally, results (3) and (4) are second stage estimates, and results (3)' and (4)' are the first stage estimates. According to results (3)' and (4)', both male and female IV (tax amount multiplied by number of cigarettes) have statistically significant results. The coefficient of IV1 is -0.005 in Table 5, meaning that the tax increase in 2006 reduced smokers by 8.5% if people smoked a pack (20 cigarettes) daily, and 14% for the tax increase in 2010.[17] The results for females are similar: the tax increase in 2006 reduced smokers by 13.6% and the tax increase in 2010 reduced smokers by 14% according to the coefficients of IV (-0.008 and -0.002) in Table 6.[18] According to results (3) and (4), we have statis-

[17] IV1 = coefficient -0.005 × (the tax after the 2006 tax increase 8.744 JPY - the tax before the 2006 tax increase 7.892 JPY) × the number of daily cigarettes in 2004 (supposing 20 cigarettes). IV2 = coefficient -0.002 × (the tax after the 2010 tax increase 12.244 the tax before the 2010 tax increase 8.744 JPY) × the number of daily cigarettes in 2007 (supposing 20 cigarettes).

[18] IV1= coefficient (-0.005) × (the tax after the 2006 tax increase 8.744 JPY - the tax before the 2006 tax increase 7.892 JPY) × the number of daily cigarettes in 2004 (supposing 20 cigarettes). IV2= coefficient (-0.002) × (the tax after the 2010 tax increase 12.244 the tax before the 2010 tax

tically nonsignificant estimates for both tax increases in 2006 and 2010. Table 5 shows that IV1 has a downward bias and IV2 has a large upward bias. As we estimated two terms separately, there is upward bias in the FE estimates if combined with the two IV results. The results for females in Table 6 show an upward bias for both IV1 and IV2, thus FE estimates for females have an upward bias. The test of IV in the bottom of Table 7 shows validity using the F-test. It is difficult to conduct a Sargan test because there is only one IV for one endogenous variable.

In addition, we found that marriage and birth suppress smoking in females. The estimate of marriage is statistically significant in Table 6 for females and indicates that married females tend to quit smoking more than unmarried women. We do not find any effect of marriage for males from Table 5.

The instrumental variables we used in this section are based on the constant price of substitute goods of smoking during the period covered by this dataset. If the price of substitute goods decrease along with an increase in tax on cigarettes, more people would shift to the substitute good and quit smoking. It may lead impact of the tax increase on reducing smokers larger and it would control time-variant unobservable individual heterogeneity properly. However, we cannot find any substitute good of smoking in Japan, to the best of our knowledge. It is one area of the future work to use substitute goods as an instrumental variable when we have such kind of goods in Japan.

increase 8.744 JPY) $\times$ the number of daily cigarettes in 2007 (supposing 20 cigarettes).

2.5 Robustness Check

2.5.1 Company Size and Job Status

Here we discuss the relationship between smoking behavior and wages, controlling for occupation and company size to whether these are omitted variables. In the previous section, we found a negative correlation between smoking behavior and unobservable wage determinants, and that the OLS estimates have omitted variable bias. In this section, we discuss the omitted variables. Generally, doctors have higher wage levels and seldom smoke, while people working in construction fields have lower wage levels and often smoke. If this example hypothesis is correct, the positive effect of occupation on wages appears through the dummy variable for smoking and β_1 will have an upward bias when we estimate equation (3) without controlling for occupation. In this part, we estimate equation (3) with two additional dummy variables: one for large companies and the other for occupation. The KHPS contains 12 occupations.[19] We define a company employing more than 500 employments as a large company.[20]

OLS estimates for males show that we overestimated the effects of smoking, education, and job tenure on hourly wages. According to Table 9, smoking males have 9.0% lower hourly wages, controlling for company size. The effect becomes

[19] The 12 occupations are Agriculture, Forestry and Fisheries; Mining; Sales; Services; Management; Clerical work; Transportation and Telecommunications; Constructions, Maintenances and Haulages; Information handling services; Technical and specialized workers; Securities; and Others. The reference is Others.

[20] The questionnaires are different for 2004 and the other years. In 2004, company sizes were separated into 100-299, 300-499 and more than 500, and changed to 100-499 and more than 500 after 2005. We used a single definition to create an identical variable for all years.

7.9% if we control for both company size and occupation. Compared to result (1) of 9.4% in Table 5, the OLS estimate has a downward bias, indicating that the effects of company size and occupation on wages appeared through smoking status in OLS estimations. FE estimates for males are statistically nonsignificant and similar to the results in Table 5, though estimates still show that smokers have 2.1-2.2% lower hourly wages. Further, both OLS and FE estimates have similar results as in Table 6 for females. Regarding the other variables, the coefficients of education, work experience, and job tenure have an upward bias in the OLS estimates, with the same appearing in the coefficients of work experience in the FE model when we control for company size and occupation. Males have 5.2% higher hourly wages if they work in a company with more than 500 employees according to the results in Table 9.[21] Females have no wage differences by company size.

[21] Looking at occupations, people who work in the service sector have 6.6% lower hourly wages than those in the other sector.

Table 9 Results of Company Size and Job Status

	Male				Female			
	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Model	OLS	OLS	FE	FE	OLS	OLS	FE	FE
Explained Variable	log wage	log wage	log wage	log wage	log wage	log wage	log wage	log wage
Smoking	-0.090	-0.079	-0.021	-0.022	0.039	0.056	-0.044	-0.043
	(0.022)***	(0.021)***	(0.027)	(0.027)	(0.029)	(0.028)**	(0.039)	(0.039)
Education	0.040	0.028			0.052	0.032		
	(0.005)***	(0.005)***			(0.006)***	(0.006)***		
Experience	0.020	0.019	0.103	0.105	0.014	0.010	0.080	0.079
	(0.005)***	(0.005)***	(0.040)***	(0.040)***	(0.005)***	(0.005)**	(0.014)***	(0.014)***
$(Experience)^2$	-0.038	-0.036	-0.147	-0.149	-0.039	-0.029	-0.079	-0.078
	(0.010)***	(0.010)***	(0.013)***	(0.013)***	(0.012)***	(0.011)***	(0.017)***	(0.017)***
Tenure	0.016	0.014	0.003	0.004	0.021	0.018	0.005	0.004
	(0.003)***	(0.003)***	(0.004)	(0.004)	(0.004)***	(0.004)***	(0.004)	(0.004)
$(Tenure)^2$	0.006	0.002	0.035	0.033	0.019	0.018	0.018	0.021
	(0.009)	(0.009)	(0.012)***	(0.012)***	(0.016)	(0.015)	(0.021)	(0.021)
Married	0.157	0.146	-0.047	-0.039	-0.095	-0.073	-0.074	-0.069
	(0.038)***	(0.036)***	(0.045)	(0.045)	(0.041)**	(0.040)*	(0.043)*	(0.044)
Children	0.129	0.123	-0.005	-0.007	-0.028	-0.021	0.073	0.072
	(0.031)***	(0.030)***	(0.029)	(0.029)	(0.038)	(0.036)	(0.029)**	(0.030)**
Big city	0.040	0.046	0.023	0.023	0.053	0.055	0.001	0.001
	(0.024)	(0.023)**	(0.045)	(0.045)	(0.026)**	(0.025)**	(0.050)	(0.050)
Company size	0.167	0.158	0.045	0.052	0.077	0.088	0.020	0.024
	(0.020)***	(0.019)***	(0.022)**	(0.022)**	(0.022)***	(0.022)***	(0.021)	(0.021)
Constant term	6.349	6.522	6.046	6.013	6.185	6.529	5.976	5.995
	(0.080)***	(0.085)***	(0.780)***	(0.782)***	(0.098)***	(0.101)***	(0.191)***	(0.193)***
Years dummy	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Occupations	No	Yes	No	Yes	No	Yes	No	Yes
R^2	0.22	0.25	0.04	0.04	0.13	0.17	0.02	0.02
N	9,339	9,339	9,339	9,339	7,498	7,498	7,498	7,498

* p<0.1; ** p<0.05; *** p<0.01. Standard error is noted in brackets.
OLS is a pooled estimate, FE is a fixed effect estimate.

As above, we know that the effects of smoking, education, and job tenure estimated in Table 5 contain effects of company size and occupation, indicating that both company size and occupation are omitted variables. However, we still found no causal relationship between smoking behavior and wages from the FE estimates, meaning that wage differences by smoking status occur through individual unobservable heterogeneity.[22] As estimates show no effect of smoking on wages after controlling for individual unobservable heterogeneity, even if we also control for company size and occupations, which seem to be omitted variables, we propose that the results in Section 2.4 are robust. This is further supported by the finding that the effect of company size on wages only appears for males.

2.5.2 Regular Workers and Non-regular Workers

We next discuss the relationship between smoking and wages by employment status. Regular and non-regular employment may have varying wage structures, thus leading to potential differences in the effect of smoking.[23] This section provides separate estimates for men and women based on employment status. In this data set, we have 90% regular male workers and 34-40% regular female workers from Table 2.

We find no wage differences for regular male workers. According to the OLS estimates in Table 10, smokers have 10.4% lower hourly wages than nonsmokers

[22] There is no causal relationship between smoking behavior and wages even in the IV estimation.

[23] According to Yuda (2013), raising tobacco prices negatively affects male employees, indicating those who work in the construction sector.

for regular workers, and no difference for irregular workers. The FE estimates, however, show no existing wage differences among smokers and nonsmokers by employment status, indicating that individual unobservable heterogeneity causes wage differences among smokers and nonsmokers for regular workers and no effect of smoking on wages for non-regular workers. We should carefully interpret the results for non-regular workers because the sample size is less than 10% of the entire sample. In addition, we found that OLS estimates have a downward bias for regular workers and an upward bias for non-regular workers.

There is no effect from smoking on wages for both regular and non-regular workers. According to Table 10, all estimates of dummy variables for smoking show statistically nonsignificant results, indicating no wage differences observed among smokers and nonsmokers regardless of employment status.

We still found no causal relationship between smoking behavior and wages for both males and females after adding employment status. Thus, smoking behavior has no influence on wage determinations for both regular and non-regular workers.[24]

[24] We observe no causal relationship between smoking behavior and wages, even in the IV estimation.

Table 10 Results of Regular and Non-regular Workers

	Male				Female			
	Regular		Non-regular		Regular		Non-regular	
	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)
Model	OLS	FE	OLS	FE	OLS	FE	OLS	FE
Explained Variable	log wage	log wage	log wage	log wage	log wage	log wage	log wage	log wage
Smoking	-0.104	-0.038	-0.037	-0.091	0.009	0.057	0.016	-0.027
	(0.021)***	(0.027)	(0.051)	(0.135)	(0.050)	(0.068)	(0.026)	(0.046)
Education	0.048		0.016		0.053		0.041	
	(0.004)***		(0.011)		(0.009)***		(0.006)***	
Experience	0.026	0.129	0.010	0.008	0.012	0.141	0.008	0.036
	(0.005)***	(0.054)**	(0.008)	(0.083)	(0.008)	(0.046)***	(0.005)*	(0.015)**
$(Experience)^2$	-0.049	-0.112	-0.024	-0.086	-0.024	-0.056	-0.024	-0.002
	(0.011)***	(0.015)***	(0.019)	(0.050)*	(0.019)	(0.031)*	(0.010)**	(0.021)
Tenure	0.016	0.011	0.014	0.012	0.027	0.026	0.009	0.001
	(0.004)***	(0.004)**	(0.011)	(0.017)	(0.007)***	(0.010)***	(0.005)*	(0.005)
$(Tenure)^2$	0.008	-0.007	-0.006	0.063	-0.019	-0.071	0.005	-0.040
	(0.010)	(0.014)	(0.033)	(0.056)	(0.022)	(0.034)**	(0.026)	(0.036)
Married	0.152	-0.075	0.023	-0.103	0.016	-0.039	-0.086	-0.110
	(0.036)***	(0.044)*	(0.081)	(0.193)	(0.044)	(0.070)	(0.040)**	(0.053)**
Children	0.049	-0.012	0.175	0.129	0.044	0.041	-0.036	0.079
	(0.030)	(0.029)	(0.085)**	(0.098)	(0.038)	(0.045)	(0.035)	(0.037)**
Big city	0.081	-0.026	0.118	-0.101	0.030	0.044	0.083	-0.071
	(0.024)***	(0.045)	(0.058)**	(0.193)	(0.040)	(0.089)	(0.024)***	(0.055)
Constant term	6.230	5.516	6.654	7.308	6.122	5.131	6.342	6.420
	(0.078)***	(1.037)***	(0.175)***	(1.450)***	(0.147)***	(0.641)***	(0.104)***	(0.191)***
Years dummy	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R^2	0.27	0.05	0.08	0.06	0.18	0.05	0.07	0.02
N	6,698	6,698	634	634	2,240	2,240	3,719	3,719

* p<0.1; ** p<0.05; *** p<0.01. Standard error is noted in brackets.
OLS is a pooled estimate, FE is a fixed effect estimate.

2.5.3 Additional Estimations

We here introduce two additional analyses for a robustness check. Table 11 reports the results.

For the first additional analysis, we use average number of daily cigarettes instead of a dummy variable for smoking status and found no effect on wages. It is possible that the effect of smoking on wages arises through number of cigarettes and not smoking status itself. In the first results in Table 11, the OLS estimate shows that male smokers have 0.3% lower hourly wages per additional daily cigarette. The FE estimate, however, is statistically nonsignificant, indicating no causal relationship between number of cigarettes and hourly wages. Both the OLS and FE estimates returned no statistically significant results for females.

In this estimation, we interpret results as "how hourly wages change with each additional daily cigarette," so our results mean that adding one more cigarette per day has no observed effect on hourly wages. Naturally, the effect of number of cigarettes on wages differs for smokers adding one more cigarette and nonsmokers adding one more cigarette (start smoking). We use subsamples that include only smokers and found coefficients of number of cigarettes still at almost zero for both males and females in the second results in Table 11. Therefore, even reducing the sample to smokers only, shows no hourly wage changes when people consume an additional cigarette daily.

For the second additional analysis, we verify the effect of past smoking behavior on hourly wages in each period, and still found no causal relationship between

Table 11 Results of Additional Analyses

	Male (All)		Female (All)	
Model	OLS	FE	OLS	FE
Mean of number of daily cigarettes	-0.003 (0.001)***	-0.001 (0.001)	0.002 (0.002)	0.002 (0.003)
R^2	0.21	0.04	0.13	0.02
N	9,323	9,323	7,486	7,486
Hausman test		Prob>chi2=0.0000		Prob>chi2=0.0000
* p<0.1; ** p<0.05; *** p<0.01. Standard error is noted in brackets. OLS is a pooled estimate, FE is a fixed effect estimate.				

	Male (Smoker)		Female (Smoker)	
Model	OLS	FE	OLS	FE
Mean of number of daily cigarettes	0.001 (0.002)	0.001 (0.002)	-0.001 (0.003)	0.003 (0.003)
R^2	0.19	0.05	0.11	
N	4,267	4,267	1,345	1,345
Hausman test		Prob>chi2=0.0000		Prob>chi2=0.1713
* p<0.1; ** p<0.05; *** p<0.01. Standard error is noted in brackets. OLS is a pooled estimate, FE is a fixed effect estimate.				

	Male		Female	
Model	OLS	FE	OLS	FE
Smoking in T-1	-0.097 (0.025)***	-0.044 (0.031)	0.052 (0.033)	-0.002 (0.042)
R^2	0.20	0.02	0.15	0.01
N	7,113	7,113	5,618	5,618
Hausman test		Prob>chi2=0.0000		Prob>chi2=0.0000
* p<0.1; ** p<0.05; *** p<0.01. Standard error is noted in brackets. OLS is a pooled estimate, FE is a fixed effect estimate.				

them. The panel data used in this study enables lag variables for smoking behavior in a previous year.[25] The OLS estimate for males, in the third results in Table 11, shows that smoking behavior in the prior year reduces hourly wages 9.7%, while the FE estimate show no statistically significant results. For females, both the OLS and FE estimates show no causal relationship between smoking behavior in the prior year and hourly wages. Thus, we know that previous smoking behavior does not affect hourly wages for either gender.

In this part, we examined the effects of number of cigarettes and past smoking behavior on current hourly wages. The results indicate that both number of cigarettes and past smoking behavior have no effect on hourly wages, indicating that all of our previous results are robust.

2.6 Discussion

2.6.1 Alcohol Consumption

In this section, we discuss the relationship between smoking and alcohol consumption. Generally, when we look at the literature related to the causal relationship between health and labor market outcomes, we find that researchers discuss the relationship between wages and smoking and between wages and alcohol consumption together (Auld 2005, Lye 2004). Alcohol consumption is also an important addictive behavior in medical science. Auld (2005) provides a model that

[25] Though we can take lag variables for eight years because the panel data covers 9 years, we use lag variables for the year prior in the analysis to consider multicollinearity.

includes alcohol consumption patterns and controls for smoking as an endogenous variables to investigate the effect of alcohol consumption and smoking on income using cross-sectional data (the Canadian General Social Survey, 1985 and 1991). The results show that "moderate drinking leads to 10% greater income than drinking abstention" and "smokers earn 8% less than non-smokers" (Auld 2005). Our study indicates similar results for male smoker in the OLS model (9.4%).

Regarding alcohol consumption behavior, Table 12 shows the descriptive statistics of alcohol consumption attribution by smoking status.[26] Although many smokers drink alcohol (82% for male and 67% for female), non-smokers also have a similar rate of alcohol consumption behavior, especially for male respondents (78%). In terms of alcohol consumption frequency, most smokers tend to drink more than three times a week than non-smokers do, and most non-smokers tend to drink once or twice a month. Table 12 also shows the correlation coefficients of smoking and alcohol consumption, which indicates a statistically significant but low positive correlation between smoking and alcohol consumption. Additionally, the correlation between hourly wages and alcohol consumption and between hourly wages and smoking for males have similar influences, though smoking is negative and alcohol consumption is positive, indicating that the effect of alcohol consumption on wages may be similar to the effect of smoking on wages estimated in this section using this sample data.

[26] At the KHPS miss the data of drinking attribution in 2004 and 2007, the sample size is smaller than Table 2.

Table 12 Descriptive Statistics and Correlation of Alcohol Consuption

	Male		Female	
	Smoker	Nonsmoker	Smoker	Nonsmoker
Descriptive Statistics (Mean)				
Drinking	0.815	0.784	0.668	0.524
Drink once or twice a month	0.189	0.200	0.240	0.284
Drink once or twice a week	0.108	0.154	0.111	0.099
Drink more than three times a week	0.519	0.430	0.317	0.142
N	3068	3795	1000	4619

	Male			Female		
	Smoking	Daily number of cigarettes	Hourly wages	Smoking	Daily number of cigarettes	Hourly wages
Correlation						
Drinking	0.039***	0.020	0.048***	0.111***	0.080***	0.034**
Drink once or twice a month	-0.015	-0.038***	-0.010	-0.037***	-0.037***	0.017
Drink once or twice a week	-0.068***	-0.081***	0.033***	0.016	-0.009	0.002
Drink more than three times a week	0.089***	0.101***	0.024**	0.177***	0.157***	0.024*

* p<0.1; ** p<0.05; *** p<0.01.

The coefficient of correlation values of smoking and hourly wages is -0.059*** for male and -0.0076 for female.

Though we have data related to alcohol consumption, there is a hereditary concern in Japan related to alcohol consumption. Genetically, humans need the metabolic enzyme called acetaldehyde dehydrogenase (ALDH) to catalyze the conversion of acetaldehyde ingested by alcohol into acetic acid. There are three types of ALDH genes: GG type (efficiently processes a high volume of alcohol), AG type (low ability to process alcohol) and AA type (inability to process alcohol). All Caucasoid (of European descent) and Negroid (of African descent) have the GG type, but Mongoloid (of Asian descent) have all types (45% of Mongoloids have AG type, and 5% have AA type). According to Harada (1999), there is a low percentage of people with the GG-type gene (NN type in Harada 1999) especially around western Japan, indicating that estimates would have selection bias.[27] Given this concern, it is necessary to have a variable available to control genetic selection bias, but this is difficult in the sample data we used. Thus, we analyzed only the effect of smoking on wages in this study.

2.6.2 Exercise

Although we find there is no evidence proving that smoking is a factor determining wages in Sections 2.4 and 2.5, smoking may be a proxy of some unobservable individual heterogeneity, such as personality, which affects wages. If myopic-style thinking and smoking have a strong relationship, and most of smokers tend to have myopic thinking, wage differences between smokers and non-smokers may

[27] For example, only 40% of people in Mie province have the GG-type gene.

come from the difference in mode of thinking and not from smoking behavior, indicating that smoking can be a proxy for myopic thinking.

How should we measure myopic thinking? Here, we suppose that people with myopic thinking do not care about their health, and we use exercise as a proxy for myopic thinking, assuming that those who do not exercise are not interested in their health and have myopic thinking. Cawley (2004) focused on the relationship between wages and obesity using the BMI to measure the effect of obesity on wages and finds that heavier females tend to have lower earnings than their lighter counterparts. In the KHPS, we use exercise instead of the BMI because this survey did not record body weight information.

Table 13 shows the descriptive statistics related to exercise and the coefficient of correlation values. The percentage of non-smokers who exercise is higher than that of smokers for both males and females, though the gaps are small (13% for male and 4% for female). The coefficients between smoking and exercising are also statistically significant but small for males and statistically insignificant and small values for females. The impact of the correlation values between exercise and hourly wages are similar to the values between smoking and hourly wages, though the former is positive and the latter is negative, and thus only males have statistically significant values. This indicates that males with have high wages also exercise and may not smoke, while females who have high wages may also exercise and do not smoke or do not exercise and smoke. As there is no strong uniformity among genders, it is hard to say that the decision to exercise reflects myopic thinking or smoke for everyone.

Table 13 Descriptive Statistics and Correlation of Exercise

	Male		Female	
	Smoker	Nonsmoker	Smoker	Nonsmoker
Descriptive Statistics (Mean)				
Exercising	0.267	0.397	0.201	0.245
Exercise one day a week	0.128	0.169	0.086	0.107
Exercise two days a week	0.066	0.095	0.039	0.057
Exercise three days a week	0.030	0.049	0.037	0.035
Exercise four days a week	0.009	0.022	0.009	0.014
Exercise five days a week	0.012	0.025	0.006	0.011
Exercise six days a week	0.006	0.012	0.007	0.007
Exercise seven days a week	0.016	0.024	0.017	0.015
N	3061	3786	998	4615

	Male			Female		
	Smoking	Daily number of cigarettes	wages wages	Smoking	Daily number of cigarettes	wages wages
Correlation						
Exercising	-0.137***	-0.136***	0.074***	-0.039***	-0.053***	0.013
Exercise one day a week	-0.057***	-0.049***	0.036***	-0.027**	-0.035***	0.013
Exercise two days a week	-0.053***	-0.061***	0.045***	-0.031**	-0.037***	0.012
Exercise three days a week	-0.047***	-0.039***	-0.001	0.005	0.009	0.023*
Exercise four days a week	-0.053***	-0.049***	0.023*	-0.016	-0.022*	-0.003
Exercise five days a week	-0.049***	-0.063***	0.012	-0.019	-0.016	-0.010
Exercise six days a week	-0.032***	-0.040***	0.037***	0.002	-0.001	-0.013
Exercise seven days a week	-0.028**	-0.029**	0.013	0.008	-0.008	-0.025*

* p<0.1; ** p<0.05; *** p<0.01.

The coefficient of correlation values of smoking and hourly wages is -0.059*** for male and -0.0076 for female.

Though it is difficult to use the KHPS data to capture some unobservable individual heterogeneity affecting wages, personality is one possible factors determining and may cause wage differences between smokers and non-smokers. Another area of future work should aim to identify the relationship between personality and wages through health attributions.

2.7 Conclusion

In this chapter, we use Japanese panel data (KHPS) to examine the hypothesis that smoking behavior reduces wage levels. In the analyses, we controlled for time-invariant individual heterogeneity that is difficult to capture using two-year panel data and cross-sectional data. Moreover, we examined IV estimations to control for time-variant individual heterogeneity and conducted several analyses to check robustness.

All results show that wage differences between smokers and nonsmokers come from individual unobservable heterogeneity. The OLS estimates indicate that smoking males have 9.4% lower hourly wages than nonsmokers, while the FE estimates show no statistically significant effect. In other words, smoking behavior does not affect hourly wages if we control for individual unobservable heterogeneity and find that people would not see an increase in wages if they quit smoking. Females show different results from males, having no statistically significant results in both the OLS and FE estimates. In sum, there is no causal relationship between smoking behavior and wages for both males and females, though only

males have wage differences by smoking status from individual unobservable heterogeneity.

Other analyses, such the IV estimation and several robustness checks have similar results. We use tobacco tax increases as the IV model, but have no statistically significant results in the estimations. We also examined several estimations adding the dummy variables of company size and occupation, providing separate estimates by employment status, using number of cigarettes smoked, and replacing present smoking status with prior smoking status. After adding company size and occupation, the coefficient of smoking status has small changes, but still indicates no causal relationship between smoking behavior and hourly wages. The robustness checks yielded similar results.

This chapter illustrates that wage differences by smoking status arise from individual unobservable heterogeneity and not from the smoking behavior itself. However, smoking undeniably has a negative effect on labor productivity through its impact on health, which leads to wage changes in the long term. To examine this mechanism, future research will require a much longer panel data survey.

References

[1] Auld, M. C. (2005) "Smoking, Drinking, and Income." *The Journal of Human Resources.* 40(2), 505-518.

[2] Ault, R. W., R. B. Ekelund Jr J. D., Jackson, R. S. Saba, and D. S. Saurman (1991) "Smoking and Absenteeism." *Applied Economics.* 23, 743-754.

[3] Barik, J. and S. Wonnacott (2009) "Molecular and Cellular Mechanisms of Action of Nicotine in the CNS." *Handbook of Experimental Phamacology.* 192, 173-207.

[4] Benowitz, N. L. (2008) "Neurobiology of Nicotine Addiction: Implications for Smoking Cessation Treatment." *The American Journal of Medicine.* 121(4A), S3-S10.

[5] Benowitz, N. L. (2010) "Nicotine Addiction." *New England Journal of Medicine.* 362 (24), 2295-2303.

[6] Bush, R. and M. Wooden (1995) "Smoking and Absence from Work: Australian Evidence." *Social Science & Medicine.* 41(3), 437-446.

[7] Cawley, J. (2004) "The Impact of Obesity on Wages." *The Journal of Human Resources.* 39(2), 451-474.

[8] Cornwell, C. and P. Rupert (1997) "Unobservable Individual Effects, Marriage and the Earnings of Young Men." *Economics Inquiry.* 35, 285-94.

[9] Gray, J. S. (1997) "The Fall in Men's Return to Marriage: Declining Productivity Effects of Changing Selection?." *The Journal of Human Resources.* 32, 481-504.

[10] Hackshaw, A. K., M. R. Law, and N. J. Wald (1997) "The Accumulated Evidence of Lung Cancer and Environmental Tabacco Smoke." *British Medical Journal.* 315, 980-988.

[11] Harada, S. (1999) "Inshu Kōdō to Idenshi" (Drinking Behavior and Genes). *Kōshūeisei.* 63(4), 234-237.

[12] Institute for Health Economics and Policy (2010) "Kinen Seisaku no Arikata ni Kansuru Kenkyū—Kitsuen ni yoru Cost Suikei—Hōkokusho"

(The report of the quality of the tobacco cessation policy—Cost estimate on Smoking). http://www.ihep.jp/publications/report/search.php?dl=26&i=1 (accessed July 15, 2013).

[13] Ishii, K. and H. Kawai (2006) "Tabakozei no Hikiage ya Kenkōzōshinhō wa Kinen ni Dokomade Yukō ka" (The Validity of the Cigarette Tax Hike and the Health Promotion Act). Y. Higuchi and The 21 Century COE Programs (Ed.) *"The Dynamism of Japanese Household Behavior 2."* 211-236, Keio University Press.

[14] Juntendō University Respiratory "Haigan nit suite" (About Lung Cancer). http://www.juntendo.ac.jp/hospital/clinic/kokyukigeka/kanja02_01.html (accessed November 30, 2013)

[15] Kawaguchi, A. (2008) *Gender Keizai Kakusa* (Gender Inequality in Economic Status). Keiso Shobo.

[16] Kawai, H. (2012) "2010 Nen Tabakozei Hikiage no Kōka—JHPS ni yoru Panel Data Bunseki" (The effect of 2010 Cigarette Tax Hike—Panel Analysis of JHPS), Y. Higuchi, T. Miyauchi, C. R. McKenzie, and Panel Data Research Center at Keio University (Ed.) *The Dynamism of Parent-child Relation and Family Behavior—Education, Health and Employment under Financial Crises.* 105-124, Keio University Press.

[17] Kitamura Y. (2005) *Panel Data Bunseki* (Panel Data Analysis), Iwanami Shoten.

[18] Leigh, P. J. (1995) "Smoking, Self-selection and Absenteeism." *Quarterly Review of Economics and Finance.* 35, 365-386.

[19] Levine, P. B., T. A. Gustafson, and A. D. Velenchik (1997) "More Bad News for Smokers? The Effects of Cigarette Smoking on Wages." *Industrial and Labor Relations.* 50(3), 493-509.

[20] Lye, J. N. and J. Hirschberg (2004) "Alcohol Consumption, Smoking and Wages." *Applied Economics.* 36, 1807-1817.

[21] The Ministry of Health, Labour and Welfare "Saishin Tobacco Jōhō: Seijin Kitsuen Ritsu (Kousei Roudou Shō Kokumin Eiyō Chōsa)" (The Newest

Tobacco Information: Adult Smoking Rate (The National Nutrition Survey by The Ministry of Health, Labour and Welfare)). http://www.health-net.or.jp/tobacco/product/pd100000.html (accessed September 30, 2013).

[22] The Ministry of Health, Labour and Welfare "Saishin Tobacco Jōhō: Seijin Kitsuen Ritsu (Kousei Roudou Shō Kokumin Eiyō Chōsa)" (The Newest Tobacco Information: Adult Smoking Rate (The Survey of Japanese Smoking Rate by Japanese Tobacco Incorporated)). http://www.health-net.or.jp/tobacco/product/pd090000.html (accessed September 30, 2013).

[23] The National Cancer Center "Tobacco to Shibō Ritsu tono Kankei ni tsuite" (The Relationship Between Smoking and Death Rate), http://epi.ncc.go.jp/jphc/outcome/252.html (accessed November 30, 2013).

[24] The World Bank (1999) "Tobacco Ryūkō no Yokusei" (Restraint of Smoking). A World Bank Publication.

[25] Uemura, K and A. Noda (2011) "Kitsuen Shūkan no Panel Bunseki—Gōriteki Izonshō Model no Kenshō" (The Panel Analysis of Smoking Habit —Test of The Rational Addiction Model). M. Seko, H. Teruyama, I. Yamamoto, Y. Higuchi, and The 21 Century COE Program (Ed.) *The Dynamism of Japanese Household Behavior 7.* 91-110, Keio University Press.

[26] Wooldridge, J. M. (2010) *Econometric Analysis of Cross Section and Panel Data second Edition.* The MIT Press.

[27] Yuda, M. (2010) "Kenkō Jōtai to Rōdō Seisansei" (Health Status and Labor Productivity). *The Japanese Journal of Labour Studies.* 601, 25-36.

[28] Yuda, M. (2011) "The Effect of Habitual Smoking on Labour Productivity." *Applied Economics Letters.* 18, 1125-1132.

[29] Yuda, M. (2012) "Tobacco ni Taisuru Juyō · Kyōkyū Shock ga Kitsuen Kōdō ni Ataeta Eikyō" (The effect of Tobacco Demand and Supply Shocks on Smoking Behavior). *Japanese Journal of Health Economics & Policy.* 24(2), 143-156.

[30] Yuda, M. (2013) "The Impact of Recent Smoking Control Policies on Individual Smoking Choice: The Case of Japan." *Health Economics Review.* Vol.3, Article 4.

3 Chapter 3 Men's Wages and Intra-household Specialization

3.1 Introduction

A considerable number of studies have been conducted over the past few decades examining the effect of marital status on an individual's wage level. Several studies using cross-sectional data found a positive effect of over 10% on male wage levels as a result of marriage (Antonovics and Town 2004; Ginther and Zavodny 2001; Korenman and Neumark 1991). Does marriage itself cause increased earnings for males, or are there other determining factors affecting male wages associated with marital status?

One famous hypothesis that explains wage disparities in marital status is called the household specialization hypothesis. According to Becker (1973; 1974; 1991), if women have a comparative advantage over men in the household sector and men have a comparative advantage over women in the market sector, then, specialization by each partner in each sector would have more efficient outcomes than if both contributed in both sectors. If this hypothesis explains the mechanism of the marriage wage premium, then males married to full-time housewives could conserve their time spent engaged in household tasks and spend more time at works. By getting married, males would increase their earnings compared to males with working wives and single males.

Only few related studies analyze the relationship between marriage and male work hours as most studies focus on the change in housework hours after marriage or a wife's work hours (Bardasi and Taylor 2008; Gray 1997; Hersch and Stratton 1997). Using panel data (the Panel Study of Income Dynamics 1968 to 1992), Lundberg and Rose (2002) estimate the effects of children on male hourly wages and work hours and find that marriage and being a father leads to higher wages and longer work hours. Although Lundberg and Rose (2002) is not a direct analysis of the relationship between marriage and male work hours, marriage also increases men's work hours. According to Lundberg and Rose (2002), Yukawa (2013) estimates the effect of marriage on men's work hours using Japanese panel data (the Keio University Household Panel Survey from 2004 to 2012) which we use in this chapter. After controlling for time-invariant unobservable individual heterogeneity, the results show married males work 112 hours more annually than single males (statistically significant at the 10% level). According to Yukawa's (2013) results, in this chapter, we estimate and discuss the effect of intra-household specialization on men's hourly wages based on the mechanism that males married to full-time housewives save their time spent engaged in housework and spend more time in market work which increases their earnings much more than that of males with working wives and single males.

Many studies have used the wife's working status or work hours as proxy variables for intra-household specialization. Using cross-sectional data (the National Longitudinal Survey of Youth 1990), Loh (1996) finds no statistically significant difference in male earnings according to a wife's work hours after marriage. How-

ever, using the same data, Gray (1997) states that male earnings increase more slowly if the wife continues to work after marriage in the US. After the year 2000, panel data analyses have more supportable evidence. Hersch and Stratton (1997) find that married males spend less time engaged in housework than single males but conclude that the impact of marriage and time spent on housework is small, and the differences cannot be explained by intra-household specialization in the US and the panel data (the National Survey of Families and Households 1987 to 1988, 1992 to 1994). Bardasi and Taylor (2008) examine this topic with British data (the British Household Panel Survey 1991 to 2003) and find that if the woman is responsible for more domestic chores, then, her husband shows 3% greater earnings than males whose wives are responsible for no housework. Also, using German panel data (the German Socio-Economic Panel 1985 to 2006) Pollmann-Schult (2011) finds that males with a non-working spouse have a higher wage premium than males with a full-time employed spouse.

In Japan, Kawaguchi (2005) shows that unobservable individual heterogeneity causes male wage differences according to marital status, although the data (the Japanese Panel Survey of Consumers 1993 to 2000) only include married males. Sato (2012) uses the data (from the Keio University Household Panel Survey 2004 to 2012) including both married and single males and finds that unobservable individual heterogeneity causes differences in male wages according to marital status. However, these two studies only consider marital status itself and not intra-household specialization. It is difficult to find studies on the relationship between intra-household specialization and male wage rates. One reason

for the lack of studies on the relationship between intra-household specialization and wage levels is that, typically, intra-household specialization only occurs after marriage. In other words, intra-household specialization is a result of marriage. Thus, if we cannot find any relationship between marital status and wage levels, this may indicate that the household specialization hypothesis is rejected. However, we believe there is room to examine the relationship between intra-household specialization and wages in Japan.

The effect of marriage on wages can be categorized in several ways, such as short-term effect, long-term effect, and an effect that mediates other factors. When we use only marital status to measure marriage premium, the result represents a mixed effect of facts related to marriage. Supposing the effect of one fact, such as intra-household specialization, has a positive but small effect on wages, the mixed effect would disappear if other facts such as marriage duration or marital life have a substantial negative effect. Therefore, we believe it is worthwhile to measure the effect of facts related to marriage on male wages, separately.

Additionally, it is more important to verify the effect of intra-household specialization on male wages in Japan compared to other European countries because of the certain existence of intra-household specialization in Japan. On International Women's Day 2014, the Organization of Economic Cooperation and Development reported on the time spent working by men and women in 26 countries.[28] Figure 1 shows that in Japan, over 80% of unpaid work is carried out by

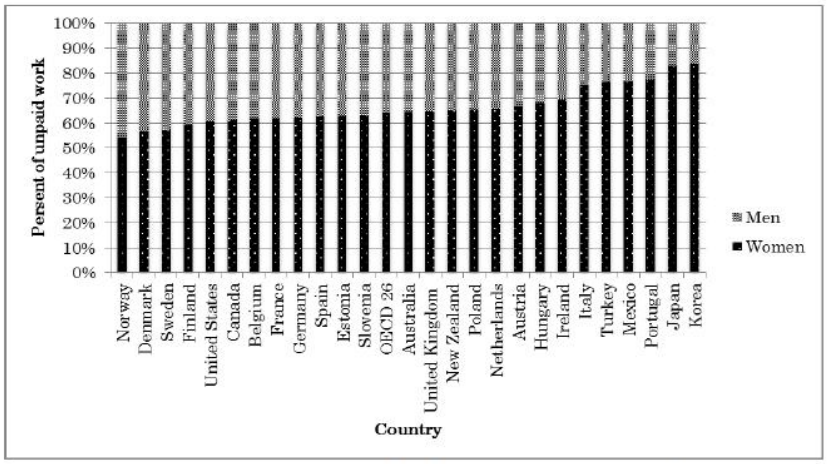
[28] "Balancing paid work, unpaid work and leisure"
http://www.oecd.org/gender/data/balancingpaidworkunpaidworkandleisure.htm(December 15, 2014)

women, and Japan has the second greatest unpaid work gender gap after Korea. Additionally, according to the White Paper on the Labour Economy 2015 by the Ministry of Health, Labour and Welfare, 42% of households in Japan had unemployed wives in 2012 and, approximately, 20% of single women aged 18 to 39 hope to become housewives in the future. Of course, this may be a cultural characteristic of Asian countries, but intra-household specialization occurs in Japan and affects male wage rates more than European countries indicating that the effect on wages between marital status and intra-household specialization is separable. Other significant results for male wage differences by marital status may be found in Japan.[29] Yukawa (2013) is the only related study to the best of our knowledge. This study examines the effect of marriage on labor supply for both males and females and also examines the effect of intra-household specialization on time spent working using the difference in educational background between married couples as a proxy variable with Japanese panel data (the Keio University Household Panel Survey 2004 to 2012). The results show that if a husband has a higher educational background than his spouse, the husband will work more than the spouse. This result supports the existence of intra-household specialization in Japan according to Becker's hypothesis (1973; 1974; 1991).To the best of our knowledge, no study examines the relationship between intra-household specialization and male wage rates in Japan. We believe that this chapter has profound significance in verifying wage differences between married males and single males because of marital

[29] Unpaid work includes routine housework, shopping, care of household members, care of non-household members, volunteering, travel related to household activities, and other unpaid work.

status and other marriage-related factors such as intra-household specialization. Additionally, Kawaguchi (2005), Sato (2013), and Yukawa (2013) are written in Japanese. We believe that this study is the first study written in English that evaluates the marriage wage premium according to marital status and intra-household specialization in Japan.

Figure 1 Percentage of Unpaid Work by Gender for OECD Countries



Source: OECD based on data from National Time Use Surveys.

In this chapter, we analyze the effect of marital status and intra-household specialization on male wages in Japan using Japanese panel data. The ordinary least square (OLS) analysis yields a wage premium for married men of 8 to 14% and married men with a full-time housewife shows an additional effect of 10 to 13%. After controlling for fixed effects, the marital and intra-household specialization effects disappear indicating that the factors causing male wage differences are not marital status and wife's working status. In other words, marriage and intra-household specialization do not cause male wage differences among married men

with a full-time housewife and others if marital status and wife's working status represent marriage and intra-household specialization.

The proxy variable we used for intra-household specialization is the "current" wife's working status. Because a "past" wife's working status should affect male wages, we used a first-difference (FD) estimator to check this fact. Our results show the robustness of the FE results. We clarify individual heterogeneous effects, which may lead to male wage differences because of marital status and the status of working wives, focusing on heterogeneous effects across organizations and occupations. Estimating the OLS model and fixed effect (FE) model by controlling for dummy variables of large company size and occupations, or estimating separately by the size of the company, the results continuously show the same facts. Several additional estimations also support our findings. In summary, we state positively that not all males have higher wages after marriage or after their wife becomes a full-time housewife. This finding indicates that no evidence of a marriage wage premium for Japanese males is found in this study after several in-depth empirical analyses.

The remainder of this chapter is organized as follows. Section 2 introduces the data and presents descriptive statistics, Section 3 explains the method and discusses the main results, and Section 4 shows the results of a robustness check. Section 5 summarizes and concludes the study.

3.2 Data and Descriptive Statistics

3.2.1 Data

The data used in this analysis is the Keio University Household Panel Survey (KHPS) from 2004 to 2012. This data contains basic annual individual information such as working status, years of working experience, tenure, education information, marital status, firm size and job type for approximately 4,000 individuals since 2004. Wave 2 has 1,400 individuals from 2007, and wave 3 has 1,000 individuals from 2012. The questionnaire obtained data for individuals and their spouses so that we also obtain sufficient basic information for spouses.[30]

The Japanese Act concerning Stabilization of Employment of elderly persons configured the retirement age as 60 years of age or older.[31] Because of this retirement requirement, income levels suddenly decline after workers with a college background reach 60 years of age, and we cannot obtain a continuous wage function for Japanese males (Kawaguchi, 2011). Therefore, the sample data only include working males from 20 to 59 years old. If there was a missing value in the data, it was also removed. We limited samples for men only because of the sample selection bias for women's wage levels. Additionally, we do not use wave 3 (2012) because wave 3 has only one year of data and does not allow us to conduct

[30] Marital status cannot distinguish between legal marriage and de facto marriage. Therefore, we define marital status as "subjective" marital status in this chapter.

[31] The age requirement changed to over 65 years of age after April 1, 2013.

a panel analysis. The average hourly wage we use is defined as the following,

$$hwage = \frac{Annual\ earnings}{Hour \times 52(weeks)}$$

where *Annual earnings* is the year amount calculated from regular payment and bonus information in a questionnaire, $Hour$ represents working hours per week including overtime work hours.[32] Table 1 describes other variables.

3.2.2 Descriptive Statistics

Figure 2 describes the average hourly wage by marital status for men in each age group. The figure shows that married males have a higher average hourly wage particularly after they reach age 30, and the average age at which males marry is approximately 28 years old (Table 2). Considering these facts, it seems quite probable that wage differences by marital status dramatically increase after an individual reaches age 30. In other words, there seems to be a higher wage level for men after marriage, and wage differences according to marital status become more significant with age.

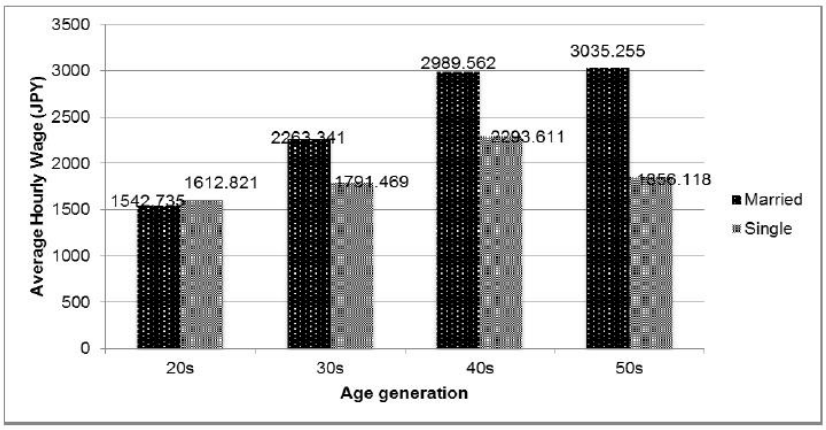
[32] We use the monthly income amount multiplied by 12 months for individuals who responded that they received income monthly or weekly. Additionally, we use a daily income amount and multiply the amount by monthly working days and 12 months for those who received income daily and use annual income for those who received income annually. There are two questionnaires concerning income: "an annual income including tax" or "the highest monthly, daily, hourly, and annual income if you have more than two jobs," and we use the latter. We establish the robustness of the results in this chapter when we use "the number of working days per month" and multiply by 12 months instead of using "working hours per week" and multiplying by 52 weeks as a robustness check. We exclude the results.

Table 1 Variabe Explanation

Explained Variable	
Wage per hour (JPY)	Hourly wage.
Individual Information	
Age	Each survey year minus birth year.
Marriage dummy	Equal to 1 if married and 0 if single.
Children	Equal to 1 with a child and 0 otherwise.
Children under 6	Equal to 1 with an under 6 years old and 0 otherwise.
Educational Information	
Years of education	Calculated from history records (15 - 68 years old).
Junior high school	Equal to 1 if highest graduated school is junior high school.
High school	Equal to 1 if highest graduated school is high school.
Vocational school	Equal to 1 if highest graduated school is vocational school.
University	Equal to 1 if highest graduated school is university.
Graduate	Equal to 1 if highest graduated school is graduated school.
Working Information	
Years of experience	Calculated from history records (15 - 68 years old).
Tenure	Tenure from first survey year and add or change length from "change a job" information in each survey year.
Regular worker	Equal to 1 if working status is a regular worker.
Company size	Equal to 1 if company size is more than 500 employees.
Occupations	Equal to 1 if a job type corresponds to one of the following, Agriculture, forestry and fisheries, Mining, Sales, Services, Management works, Clerical works, Transportation and telecom works, Field works, Information technology engineer, Professional and technique works, Security, Others. Reference group is Others in estimation equations.
Change of job from last year	Equal to 1 if the job changed from the previous year.
Area Information	
Living in big city	Equal to 1 if the city is one of 14 big cities.
Other Information	
Year Dummy	Equal to 1 for each year. The reference group is 2004 in estimation equations.

In the first year survey (2004), the questionnaire only used a historical questionnaire for those aged between 18 and 68 years old. The historical questionnaire for those aged between 15 and 17 years old was added in the next year (2005). We use both as one set of historical data for those aged between 15 and 68 years old to calculate years of education, years of experience and tenure.

Figure 2 Wage Gap Between Married and Single Men in Japan



Source: KHPS 2004-2012.

Table 2 reports descriptive statistics for married and single males including individual, marital, and partner information. For married males, the average wage per hour is approximately 2,718 JPY or 1,900,000 JPY per year higher than a single male with an average wage per hour of 1,804 JPY, which implies an observable marriage wage premium for males in Japan.

For other variables, there is almost no difference in education years, and married males have more experience in the labor market and longer tenure than single males. This may be because of the average age difference between married and single individuals, and it is one possible reason for wage differences according to marital status. To eliminate this effect, we controlled for years of experience and tenure in estimations.

Both married men and single men have a similar distribution of educational

backgrounds. Almost 40 to 45% of men are high school graduates, and 34% are university graduates. Married males are composed of approximately 2% more junior high school graduates, and single males are composed of approximately 2.3% more vocational school graduates and 1% more graduate school graduates. We find that educational background does not affect wage differences according to marital status. Despite this, we still controlled for education years for the return on wages from education.

In Table 2, approximately 33.5% of wives are full-time housewives. "Other" wives study and care for family members and convalescents. Almost 35% of wives are non-regular workers, and 26.5% of wives are regular workers. Non-regular workers include part-time workers, contract workers, contingent workers, and temporary workers.

The descriptive statistics for males by the working status of their wives are shown in Table 3.[33] With respect to hourly wages, males have higher wages if their wives are engaged in full-time housework compared to males whose wives work outside the home or otherwise. Particularly, once males reach their 30s, Figure 3 indicates that intra-household specialization may increase male wage levels. However, we also consider the possibility of reverse causality. A woman may become a full-time housewife solely because her husband has a higher wage level compared to others. This would happen simultaneously with marriage; therefore, it is difficult to identify reverse effects. We assume this reverse causality is a time-

[33] Wage differences for each age generation between males by their marital status and wife's working status are shown in Figure 3.

Table 2 Descriptive Statistics by Marital Status

	Men			
	Married		Single	
	Mean	SD	Mean	SD
Explained Variable				
Wage per hour (JPY)	2784.388	3018.342	1836.550	2106.686
Individual Attributes				
Age	45.466	8.541	36.742	10.439
Duration of marriage	17.343	8.882		
Age of getting marriage	28.166	4.779		
Children	0.890	0.313	0.054	0.225
Children under 6	0.244	0.430	0.001	0.034
Educational Attributes				
Years of education	13.686	2.941	13.798	2.891
Junior high school	0.037	0.188	0.033	0.178
High school	0.448	0.497	0.428	0.495
Vocational school	0.073	0.260	0.090	0.287
University	0.362	0.481	0.339	0.473
Graduate school	0.043	0.203	0.056	0.231
Work Attributes				
Years of experience	24.938	9.214	15.868	11.062
Tenure	14.949	11.013	6.836	7.619
Regular worker	0.202	0.401	0.210	0.407
Company size > 500 employees	0.309	0.462	0.231	0.422
Change of job from last year	0.039	0.193	0.078	0.268
Area Attributes				
Residence in a big city	0.274	0.446	0.285	0.451
Working status of Wife				
Full-time housewife	0.335	0.472		
Others	0.048	0.214		
Irregular worker	0.352	0.478		
Regular worker	0.265	0.441		
N	5,642		1,770	

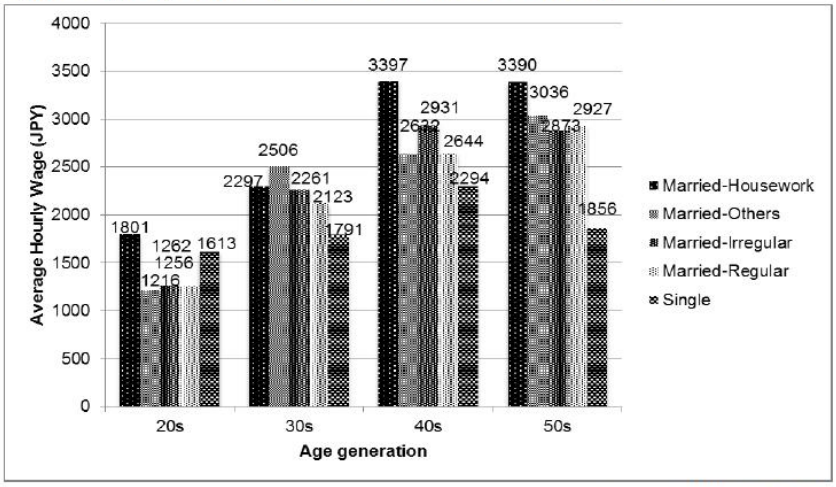
invariant effect (supposing every female maintains a constant possibility to be a full-time housewife throughout her life). Therefore, we used a fixed effects model to control for this endogeneity.

Table 3 Descriptive Statistics by Wife's Working Status

	Men			
	Full-time housewife		Other working status*	
	Mean	SD	Mean	SD
Explained Variable				
Wage per hour (JPY)	2946.004	2800.091	2702.848	3119.858
Individual Attributes				
Age	43.342	8.975	46.537	8.106
Duration of marriage	15.071	8.789	18.489	8.707
Age of getting marriage	28.311	4.397	28.093	4.960
Children	0.931	0.253	0.869	0.337
Children under 6	0.421	0.494	0.155	0.362
Educational Attributes				
Years of education	14.141	3.096	13.457	2.833
Junior high school	0.023	0.149	0.044	0.205
High school	0.405	0.491	0.47	0.499
Vocational school	0.063	0.244	0.078	0.268
University	0.402	0.49	0.342	0.475
Graduate school	0.078	0.269	0.025	0.157
Work Attributes				
Years of experience	22.405	9.549	26.215	8.768
Tenure	14.543	10.507	15.153	11.256
Regular worker	0.209	0.407	0.198	0.398
Company size > 500 employees	0.351	0.477	0.287	0.453
Change of job from last year	0.038	0.191	0.039	0.193
Area Attributes				
Residence in a big city	0.341	0.474	0.239	0.427
N	1,892		3,750	

* Wives are engaged in work, study, caring, and not involving housework.

Figure 3 Wage Gap for Men by Marital Status and Wife's Working Status



Source: KHPS 2004-2012.

Table 4 shows the transition matrix for males. The upper matrix shows the change in marital status, and the lower matrix shows the change in a wife's working status. A total of 5.11% of males changed their marital status from single to married according to these data, which is a sufficient marital change rate compared to the Japanese marriage change rate at 5.2% per 1,000 of the population, according to Japanese national vital statistics for 2014 for all age groups.[34] We believe this marital change rate is sufficient for the fixed effect model. The difference between the KHPS and the national data may be caused by the differences in the included generations (all generations in the national data and 20 to 59 year olds in the estimated sample in this paper) and a non-random attrition problem with the

[34] The divorce rate is approximately 0.6% from our sample data in Table 4 while it is approximately 1.7% per 1,000 of the population according to the national vital statistics in 2014. Additionally, the sample size of newly divorced men is small. It is effective to remove this sample to distinguish the marriage premium from the divorce premium. This can be one of the robustness checks.

KHPS. One future work is to control this attrition problem to review the robustness of previous studies.[35] Regarding the wife's working status, approximately 8.33% of wives quit their job or changed their working status to full-time housewife once married.[36] Additionally, approximately 19.53% of wives start work or commit to other responsibilities, such as caring for family members, rather than assuming full-time housework. We consider this transit rate to be sufficient for a fixed effect model.

3.3 Intra-household Specialization and Wage Premium

3.3.1 Empirical Methodology

For the intra-household specialization effect, we use the interaction term for marriage and wife's working status as a proxy variable.

In line with Wooldridge (2010), the estimation equation is the following Mincer equation,

$$\ln(hwage_{it}) = \alpha + \beta_1(Marriage)_{it} + \beta_2(Duration\ of\ Marriage)_{it} + (Marriage \times Working\ status\ of\ wife)_{it}\beta_3 + X_{it}\beta_4 + \beta_5 d_t + c_i + v_{it} \quad (1)$$

[35] One method to control for sample attrition bias is to use weighting to render the KHPS and the national data comparable. However, there is no comparable national data, and we decided to leave this problem for the future work.

[36] It is difficult to find a related national statistic. One possible statistic is in the White paper in 2015 by the Ministry of Health, Labour and Welfare in which we know there are approximately 8.7% of single women aged from 18 to 39 years old who intend to be a full-time housewife in 2010.

Table 4 Transition Matrix of Males

		T + 1			
		Single	Married	Total	
		0	1		
T	Single	1,243	67	1,310	N
	0	94.89	5.11	100	%
	Married	27	4,311	4,338	N
	1	0.62	99.38	100	%
	Total	1,270	4,378	5,648	N
		22.49	77.51	100	%

		T + 1			
		Other work*	Housework**	Total	
		0	1		
T	Other work	2,586	235	2,821	N
	0	91.67	8.33	100	%
	Housework	291	1,199	1,490	N
	1	19.53	80.47	100	%
	Total	2,877	1,434	4,311	N
		66.74	33.26	100	%

* Wives are engaged in work, study, caring, and not involving housework.

** Wives are full-time housewives.

where $\ln(hwage_{it})$ is the log of the hourly wage for individual i in time t; $Marriage$ is a dummy variable equal to one if married; $Duration\ of\ Marriage$ is the duration of marriage for each married male: $Marriage \times Working\ status\ of\ wife$ is the interaction term of marriage and the working status of the wife; X is a vector of individual attribution such as years of education; working experience and tenure; d is a year dummy; c is unobservable individual information, and the random variable v is an error term.[37]

The marriage effect on wages can be categorized in several ways such as short-term effect, long-term effect, and an effect mediating other factors. Males gain marriage utility from marital status and their marital life. If a man experiences comfort from living with his wife over time, for example, his wife cleans every day and prepares well-balanced meals. Then, the husband is free to concentrate on his work. This may lead to an increasing wage level. However, a dummy variable for marital status will not capture this effect. To catch this time-dependent effect, we use marriage duration as a proxy variable for the passage of time for the effect of marriage on wages.

We categorize wives' working status into four types: full-time housework; others including studying, caring for family members, and job searching; non-regular workers, and regular workers. Non-respondents for the wife's working

[37] Ginther and Zavodny (2001) show that the marriage effect on wages increases by approximately 10% according to the duration of marriage in OLS estimations compared with the period just after marriage and the period six years after marriage. Additionally, we assume that "duration of marriage" contains a motivation or satisfaction effect from marriage and having a family.

status were removed from the estimated data.[38] We set the interaction term for marriage and regular workers as a basis so that the interpretation is a comparison between the regular worker and another wife's working status. For example, if the coefficient of the interaction term of marriage and full-time housewives becomes positive and statistically significant, this implies that males have higher wages if their wives change their working status from regular worker to full-time housewife. This also implies that intra-household specialization causes a male wage premium according to marital status and wife's working status.

Typically, salaries increase rapidly, and there is more childcare support in a large company than a smaller company. Bang and Basu (2011) remark that "less skill-intensive industries often pay lower wages," and the authors also find that "employment in higher skill, higher paying industries is lower for married women." If an individual works for a larger company, the wage rate may be higher than the rate with a minor company in the same industry sector. Additionally, job type may affect a person's wage rate. For example, if an individual is a doctor, his wage rate may be higher than a company worker in the same age group. To consider these possible endogeneities between company-based information and marital status, we also use control dummy variables for company size and occupation type in the following equation according to several previous studies (Loh

[38] The number of removed samples is approximately 150. All data we show in tables are the data after exclusion.

1996, Gray 1997, Kawaguchi 2005, Sato 2012).

$$\ln(hwage_{it}) = \alpha + \beta_1(Marriage)_{it} + \beta_2(Duration\ of\ Marriage)_{it} + (Marriage \times Working\ status\ of\ wife)_{it}\beta_3 + X_{it}\beta_4 + \beta_5 d_t + \beta_6(Company\ size)_{it} + (Occupation\ types)_{it}\beta_7 + c_i + u_{it} \quad (2)$$

where *Company size* is a dummy variable for company size equal to one if a company has more than 500 employees and is equal to zero otherwise including the civil service. *Occupation types* are dummy variables equal to one if a job type corresponds to a job type shown in Table 1. The reference group is "Others." The random variable u is an error term.

3.3.2 Empirical Results and Discussion

Table 5 summarizes the results. Results (1) to (3) are OLS estimates, and results (4) to (6) are FE estimates. Appendix Table 1 shows the full results of Table 5 of both the OLS and FE estimates.

OLS estimates in result (1) are from equation (1) without the interaction term of marital status and wife's working status. The results show that married males have a 13.6% higher hourly wage than single males. Result (2) shows that the effect of marital status on wages decreases (7.8%) compared to result (1), and a male married to a full-time housewife has a 13.5% higher hourly wage rate than a married male with a regular working wife. This implies that males married to full-

Table 5 Results of OLS and FE estimates

	(1)	(2)	(3)	(4)	(5)	(6)
Model	OLS	OLS	OLS	FE	FE	FE
Explained Variable	ln (Wage)	ln (Wage)	ln (Wage)	ln (Wage)	ln (Wage)	ln (Wage)
Married	0.136	0.078	0.088	-0.070	-0.075	-0.069
	(0.045)***	(0.047)*	(0.044)**	(0.048)	(0.051)	(0.051)
Duration of marriage	0.009	0.009	0.007	-0.002	-0.001	-0.002
	(0.002)***	(0.002)***	(0.002)***	(0.004)	(0.004)	(0.004)
Children under 6 years old	-0.010	-0.043	-0.046	-0.010	-0.016	-0.015
	(0.026)	(0.027)	(0.026)*	(0.024)	(0.025)	(0.025)
Married × housewife		0.135	0.100		0.024	0.027
		(0.031)***	(0.028)***		(0.029)	(0.029)
Education years	0.046	0.045	0.028			
	(0.005)***	(0.005)***	(0.005)***			
Experience years	0.020	0.021	0.020	0.130	0.130	0.128
	(0.005)***	(0.005)***	(0.005)***	(0.039)***	(0.039)***	(0.039)***
$(Experienceyears)^2$	-0.047	-0.049	-0.044	-0.113	-0.113	-0.111
	(0.011)***	(0.011)***	(0.010)***	(0.015)***	(0.015)***	(0.015)***
Tenure	0.021	0.021	0.016	0.015	0.015	0.015
	(0.004)***	(0.004)***	(0.003)***	(0.004)***	(0.004)***	(0.004)***
$(Tenure)^2$	-0.005	-0.005	-0.007	-0.006	-0.006	-0.007
	(0.010)	(0.010)	(0.009)	(0.014)	(0.014)	(0.014)
Company size			0.164			0.080
			(0.020)***			(0.026)***
Constant term	6.306	6.311	6.424	5.470	5.468	5.441
	(0.105)***	(0.104)***	(0.119)***	(0.734)***	(0.734)***	(0.736)***
R^2	0.26	0.26	0.31	0.05	0.05	0.05
N	7,412	7,412	7,412	7,412	7,412	7,412

* p<0.1; ** p<0.05; *** p<0.01. Standard error is noted in brackets.
Other explained variables contain interaction terms of married dummy and wife's working status (non-regular worker, other unemployment status except full-time housewife, regular work dummy, big city dummy, and year dummies in all estimations. Occupation dummies are only in estimations (3) and (6). Appendix Table 1 shows full results.

time housewives have a 13.5% higher hourly wage than males married to regular working wives. The sum of both effects is 21.3% indicating that a man married to a full-time housewife has an hourly wage that is 21.3% higher than a man who is single. Result (3), which includes the company size and occupation type dummies, shows a higher marital effect (8.8%) and a lower full-time housewife effect (10%) than result (2). The sum of these effects (18.8%) is lower than result (2) (21.3%). This indicates that equation (1) over-estimated the effect of a full-time housewife and the sum of the marriage-related effect. Comparing result (1) to result (3), we find that the effect of company size and occupation type mediates the effect of marital status and wife's working status on male wage levels. We also find that if males have a marriage duration that is one year longer, males have a 0.9% higher hourly wage from results (1) and (2). After controlling for company size and occupation types, the effect is reduced to 0.7% in result (3). Therefore, company size and occupation type could mediate marriage duration also. In sum, OLS estimates show that marital status and a wife's working status represent marriage and intra-household specialization and other factors such as working for a large company.

With respect to other variables, if males have one more year of education, they earn, approximately, a 4.5% higher hourly wage in results (1) and (2) and a 2.8% higher wage after controlling for company size and occupation types in result (3). Tenure also shows similar findings in results (1) to (3), but years of experience does not change in any of the results.[39] Regardless of each result, education,

[39] If a male has one more year working in the same company, his wage would increase by 2.1%,

working experience, and company size affect wage levels, and this is consistent with the existing empirical evidence.

Even if the OLS results show a positive and statistically significant marriage-related effect on wages, FE estimates show no statistically significant results. Note that this result indicates that no wage differences are observed when males change their marital status or when their wives change their working status and do not indicate that there are no wage differences between married men and single men. Additionally, three coefficients for marital status became negative. It is difficult to interpret the meaning because the sample data consists of both males who married and males who divorced during the experimental periods. As the effect on wages would be different among married and divorced males, in the following section, we separate the samples into two: single, married, and newly married males; single, married, and newly divorced males as a robustness check.

The coefficient of the interaction term for married and full-time housewives is still positive but smaller than the OLS estimation and not statistically significant. It is also difficult to interpret the meaning because the sample data consists of wives changing their work from full-time housework to other work (regular work, non-regular work and others) and, conversely, there are 24 patterns. Therefore, we simply assume that these FE results indicate that a change in working status of wives does not cause male wage disparities.

The effect of marriage duration also disappeared in the FE estimates. The

but 1.6% after controlling for company size and job type. However, if a male has one more year of experience in the labor market, he would have approximately a 2% higher wage level regardless of company size and job types.

effect of years of experience, tenure, and company size decreased compared to OLS estimations but were still positive and statistically significant.

Although housewives have a partial effect on male wages in the OLS estimates, the fixed effect model showed that most factors causing wage differences depend on the change in marital status, and a wife's working status show some unobserved individual heterogeneity.[40] In short, men who may be particularly attractive, competent, or who possess some other characteristic that is unobserved in the data might be appreciated more by a boss or a potential spouse leading to both marriage and a higher wage. In addition, a woman may become a full-time housewife because of her husband's high wage or cultural observance. This result implies that these possible potential factors do affect male marriage wage premiums instead of marriage itself or intra-household specialization in Japan.

3.4 Robustness Check

3.4.1 Subsample Analysis

As the full sample contains both newly married males and newly divorced males, the FE results of marital status mix the effect of changing marital status from single to married (marriage) and from married to single (divorce). In order to distinguish the mixed effect of marriage and divorce, the sample was separated

[40] Korenman and Neumark (1991), Cornwell and Rupert (1995), Loh (1996), Gray (1997), Hersch and Stratton (1997), and Sato (2012) find that the marriage wage premium reduced or disappeared by controlling for individual time-invariant fixed effects.

into two parts: single, married, and newly married males; single, married, and newly divorced males. Tables 6 and 7 provide the results.

Table 6 Results of Subsample Analysis (Single male, Married male and Newly-married male)

	(7)	(8)	(9)	(10)	(11)	(12)
Model	OLS	OLS	OLS	FE	FE	FE
Explained Variable	ln (Wage)	ln (Wage)	ln (Wage)	ln (Wage)	ln (Wage)	ln (Wage)
Married	0.158	0.098	0.106	-0.040	-0.045	-0.041
	(0.046)***	(0.049)**	(0.046)**	(0.053)	(0.056)	(0.056)
Duration of Marriage	0.009	0.009	0.007	-0.002	-0.001	-0.002
	(0.002)***	(0.002)***	(0.002)***	(0.007)	(0.007)	(0.007)
Married × Housewife		0.134	0.099		0.021	0.024
		(0.031)***	(0.028)***		(0.029)	(0.029)
Firm size / Job Type Dummy	No	No	Yes	No	No	Yes
R^2	0.26	0.27	0.31	0.04	0.04	0.05
N	7,246	7,246	7,246	7,246	7,246	7,246

* p<0.1; ** p<0.05; *** p<0.01. Standard error is noted in brackets.

Table 7 Results of Subsample Analysis (Single male, Married male and Newly-divorced male)

	(13)	(14)	(15)	(16)	(17)	(18)
Model	OLS	OLS	OLS	FE	FE	FE
Explained Variable	ln (Wage)	ln (Wage)	ln (Wage)	ln (Wage)	ln (Wage)	ln (Wage)
Married	0.161	0.099	0.106	-0.037	-0.040	-0.031
	(0.052)***	(0.055)*	(0.052)**	(0.136)	(0.138)	(0.138)
Duration of Marriage	0.008	0.009	0.007	-0.002	-0.002	-0.002
	(0.003)***	(0.003)***	(0.002)***	(0.006)	(0.006)	(0.006)
Married × Housewife		0.129	0.092		0.019	0.023
		(0.031)***	(0.028)***		(0.031)	(0.031)
Firm size / Job Type Dummy	No	No	Yes	No	No	Yes
R^2	0.26	0.27	0.31	0.04	0.04	0.05
N	6,970	6,970	6,970	6,970	6,970	6,970

* p<0.1; ** p<0.05; *** p<0.01. Standard error is noted in brackets.

Even when separating the effect of marriage and divorce, the estimates still show no statistically significant results. Table 6 shows that married males have approximately a 10 to 15% point higher hourly wage than single males, and married males with full-time house wives have approximately 10 to 13% point higher

hourly wage than married males with regular working wives in the OLS estimates. Table 7 also shows similar results (approximately 10 to 16% for marital status and 10 to 13% for housewives). Both FE estimates of marital status in Tables 6 and 7 have no statistically significant results, and the coefficients are all negative indicating no wage differences observed when males change their marital status. This supports the robustness of the results in the previous section. As the investigation period, however, is only for the nine years, and both samples contain periods after marriage (divorced) for only a few years, these results also indicate that marriage does not increase male wage levels immediately or fully, indicating the absence of causality between marriage and wages. Furthermore, these results may also indicate there is no "temporary" wage increase (drop) from marital change.[41]

From these two subsample analyses, we establish that the results in Section 3.4 are robust for the nine years of panel data. It is still necessary to have a longer period of panel data to examine the effect of marriage on wages in the long term.

3.4.2 First Difference Estimation and "Past" Wife's Working Status

We are concerned with the accuracy of the variable "wife's working status." In the previous section, we simply used the "current" wife's working status. We consider that the number of years for which a wife had been a full-time housewife

[41] Though the results are OLS estimations, Ginther and Zavodny (2001) show that the marriage effect is less than 10% for males who are recently married and approximately 16 to 20% for males who have been married for six years.

might represent intra-household specialization more accurately than the current wife's working status. For example, a longer duration as a housewife implies better housework and frees husbands to pursue their own careers. Thus, using the number of years as a housewife as a proxy for intra-household specialization may show positive results. Unfortunately, that variable is not available from KHPS. Therefore, we apply two other models: the first-difference (FD) method or the use of the interaction term of "current" marital status and a "past" wife's working status.

First, we apply the first-difference method to estimate equations (1) and (2). In Table 8, result (19) is the FD estimate without the interaction term of marital status and current wife's working status, and it shows no marriage premium for males. Results (20) to (21), which are the results with the interaction term of marital status, current wife's working status (20), and dummies for company size and occupation types (21), show what other variables are the same as those of result (19): no statistically significant results are found. Regardless of each result, education, working experience and company size affect wage levels. Appendix Table 2 shows the full results of Table 8.

Second, we use three interaction terms of "current" marital status and three "past" periods of wife's working status to examine the effect of wife's working status on male wages instead of the number of years as a housewife. Three interaction terms are as follows: the interaction term of "current" marital status and wife's working status one year earlier; the interaction term of "current" marital status and wife's working status two years earlier, and the interaction term

Table 8 Results of FD Estimation

	(19)	(20)	(21)
Model	FD	FD	FD
Explained Variable	ln (Wage)	ln (Wage)	ln (Wage)
Married	-0.069	-0.055	-0.048
	(0.078)	(0.082)	(0.083)
Duration of marriage	0.004	0.005	0.005
	(0.005)	(0.005)	(0.005)
Children under 6 years old	-0.010	-0.015	-0.014
	(0.040)	(0.041)	(0.041)
Married × housewife		-0.013	-0.009
		(0.040)	(0.040)
Married × other unemployment status		0.021	0.027
		(0.046)	(0.046)
Married × non-regular worker		-0.043	-0.039
		(0.034)	(0.034)
Education years	0.354	0.356	0.350
	(0.173)**	(0.173)**	(0.189)*
Experience years	0.267	0.270	0.271
	(0.091)***	(0.090)***	(0.090)***
$(Experience\ years)^2$	-0.083	-0.085	-0.084
	(0.029)***	(0.029)***	(0.029)***
Tenure	0.021	0.021	0.020
	(0.009)**	(0.009)**	(0.009)**
$(Tenure)^2$	-0.038	-0.037	-0.035
	(0.028)	(0.028)	(0.027)
Regular worker	-0.059	-0.059	-0.051
	(0.072)	(0.072)	(0.071)
Big city	-0.068	-0.070	-0.076
	(0.079)	(0.079)	(0.078)
Company size			0.080
			(0.035)**
Constant term	-0.028	-0.029	-0.023
	(0.029)	(0.029)	(0.028)
R^2	0.01	0.01	0.02
N	5,070	5,070	5,070

* p<0.1; ** p<0.05; *** p<0.01. Standard error is noted in brackets.
All variables are the difference between a variable in time t and time t-1.
Other explained variables contain year dummies in all results and occupation dummies in result (21). Appendix Table 2 shows the full results for result (21).

of "current" marital status and wife's working status three years earlier. Table 9 summarizes the results. Results (22) and (23) are OLS estimates and results (24) and (25) are FE estimates. OLS estimates show that the effect of marital status on male wages increases over time while the effect of being a housewife decreases over time. Although OLS estimates have statistically significant results, FE estimates show interesting results. Over time, the effect of being a housewife on male wages disappears, but Table 9 shows statistically significant positive results of 5% for the effect of the occupation of a full-time housewife and 10% for the effect of a wife's occupation as a non-regular worker. The table indicates that married males with a full-time housewife have a 7.3% higher hourly wage than married males with a regular working wife and a similar percentage for married males with a non-regular working wife at 6.2%. The effect of being a full-time housewife may have a short-term effect on wages. Regarding Tables 9-2 and 9-3, no statistically significant results are observed in the FE estimates indicating that there is no effect from a change in a wife's working status on male wages.

From these two analyses, we establish that the results in Section 3 are robust, and there is no effect from marital status and full-time housewives on male wages.

3.4.3 Hours Spent on Housework Among Couples

We use the number of hours that husbands spend on housework as a proxy variable instead of marital status and the interaction term of marriage and the wife's working status. Figure 4 describes the amount of time spent on housework per

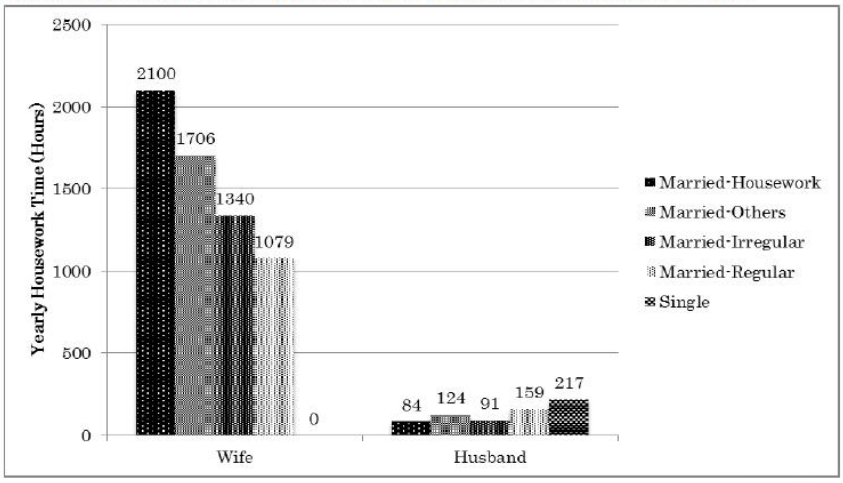
Table 9 Results of Estimations with "Past" Wife's Working Status

	(22)	(23)	(24)	(25)
Model	OLS	OLS	FE	FE
Explained Variable	ln (Wage)	ln (Wage)	ln (Wage)	ln (Wage)
9-1. T × T-1				
Married	0.067	0.081	-0.077	-0.066
	(0.052)	(0.050)	(0.064)	(0.064)
Duration of marriage	0.007	0.005	-0.002	-0.002
	(0.003)***	(0.002)**	(0.006)	(0.006)
Married × housewife*	0.183	0.145	0.073	0.073
	(0.034)***	(0.031)***	(0.036)**	(0.036)**
Married × other unemployment status*	0.125	0.120	0.069	0.068
	(0.052)**	(0.050)**	(0.046)	(0.046)
Married × non-regular worker*	0.092	0.066	0.063	0.062
	(0.032)***	(0.029)**	(0.033)*	(0.033)*
R^2	0.27	0.32	0.03	0.03
N	5,070	5,070	5,070	5,070
9-2. T × T-2				
Married	0.125	0.134	-0.001	0.013
	(0.058)**	(0.055)**	(0.079)	(0.079)
Duration of marriage	0.005	0.003	0.002	0.001
	(0.003)*	(0.003)	(0.008)	(0.008)
Married × housewife	0.160	0.125	-0.016	-0.012
	(0.037)***	(0.034)***	(0.041)	(0.041)
Married × other unemployment status	0.162	0.155	0.045	0.053
	(0.059)***	(0.055)***	(0.053)	(0.053)
Married × non-regular worker	0.066	0.038	-0.016	-0.013
	(0.036)*	(0.032)	(0.039)	(0.039)
R^2	0.26	0.31	0.02	0.03
N	3,782	3,782	3,782	3,782
9-3. T × T-3				
Married	0.167	0.183	0.034	0.041
	(0.065)**	(0.061)***	(0.107)	(0.107)
Duration of marriage	0.003	0.002	0.004	0.002
	(0.003)	(0.003)	(0.010)	(0.011)
Married × housewife	0.152	0.116	-0.017	-0.013
	(0.040)***	(0.037)***	(0.050)	(0.050)
Married × other unemployment status	0.114	0.086	-0.049	-0.053
	(0.066)*	(0.062)	(0.065)	(0.065)
Married × non-regular worker	0.081	0.056	0.037	0.039
	(0.040)**	(0.037)	(0.047)	(0.047)
R^2	0.25	0.31	0.02	0.03
N	2,729	2,729	2,729	2,729

* p<0.1; ** p<0.05; *** p<0.01. Standard error is noted in brackets.
Other explained variables contain education years in results (22), experience years and its square, tenure and its square, regular worker dummy, big city dummy and year dummies, in all results. Dummies of company size and occupation types are in estimations (23) and (25). We exclude other full results.

year for married couples according to a wife's working status. Housewives spend approximately 2,100 hours per year (about six hours per day) on housework, and regular working wives spend approximately 1,079 hours per year (about three hours per day) on housework. On the other hand, married males with full-time housewives spend 84 hours per year (about 14 minutes per day) on housework, and married males with regular working wives spend 159 hours per year (26 minutes per day) on housework. Full-time housewives spend twice as much time on housework as regular working wives, and the husbands of full-time housewives spend half as much time on housework as husbands with regular working wives. If this represents a difference in comparative advantage, it might represent a substitute for the wife's working status on the effect on male wages.

Figure 4 Housework Time Depends on Wife's Working Status for Married Couples



Source: KHPS 2004-2012.

We used a sample composed of nuclear families and singles who live alone only to exclude the distribution of chores to other family members such as parents.

The results in Table 10 (full results in the Table 5 of the Appendix), however, show no effect from the number of hours a wife spends on housework on the husband's wage levels for the FE estimates although the OLS estimates are statistically significant. When a man participates more in housework, his wage level decreases by 14.2 to 15.2% according to the OLS estimates. The negative effects disappear in the FE estimates. This finding is supported by the robustness results in Section 3.

Figure 4 shows obvious differences in the time spent on housework depending on marital status and a wife's working status. It is likely that the time spent on housework by a wife may not transfer to the husband's work time but to the husband's leisure time instead. Unfortunately, the KHPS is not a survey on time use; therefore, it is impossible to calculate leisure times. Using a time use survey to clarify the mechanism of time use and the relationship between wages and marriage is an opportunity for future research.

3.4.4 Company Size

In Section 3, we control heterogeneity for both wages and marital-related findings and found no causality between a change in marital status and male wages and between a change in a wife's working status and male wages. In this section, we examine any heterogeneous effect of marriage on male wages, such as company size or occupation types. The Appendix Tables 1 show that there are few occupation types that have statistically significant effects on male wages at

Table 10 Results for the Amount of Hours per Week Males Spend on Housework

	(26)	(27)	(28)	(29)
Model	OLS	OLS	FE	FE
Explained Variable	ln (Wage)	ln (Wage)	ln (Wage)	ln (Wage)
The male proportion of housework hours per week	-0.152	-0.142	0.029	0.022
	(0.058)***	(0.055)***	(0.061)	(0.061)
Duration of marriage	0.008	0.006	0.006	0.006
	(0.003)**	(0.003)**	(0.007)	(0.007)
Children under 6 years old	-0.006	-0.009	-0.012	-0.011
	(0.030)	(0.029)	(0.032)	(0.032)
Education years	0.046	0.026		
	(0.006)***	(0.007)***		
Experience years	0.022	0.022	0.067	0.076
	(0.008)***	(0.007)***	(0.089)	(0.089)
$(Experience\ years)^2$	-0.051	-0.047	-0.106	-0.103
	(0.017)***	(0.015)***	(0.028)***	(0.028)***
Tenure	0.018	0.013	0.007	0.006
	(0.005)***	(0.005)***	(0.007)	(0.007)
$(Tenure)^2$	0.004	0.002	0.014	0.013
	(0.014)	(0.013)	(0.026)	(0.026)
Regular worker	0.002	0.031	0.066	0.064
	(0.071)	(0.067)	(0.080)	(0.080)
Big city	0.049	0.061	-0.093	-0.097
	(0.032)	(0.030)**	(0.078)	(0.078)
Company size		0.175		0.076
		(0.027)***		(0.038)**
Constant term	6.444	6.690	6.508	6.386
	(0.136)***	(0.149)***	(1.653)***	(1.657)***
R^2	0.21	0.27	0.02	0.03
N	3,546	3,546	3,546	3,546

* p<0.1; ** p<0.05; *** p<0.01. Standard error is noted in brackets.
Other explained variables contain year dummies in all estimations.
Occupation dummies are only in estimations (27) and (29).
Appendix Table 5 shows full results.

a high percentage, whereas company size has a statistically significant positive effect on male wages even when controlling for unobservable individual heterogeneity. We assume that the effects of marital status or wife's working status on male wages are different for the employees of major and minor companies. For example, men who are married and employed by a large company are less likely to change jobs because they are well paid. Large company employers tend to have more incentives to promote or train employees than smaller companies. Thus, wage disparities occur only in a large company and not in a small company. In this section, we use two samples according to company size: one is a company with over 500 employees (a major company), and the other is a company with less than 500 employees (a minor company).

Tables 11 and 12 summarize the results. Table 11 reports the results of major companies, and Table 12 reports the results of minor companies. In Table 11, the OLS estimates show statistically significant positive effects for marital status and being a housewife on male wages, but the former effects disappear in Table 12 (for employees of minor companies). Although there are differences between the effects of marital status and a wife's working status in the OLS estimates, the FE estimates show no effects of marital status change and a change in a wife's working status except for wives who change working status to or from a state of unemployment. These estimates indicates that there is no difference in wage disparities according to a change in marital status between employees of a company with over 500 employees and a company with less than 500 employees.

Table 11 Results of Company Size (Over 500 Employees)

	Company Size (Over 500 Employees)			
	(30)	(31)	(32)	(33)
Model	OLS	OLS	FE	FE
Explained Variable	ln (Wage)	ln (Wage)	ln (Wage)	ln (Wage)
Married	0.165	0.161	-0.093	-0.085
	(0.070)**	(0.069)**	(0.097)	(0.098)
Duration of marriage	-0.000	-0.001	-0.002	-0.003
	(0.004)	(0.003)	(0.007)	(0.007)
Children under 6 years old	-0.129	-0.127	0.008	0.005
	(0.045)***	(0.044)***	(0.040)	(0.040)
Married × housewife	0.164	0.133	-0.009	-0.006
	(0.049)***	(0.046)***	(0.052)	(0.052)
Married × other unemployment status	0.037	0.040	-0.127	-0.117
	(0.069)	(0.067)	(0.067)*	(0.068)*
Married × non-regular worker	0.064	0.042	-0.066	-0.065
	(0.045)	(0.044)	(0.049)	(0.049)
Education years	0.040	0.029		
	(0.007)***	(0.007)***		
Experience years	0.017	0.014	0.078	0.072
	(0.008)**	(0.008)*	(0.094)	(0.096)
$(Experience\ years)^2$	-0.033	-0.022	-0.157	-0.155
	(0.019)*	(0.019)	(0.036)***	(0.037)***
Tenure	0.029	0.026	0.003	0.002
	(0.007)***	(0.006)***	(0.010)	(0.010)
$(Tenure)^2$	-0.021	-0.025	0.036	0.040
	(0.018)	(0.018)	(0.032)	(0.033)
Regular worker	0.217	0.188	-0.068	-0.062
	(0.085)**	(0.087)**	(0.125)	(0.126)
Big city	0.024	0.024	0.114	0.109
	(0.034)	(0.032)	(0.065)*	(0.066)*
Constant term	6.188	6.387	6.879	6.920
	(0.144)***	(0.161)***	(1.713)***	(1.736)***
R^2	0.34	0.37	0.07	0.08
N	1,963	1,963	1,963	1,963

* p<0.1; ** p<0.05; *** p<0.01. Standard error is noted in brackets.
Other explained variables contain year dummies in all results.

Table 12 Results of Company Size (Less than 500 Employees)

	Company Size (Less than 500 Employees)			
	(34)	(35)	(36)	(37)
Model	OLS	OLS	FE	FE
Explained Variable	ln (Wage)	ln (Wage)	ln (Wage)	ln (Wage)
Married	0.034	0.058	-0.081	-0.073
	(0.056)	(0.053)	(0.067)	(0.068)
Duration of marriage	0.012	0.010	0.005	0.003
	(0.003)***	(0.003)***	(0.006)	(0.006)
Children under 6 years old	-0.003	-0.014	-0.040	-0.036
	(0.033)	(0.032)	(0.035)	(0.035)
Married × housewife	0.113	0.090	0.030	0.029
	(0.037)***	(0.033)***	(0.039)	(0.040)
Married × other unemployment status	0.074	0.068	0.067	0.070
	(0.055)	(0.053)	(0.049)	(0.049)
Married × non-regular worker	0.030	0.024	0.022	0.025
	(0.036)	(0.033)	(0.037)	(0.037)
Education years	0.046	0.030		
	(0.006)***	(0.007)***		
Experience years	0.023	0.021	0.285	0.296
	(0.006)***	(0.006)***	(0.065)***	(0.066)***
$(Experience\ years)^2$	-0.052	-0.046	-0.115	-0.114
	(0.014)***	(0.013)***	(0.021)***	(0.021)***
Tenure	0.018	0.015	0.015	0.015
	(0.004)***	(0.004)***	(0.006)**	(0.006)**
$(Tenure)^2$	-0.004	-0.011	-0.013	-0.014
	(0.012)	(0.012)	(0.019)	(0.020)
Regular worker	-0.026	-0.014	-0.071	-0.068
	(0.063)	(0.059)	(0.047)	(0.048)
Big city	0.064	0.076	-0.111	-0.109
	(0.031)**	(0.030)**	(0.070)	(0.070)
Constant term	6.253	6.391	2.300	2.058
	(0.123)***	(0.142)***	(1.274)*	(1.284)
R^2	0.22	0.26	0.04	0.04
N	4,870	4,870	4,870	4,870

* p<0.1; ** p<0.05; *** p<0.01. Standard error is noted in brackets.
Other explained variables contain year dummies in all results.

3.4.5 Age Groups

Table 2 shows that the mean for marriage duration is approximately 17.3 years, and most individuals from the data are in their 40s combined with the mean married age for the current marriage (28 years old). Additionally, the sample size by age groups shows that married males in their 40s and 50s account for approximately 2,000 individuals for each group, married males in their 30s account for 1,397 individuals, and married males in their 20s account for 164 individuals. Therefore, our overall samples include more married males in their 40s and 50s. On the other hand, the single males group has more individuals in their 20s and 30s than in their 40s and 50s.[42] This sample size difference may be a possible reason for larger wage differences according to marital status. Thus, we estimated the equations separately by age group.

Appendix Table 4 shows the separated results for each age group. For all age groups, we find a 7 to 24% positive effect for full-time housewives in the OLS estimates and no statistically significant effect in the FE estimates.[43] The marital status effect on wages appeared strong only in the OLS estimates for those aged in their 50s, but the FE estimates show no statistically significant causality between

[42] Sample size by marital status and age groups: 164 (aged in their 20s and married), 1397 (aged in their 30s and married), 2019 (aged in their 40s and married), 2062 (aged in their 50s and married), 561 (aged in their 20s and single), 590 (aged in their 30s and single), 320 (aged in their 40s and single), 299 (aged in their 50s and single). The sample size by marital status is 5,642 individuals for married males and 1770 individuals for single males.

[43] In Appendix Table 4, the FE estimates of marital status are the following; 20s, from -22.9 to -19.2%; 30s, from -0.8 to 1.7%; 40s, from -1.3 to 2.3%; and 50s, from -3.2 to 2.7%. The FE estimates of full-time housewives are the following: 20s, from 3.3 to 6.3%; 30s, from -2.4 to 1.4%; 40s, 4.6%; and 50s, from 5.9 to 6.0%. All results are not statistically significant.

marital status and wages for all age groups.

The effect of marital status observed in Table 5 may catch up with the effect for those aged in their 50s indicating that wage disparities according to marital status is barely a factor caused by marriage within each group. Wage disparities, however, are shown in Figure 2 for each group except for those aged in their 20s, and the interaction term of marriage and full-time housewives shows statistically significant positive results for all age groups. It is possible that this interaction term absorbs the effect of marital status for those in their 20s to 40s in the OLS estimates. However so, we still find no effect from marital status and a wife's occupation as a full-time housewife on male wages in the FE estimates (footnote 16), which is confirmed by the robustness of the results in Section 3.

3.5 Conclusion

In this chapter, we applied an intra-household specialization hypothesis to examine the reason for observed wage differences according to marital status for Japanese men using Japanese panel data. The OLS estimates yielded a marriage wage premium for males of 8 to 14% and males with full-time housewives had a marriage premium of an additional 10 to 13%, results that are consistent with the literature. However, both effects disappeared in the FE estimates, and we conclude that the wage gap according to males' marital status is explained by unobservable individual heterogeneity. We conducted several subsample analyses to control for specific and possible heterogeneity, such as the fixed effect instrumental variable

method, the first difference method, using "past" wife's working status or the proportion of hours males spend on housework instead of "current" wife's working status, and estimating models by age generation. However, we found no statistically significant positive or negative effects from any factors related to marriage on male wages, indicating that the FE results are robust.

Although we did not find any clear evidence of the effect of intra-household specialization on male wages, wage differences between married males and single males are obvious. This chapter indicates that intra-household specialization is not a factor in wage determination in Japan, and there is still room to reveal an alternative factor that leads to wage disparities according to marital status such as personality traits, environmental factors, or cultural characteristics. One area for future study is to clarify the specific factors of unobservable individual heterogeneity affecting men's wages and representing the relationship between marriage and wages for women in Japan. Furthermore, it is also an important future work to control for attrition bias of the KHPS and review the robustness of the relationship between marriage and wages in Japan.

References

[1] Antonovics, K. and R. Town (2004) "Are All the Good Men Married? Uncovering the Sources of the Marital Wage Premium." *American Economic Review.* 94(2), 317-321.

[2] Bang J. T. and B. Basu (2011) "Marriage, Fertility, and the Selection of Women into High-Skill Industries." *Applied Economics Letters.* 19(9), 829-834.

[3] Bardasi, E. and M. Taylor (2008) "Marriage and Wages: A Test of the Specialization Hypothesis." *Economica.* 75, 569-591.

[4] Becker, G. S. (1973) "A Theory of Marriage: Part 1." *Journal of Political Economy.* 81, 813-846.

[5] Becker, G. S. (1974) "A Theory of Marriage: Part 2" *Journal of Political Economy.* 82, S11-S26.

[6] Becker, G. S. (1991) *A Treatise on the Family.* Cambridge, MA: Harvard University Press.

[7] Cornwell, C. and P. Rupert (1995) "Marriage and Earnings." *Federal Reserve Bank of Cleveland Economic Review.* 31(4), 10-20.

[8] Ginther, D. K. and M. Zavodny (2001) "Is the Marriage Premium due to Selection? The Effect of Shotgun Wedding on the Return to Marriage." *Journal of Population Economics.* 14, 313-328.

[9] Gray, J. S. (1997) "The Fall in Men's Return to Marriage: Declining Productivity Effects of Changing Selection?." *The Journal of Human Resources.* 32, 481-504.

[10] Hersch, J. and L. Stratton (1997) "Housework, Fixed Effects and Wages of Married Workers." *Journal of Human Resources.* 32, 285-307.

[11] Kawaguchi, A. (2005) "Kekkon to Shussan wa Danjo no Chingin ni Donoyōna Eikyō wo Oyoboshiteirunoka" (Does Marriage and Fertility Affect Men and Women's Income?). *The Japanese Journal of Labour Studies.* 535, 42-55.

[12] Kawaguchi, D. (2011) "Mincer gata Chingin Kansū no Nihon no Rōdōshijō heno Tekiyō" (Application to the Japanese Labor Market of the Mincer Warnings Function). *Current Trends in Economics 2011.* Tokyo Keizai Shimpo-sha, 67-98.

[13] Korenman, S. and D. Neumark (1991) "Does Marriage Really Make Men More Productive?. *Journal of Human Resources.* 26(2), 282-307.

[14] Loh, E. S. (1996) "Productivity Differences and the Marriage Wage Premium for White Males." *Journal of Human Resources.* 31(3), 566-589.

[15] Lundberg, S. and E. Rose (2002) "The effects of sons and daughters on men's labor supply and wages." *The Review of Economics and Statistics.* 84(2), 251-268.

[16] National Institute of Population and Social Security Research (2010) "The 14th Japanese National Fertility Survey." http://www.ipss.go.jp/ps-doukou/j/doukou14/doukou14.asp (accessed December 6, 2015)

[17] Pollmann-Schult, M. (2011) "Marriage and Earnings: Why Do Married Men Earn More than Single Men?." *European Sociological Review.* 27, 147-163.

[18] Ministry of Health, Labour and Welfare (2014) "Japanese National Vital Statistics." http://www.mhlw.go.jp/toukei/saikin/hw/jinkou/kakutei14/index.html (accessed December 6, 2015)

[19] Ministry of Health, Labour and Welfare (2015) "The White Paper." http://www.mhlw.go.jp/wp/hakusyo/kousei/15/ (accessed December 6, 2015)

[20] Organization for Economic Co-operation and Development (OECD) (2014) "Balancing Paid Work, Unpaid Work and Leisure." OECD Gender of equality webpage. http://www.oecd.org/gender/data/balancingpaidworkunpaidworkandleisure.htm (accessed December 15, 2014).

[21] Sato, K. (2012) "Propensity Score Matching Hō wo Mochiita Dansei no Marriage Premium no Kenshō" (Verify Male Marriage Wage Premium with

Propensity Score Matching) *Economic and Social Research Institute Economic Analysis.* 187, 47-68.

[22] Wooldridge, J. M. (2010) *Econometric Analysis of Cross Section and Panel Data second Edition.* The MIT Press.

[23] Yukawa, S. (2013) "Kekkon ga Dansei no Rōdōkyōkyū ni Ataeru Eikyō." (The Effect of Marriage on Male Labor Supply) Joint Research Center For Panel Studies Discussion Paper Series, DP2012-008.

4 Chapter 4 Variation in the Effects of the Big-Five Personality Traits; The 10-Item Scale versus the 44-Item Scale

4.1 Introduction

In Chapters 2 and 3, we find that wage differences between smokers and non-smokers and between married males who have full-time housewives and other males can be ascribed to individual unobservable differences, even after controlling for years of education, work experience, and job tenure effects. One important and curious area for future study is to clarify the specific factors of unobservable individual heterogeneity affecting wages. As Heckman et al. (2006) demonstrated the importance of both cognitive and non-cognitive skills on labor market outcomes, it has become popular to use personality traits as non-cognitive predictors of these outcomes. One key framework with which features of an individual's personality can be measured is commonly referred to as the Big-Five inventory.

In the field of psychology, researchers have established various means of quantitatively capturing human nature. The Big-Five personality traits are five broad dimensions that describe human personality in the field of psychology. These five dimensions of personality include: Extraversion, Agreeableness, Conscientiousness, Neuroticism, and Openness to Experience. This five-factor personality model was originally developed in the 1960s, and has undergone numerous revi-

sions given researchers' attempts to quantitatively capture personality. In applying the concept of the Big-Five to empirical research in economics, time limitations restrict the degree to which we can administer long questionnaires that measure personality traits. Instead, it is imperative that we utilize short (and precise) instruments that accurately measure the Big-Five personality traits.

In an attempt to shorten preliminary iterations of the Big-Five inventory, Gosling et al. (2003) developed five- and 10-item indices. They concluded that 10-item inventories designed to measure the Big-Five personality traits are as accurate as those that are comprised of 44-items. However, this finding does not suggest that 10-item Big-Five inventories would exert the same effects as 44-item inventories on academic or economic outcomes. To clarify the respective influences these indices would exert, in this chapter, we leverage two data sets—derived from the 10-item and 44-item inventories—to evaluate if the former measuring procedure is effective for empirical economic research.

Using inverse probability weighting to control distribution differences across the two datasets, we found that the effects of 10-item inventories on annual income do not perfectly correspond to the effects of 44-item inventories. Most notably, our results indicate that the Agreeableness dimension of the 10-item Big-Five inventory exerts slightly different effects on annual income than the 44-item inventory. In response to this result, we also estimated the effect of each individual item on annual income to identify the sources of variation in the dependent variables. The results identified several items that exerted distinct effects on annual income, indicating that these are the primary sources of the variance in the outcome.

To explore these issues further, we have organized this chapter into a series of interrelated sections. In Section 4.2, we review relevant literature. Following this, we describe our data and summarize it with descriptive statistics in Section 4.3. In Section 4.4, we describe the main results of our analyses. Finally, we offer some concluding remarks in Section 4.5.

4.2 Literature Review

Researchers often use panel data, which consists of repeated measurements of certain variables over time (Wooldridge 2005), to examine causality in economics. Panel data is particularly useful in economics because it allows for more accurate estimates of an effect by excluding time-invariant information, or "unobservable individual heterogeneity," which can influence both the outcome and the observable information. For example, according to Heckman (2000), the effects of cognitive skills (e.g., educational background) on human capital are biased if the influences of non-cognitive skills—like personality traits—are controlled for.

After Heckman and Rubinstein (2001) found that both cognitive and non-cognitive skills increase individual wages, many economics researchers began to explore the association between non-cognitive skills and educational or labor outcomes. Bowles et al. (2001), for example, found that non-cognitive skills partially influence the return on education. Similarly, Heckman et al. (2006) demonstrated that both self-control and self-esteem have a positive influence on individual wages; Fletcher (2013) showed that the "Extroversion" dimension of

the Big-Five Inventory exerts a similar effect on wages. Other cross-sectional and panel studies have also shown personality factors to have significant effects on wages (Heineck and Anger 2010; Mueller and Plug 2006; Nyhous and Pons 2005; Osborne-Groves 2005). Using Japanese data, Lee and Ohtake (2014) explored how non-cognitive skills (in the form of Big-Five personality traits) and behavioral characteristics (i.e., risk-aversion rate and time-discount rate) affect labor market outcomes in Japan and the United States. Their results indicate that the relationship between personality factors and wages is moderated by country and gender.

The most well-known and comprehensive version of the Big-Five inventory, called the NEO Personality Inventory (or the NEO Personality Inventory, Revised NEO-PI-R) was developed by Costa and McCrae (1991) and contains 240 items. Though this index is comprehensive, experts found that completion of the inventory took roughly 45 minutes (Gosling et al. 2003). Other psychology researchers have developed shortened versions of the original NEO Personality Inventory, including 100-item (Goldberg 1992), 60-item (Costa & McCrae 1992), and 44-item (Benet-Martinez & John 1998; John & Srivastava 1999) indices. However, each of these required five minutes to complete. Though five minutes is a marked improvement on the 45 minutes required by the original NEO Personality Inventory, it is still relatively lengthy for experimental use. Gosling et al. (2003) attempted to reduce the length of the questionnaire further, to five or 10 items.[44] In their

[44] They selected each descriptor from the existing Big-Five instruments—Goldberg's (1992) list of unipolar and bipolar Big-Five markers and John and Srivastava's (1999) Adjective Checklist Big-Five markers—under the following five guidelines: "retain breadth of coverage, represent

experiment, undergraduate students were assessed using both short (five or 10 items) and long (44 items) instruments. Specifically, they examine the convergent correlations between short and long instruments to determine if the five- and 10-item indices could measure personality as effectively as their 44-item index. Their results show that the 10-item index captures the Big-Five personality traits as effectively as the 44-item inventory from which it was derived. [45]

In Japan, scholars at Osaka University used the 10-item index in the context of a research project called the Preference Parameters Study. Concise, reliable indices would facilitate research on how the Big-Five personality traits influence specific variables. To this end, we seek to indicate how the 10-item Big-Five inventory compares to the more widely-used 44-item inventory when used in the estimation of annual income.

---

both poles of each dimension, avoid items that were evaluatively extreme, avoid items that were simply negations, and avoid redundancy among items" (Gosling et al. 2003 p.516). The items are listed in Appendix Table 1.

[45] The convergent correlation is an approach used by researchers in sociology, psychology, and other behavioral sciences to estimate the degree of two measures to know how they are related. If two measures are theoretically similar, then correlation coefficient should be high, and vice versa. Convergent correlations between five-item and 44-item indices for the Big-Five personality traites are 0.80 (Extraversion), 0.58 (Agreeableness), 0.65 (Conscientiousness), 0.69 (Neuroticism), and 0.48 (Openness to experiences). Convergent correlations between 10-item and 44-item indices for the Big-Five personality traits are 0.87 (Extraversion), 0.70 (Agreeableness), 0.75 (Conscientiousness), 0.81 (Neuroticism), and 0.65 (Openness to experiences). All results are statistically significant at the 1% level(Gostling et al. 2003).

4.3 Data and Descriptive Statistics

4.3.1 4.3.1 Data

We used two sets of data to perform our analyses. The first dataset (hereafter Data 1) was comprised of data collected for the Preference Parameters Study performed by researchers from the Osaka University of Japan (JPPS). These data were from 2003 to 2013.[46] The other dataset (hereafter, Data 2) was collected via a nationwide Internet survey in Japan between 2011 and 2012.[47] Data 2 were collected for a research project sponsored by the Japan Society for the Promotion of Science. Both datasets included respondents' working status, years of working experience, tenure, and education levels.

The two respective datasets used two different measures for the Big-Five personality traits. Data 1 included data derived from Gosling et al.'s (2003) Ten-item Personality Inventory. These data were available only from 2012. Data 2 per-

[46] Data 1 comprised respondents from four waves of data collection. Wave 1 had 1,418 individuals since 2003; Wave 2 included data from 3,161 individuals since 2004; Wave 3 had 1,396 individuals since 2006; and Wave 4 featured 3,704 respondents since 2009. The questionnaire used to collect data contained items related to both basic information and respondent preferences. The purpose of these data was "to calculate parameters of preferences defining utility function; time preference, risk aversion, habit formation, externality." See $http://www.iser.osaka-u.ac.jp/coe/journal/eng_panelsummary.html$ for more details about the data.

[47] The survey was sent via the Internet to 16,930 randomly selected individuals between February 16 and 22, 2011. Of these surveys, 11,556 were returned. All respondents were monitors registered with a private Internet survey institute. To ensure the external validity of the survey within Japan, respondent sets were divided along 15 lines (age [five groups] × income class [three groups]). These 15 groups were based on the recommendations of two official statistical publications—the 2005 Population Census and the 2009 Comprehensive Survey of Living Conditions of the People on Health and Welfare. This survey contained subjective assessments of well-being, personal traits, and perceived neighborhood characteristics.

sonality data were derived from the 44-item Personality Inventory, though only in the year 2011. This is a well-established and pervasive procedure for measuring personality. In analyses, we normalized and scaled the Big-Five personality traits (Extraversion, Agreeableness, Conscientiousness, Neuroticism, and Openness to experience) to be between 0 and 1.[48]

4.3.2 Descriptive Statistics and Weighting

4.3.2.1 Descriptive StatisticsTable 1 summarizes the descriptive statistics provided by the respondents, including their personality data. As we compare the estimation of the Big-Five personality traits of the income equation, the sample data include only working individuals under the age of 60. Because of mandatory retirement in Japan, income declines rapidly after 60 years of age.

A comparison of the two datasets indicates that Data 2 respondents tended to be better educated and have a higher annual income than Data 1 respondents. In contrast, Data 1 respondents tended to be older and have more work experience than Data 2 respondents. For males, Table 1 shows that Data 2 respondents make about JPY 150,000 more per year than their Data 1 counterparts. In addition,

[48] Data 1 consisted of ten questions; Data 2 consisted of 44 questions. For each questionnaire, the items were intended to measure one of the Big-Five personality traits. Items in the 10-question survey took the form of Likert scales ranging from 1 (Strongly Disagree) to 7 (Strongly Agree). Items in the 44-question survey too were in the form of Likert scales, but ranged from 1 (Strongly Disagree) to 6 (Strongly Agree). For both instruments, all statements that were oppositely worded were reverse coded. We also used a min-max normalization method to standardize responses on a scale from 0 to 1. This normalization method can be described with the following formula: $Normalized(x_i) = \frac{x_i - X_{min}}{X_{max} - X_{min}}$, where X_{min} is the minimum value for variable X, and where X_{max} is the maximum value for variable X. Following normalization, we averaged the standardized values of all items associated with a given personality trait within each respective instrument.

Table 1 Descriptive Statistics

	Male				Female			
	Data 1		Data 2		Data 1		Data 2	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Explained variable								
Annual income (10,000 JPY)	524.39	268.39	541.64	314.88	238.03	173.23	237.33	168.14
Individual attributes								
Age	45.81	8.67	42.56	9.67	44.75	8.91	38.85	10.55
Years of education	13.86	2.27	14.95	2.01	13.34	1.73	14.30	1.81
Junior high school	0.04	0.20	0.02	0.13	0.03	0.16	0.01	0.10
High school	0.45	0.50	0.21	0.41	0.47	0.50	0.25	0.44
Vocational school	0.08	0.28	0.14	0.35	0.31	0.46	0.34	0.47
University	0.39	0.49	0.54	0.50	0.19	0.39	0.35	0.48
Graduate school	0.04	0.20	0.10	0.29	0.01	0.09	0.04	0.20
Weekly work hours	50.16	12.39	43.58	12.75	34.70	13.92	33.11	14.30
Potential work experience	25.94	9.05	21.61	9.90	25.41	9.43	18.55	11.01
Tenure	17.39	10.69	12.66	10.17	9.52	8.75	6.62	6.94
Big Five personality traits								
Extraversion	0.49	0.22	0.44	0.14	0.54	0.22	0.47	0.15
Agreeableness	0.65	0.16	0.60	0.11	0.66	0.15	0.61	0.11
Conscientiousness	0.49	0.18	0.56	0.13	0.48	0.18	0.56	0.13
Neuroticism	0.49	0.17	0.50	0.12	0.52	0.17	0.52	0.13
Openness to Experience	0.51	0.17	0.51	0.14	0.46	0.18	0.51	0.14
N	984		3,840		915		2,198	

roughly 80% and 75% of the respondents that comprise Data 2 graduated from vocational school, university, or graduate school. Half of the respondents in Data 1 graduated from junior high school or high school. Data 1 respondents work between one to six hours per week more than Data 2 respondents (and have five to seven years' of additional experience in the labor market).

Data on personality factors indicate that Data 1 respondents score higher than Data 2 respondents in Extraversion and Agreeableness. In contrast, Data 2 respondents score higher or similarly on Conscientiousness, Neuroticism, and Openness to Experience as compared to their Data 1 counterparts. Taken together, Table 1 indicates that the two respective sets of respondents differed in terms of age, educational background, and experience in the labor market.

4.3.2.2 Descriptive Statistics with Inverse Probability WeightingAs shown in the previous section, respondents that comprise the two datasets differ in terms of age, educational background, and experience in the labor market. To utilize these respective datasets to estimate the models described above (thereby allowing for comparison of the two datasets), it is first necessary to control for the differences in the populations that comprise them. To render the two datasets comparable, we applied an inverse probability weighting (IPW) method. Generally, IPW offers solutions to problems associated with missing data and sample selection. For the purposes of this analysis, we used IPW to transform the background variables in each dataset such that they follow relatively similar distributions.

First, we combined two data sets and used logistic estimation to determine the

probability of being from Data 1. The equation model is expressed as follows

$$Data_i = \alpha + X_i\beta_1 + e_i$$

where $Data_i$ represents a dummy variable equal to one if an individual is from Data 1, and equal to zero for an individual who is from Data 2. The variable X consists of sex, age, educational background, annual income, and weekly working hours. The random variable e_i is an error term. Then, we consider the reciprocal of the estimated probability of being in Data 1 as the IPW for each individual.

Table 2 Descriptive Statistics with IPW

	Male				Female			
	Data 1		Data 2		Data 1		Data 2	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Explained variable								
Annual income (10,000 JPY)	512.54	10.32	542.45	5.15	240.82	6.26	236.24	3.86
Individual attributes								
Age	41.91	0.41	43.60	0.16	41.10	0.38	40.95	0.24
Years of education	14.84	0.08	14.69	0.04	14.00	0.07	13.95	0.04
Junior high school	0.02	0.00	0.03	0.00	0.01	0.00	0.02	0.00
High school	0.26	0.01	0.25	0.01	0.30	0.01	0.34	0.01
Vocational school	0.11	0.01	0.13	0.01	0.36	0.02	0.32	0.01
University	0.53	0.02	0.50	0.01	0.30	0.02	0.29	0.01
Graduate school	0.09	0.01	0.08	0.00	0.02	0.01	0.03	0.00
Weekly work hours	49.27	0.57	43.67	0.21	34.94	0.55	32.97	0.31
Potential work experience	21.07	0.44	22.91	0.17	21.10	0.41	21.00	0.26
Tenure	14.45	0.38	13.27	0.18	8.01	0.26	7.29	0.18
Big Five personality traits								
Extraversion	0.49	0.01	0.44	0.00	0.54	0.01	0.47	0.00
Agreeableness	0.65	0.01	0.60	0.00	0.66	0.01	0.61	0.00
Conscientiousness	0.48	0.01	0.56	0.00	0.47	0.01	0.56	0.00
Neuroticism	0.49	0.01	0.50	0.00	0.53	0.01	0.51	0.00
Openness to Experience	0.51	0.01	0.51	0.00	0.47	0.01	0.51	0.00
N	984		3,840		915		2,198	
N with IPW	4,835		4,890		2,804		3,289	

Table 2 offer descriptive statistics derived from the application of the IPW method. After adjusting the data with IPW, Data 1 and Data 2 appear to have similar values for each variable. According to Table 2, half of all males in both datasets graduated from university, and 30% of all females in both datasets graduated from high school, vocational school, or university. In addition, the average age of the respondents in both datasets was adjusted to the early 40s. However, as shown in Table 2, there remain a number of small differences between Data 1 and Data 2. For instance, Data 1 respondents still report having longer working hours at their positions than Data 2 respondents. Differences in annual income were adjusted, but slight differences remain for males. To confirm the robustness of these small differences, we added occupation and industry information to make another IPW.[49] Appendix Table 2 shows the descriptive statistics using the results from the new IPW. Although this new IPW allows for the control of differences between many variables, there remain slight differences between the two datasets in terms of annual income and weekly working hours.

Though adjustments have brought the Big-Five personality traits in the two datasets into closer alignment, there remain obvious differences. Data 1 respondents tended to score higher than their Data 2 counterparts in Extraversion and Agreeableness; Data 2 respondents scored higher in Conscientiousness. The ad-

[49] We controlled company size (equal to one if company size is more than 500 employees), seven occupations (Agriculture, forestry and fisheries; Files works; Sales; Services; Clerical works; Professional and technique works; Management works; and Other works, which is the reference group), eight industry sectors (Agriculture, forestry and fisheries; Construction; Manufacturing; Wholesale trade and retail trade; Finance, insurance and real estate; Transportation and telecommunications; Utilities; Services; and Other industries, which is the reference group).

justments did bring the respective participant sets closer in some instances: Males in Data 1 and 2 reported being similar in terms of Neuroticism and Openness to Experience.

4.4 Results and Discussion

4.4.1 Correlations between the Big-Five personality traits and Individual Attributes

If both the Big-Five personality traits in Data 1 and 2 represent the same personality of identical individuals, and they are indeed factors of unobservable individual heterogeneity leading to wage differences between smokers and nonsmokers and between married males who have full-time housewives and other males in Chapters 2 and 3, the impact of the effect of the Big-Five personality traits on wages would be the same for the two datasets. First, we review and compare the correlations between the Big-Five personality traits and Individual attributes for Data 1 and 2 in Tables 3 and 4, respectively.[50] Table 3 shows the results for males and Table 4, for females.

Table 3 shows that there are obvious differences between Data 1 and 2 for males. For example, in Data 2, Extraversion and Agreeableness have positive correlation though negative correlation is observed in Data 1 (the coefficient is not statistically significant). Other results for the Big-Five personality traits show

[50] As Data 1 and 2 contain only the category data for annual income, we use the median annual income for each category as the individual wage level in the present study.

Table 3 The correlation between Big Five personality traits and Individual Attributes of Male

	Extraversion		Agreeableness		Conscientiousness	
	Data 1	Data 2	Data 1	Data 2	Data 1	Data 2
Big Five personality traits						
Extraversion	1.0000	1.0000				
Agreeableness	-0.0358	0.0339**	1.0000	1.0000		
Conscientiousness	0.2364***	0.2947***	0.2085***	0.5309***	1.0000	1.0000
Neuroticism	-0.2203***	-0.3831***	-0.2705***	-0.3936***	-0.2646***	-0.5553***
Openness to Experience	0.3253***	0.4506***	0.0158	0.3084***	0.1504***	0.4433***

	Extraversion		Agreeableness		Conscientiousness	
	Data 1	Data 2	Data 1	Data 2	Data 1	Data 2
Individual attributes						
Annual income	0.0638**	0.1291***	0.1196***	0.1178***	0.1907***	0.2304***
Age	-0.0129	0.0545***	0.1085***	0.1388***	0.1326***	0.1811***
Educational attributes						
Years of education	-0.0027	0.0419***	0.1284***	0.0718***	0.0684**	0.0672***
Junior high school	0.0456	-0.0213	-0.0572*	-0.0126	0.0496	-0.0198
High school	-0.0284	-0.0294*	-0.0925***	-0.0630***	-0.0920***	-0.0440***
Vocational school	-0.0341	-0.0203	-0.0174	-0.0148	-0.0322	-0.0276*
University	0.0539*	0.0410**	0.1150***	0.0445***	0.0725**	0.0339**
Graduate school	-0.0573*	0.0047	0.0297	0.0345**	0.0467	0.0447***
Working attributes						
Potential work experience	-0.0116	0.0447***	0.0718**	0.1209***	0.1099***	0.1632***
Tenure	-0.0132	0.0101	0.0564*	0.0268*	0.0980***	0.1028***
Weekly work hours	0.0232	0.0512***	0.0708**	0.0479***	0.0523	0.0609***
Regular work	0.0271	0.0713***	0.0671**	0.0053	0.0881***	0.0816***
Smoking						
Smoking	0.1238***	0.0899***	-0.0111	-0.0260	-0.0716**	0.0146
Marriage related attributes						
Marriage	0.1227***	0.1501***	0.0634**	0.0600***	0.1407***	0.1697***
Children	0.1206***	0.1369***	0.0452	0.0430***	0.1225***	0.1553***
Spouse housework	0.0264	0.0250	0.0455	0.0319**	0.0659**	0.0789***
Spouse other work	0.0033	0.0092	0.0147	0.0584***	0.0297	0.0269*
Spouse non-regular work	0.0279	0.0650***	-0.0167	0.0450***	0.0231	0.0718***
Spouse regular work	0.0793**	0.0908***	0.0343	-0.0211	0.0376	0.0409**

* p<0.1; ** p<0.05; *** p<0.01. The sample data include only working individuals under the age of 60.

Table 3 The correlation between Big Five personality traits and Individual Attributes of Male(Cont.)

	Neuroticism		Openness to Experience	
	Data 1	Data 2	Data 1	Data 2
Big Five personality traits				
Extraversion				
Agreeableness				
Conscientiousness				
Neuroticism	1.0000	1.0000		
Openness to Experience	-0.2155***	-0.2993***	1.0000	1.0000

	Neuroticism		Openness to Experience	
	Data 1	Data 2	Data 1	Data 2
Individual attributes				
Annual income	-0.1027***	-0.2320***	0.0312	0.1480***
Age	-0.0336	-0.1638***	-0.0194	0.1695***
Educational attributes				
Years of education	-0.1187***	-0.1034***	0.0250	0.0835***
Junior high school	0.0112	0.0520***	-0.0006	-0.0232
High school	0.1041***	0.0507***	-0.0239	-0.0586***
Vocational school	0.0183	0.0605***	0.0180	-0.0200
University	-0.0970***	-0.0614***	-0.0019	0.0302*
Graduate school	-0.0577*	-0.0607***	0.0389	0.0637***
Working attributes				
Potential work experience	-0.0025	-0.1389***	-0.0249	0.1486***
Tenure	0.0100	-0.0902***	-0.0644**	0.0558***
Weekly work hours	-0.0896***	-0.0545***	0.0666**	0.0537***
Regular work	-0.0527	-0.1243***	-0.0275	0.0579***
Smoking				
Smoking	0.0224	-0.0158	-0.0083	0.0119
Marriage related attributes				
Marriage	-0.0945***	-0.1673***	-0.0055	0.0678***
Children	-0.0749**	-0.1371***	-0.0118	0.0720***
Spouse housework	-0.0440	-0.1030***	-0.0203	0.0050
Spouse other work	-0.0095	-0.0250	0.0098	0.0501***
Spouse non-regular work	-0.0106	-0.0530***	0.0068	0.0299*
Spouse regular work	-0.0327	-0.0302	-0.0014	0.0396**

* p<0.1; ** p<0.05; *** p<0.01.
The sample data include only working individuals under the age of 60.

stronger correlations in Data 2 than in Data 1, though the directions remain the same. Regarding correlations between the Big-Five personality traits and Individual attributes, Data 2 mostly shows stronger correlations than Data 1. The directions of the correlation are opposite between Extraversion and age, educational attributes (years of education, junior high school, and graduate school), and working attributes (potential work experience and tenure); between Agreeableness and spouse working status (regular worker and non-regular worker); between Conscientiousness and educational attributes (junior high school) and smoking status; between Neuroticism and tenure and smoking. The opposite correlation between Openness to Experience and individual attributes in the two datasets are particularly in working attributes, smoking, and marriage-related attributes. Appendix Table 3 summarizes the estimation results of a simple linear regression for each Big-Five personality trait on annual income, years of education, smoking and marriage for males. Unsurprisingly, the results of Openness to Experience are different for the two datasets: the effects on annual income and marriage are positive but statistically insignificant in Data 1, the effects on years of education and smoking are negative but statistically insignificant in Data 1 and only on smoking in Data 2. Other Big-Five personality traits also show opposite effects for Data 1 and 2 on years of education (only Extraversion) and smoking (except Extraversion).

In Table 4, for females, the differences observed are higher than those for males. Basically, Data 2 have stronger correlations between the Big-Five personality traits and other factors if the directions of the correlation are the same for the two datasets. However, the directions are mostly opposite, with the exception of

Table 4 The correlation between Big Five personality traits and Individual Attributes of Female

	Extraversion		Agreeableness		Conscientiousness	
	Data 1	Data 2	Data 1	Data 2	Data 1	Data 2
Big Five personality traits						
Extraversion	1.0000	1.0000				
Agreeableness	-0.0031	0.0709***	1.0000	1.0000		
Conscientiousness	0.1567***	0.2724***	0.1908***	0.5084***	1.0000	1.0000
Neuroticism	-0.1577***	-0.3638***	-0.2528***	-0.3900***	-0.2147***	-0.5282***
Openness to Experience	0.3186***	0.4182***	-0.0461	0.2515***	0.1343***	0.3943***

	Extraversion		Agreeableness		Conscientiousness	
	Data 1	Data 2	Data 1	Data 2	Data 1	Data 2
Individual attributes						
Annual income	0.0981***	0.1191***	0.0389	0.0091	0.0752**	0.0827***
Age	-0.0109	0.0795***	0.0808**	0.1842***	0.1616***	0.2075***
Educational attributes						
Years of education	-0.0023	0.0491**	0.0227	0.0288	-0.0211	0.0836***
Junior high school	0.0669**	-0.0038	0.0151	-0.0425**	-0.0222	-0.0461**
High school	-0.0287	-0.0613***	-0.0622*	-0.0206	0.0144	-0.0510**
Vocational school	-0.0071	0.0455**	0.0637*	0.0235	0.0338	-0.0032
University	0.0087	-0.0121	0.0098	-0.0033	-0.0476	0.0330
Graduate school	0.0402	0.0564***	-0.0530	0.0191	-0.0073	0.0642***
Working attributes						
Potential work experience	-0.0099	0.0681***	0.0723**	0.1717***	0.1566***	0.1850***
Tenure	-0.0253	0.0489**	0.0331	0.0750***	0.0340	0.1170***
Weekly work hours	0.0192	-0.0168	0.0023	-0.0818***	0.0021	-0.0414*
Regular work	0.0242	0.0447*	0.0033	-0.0505**	-0.0164	-0.0150
Smoking						
Smoking	0.1336***	0.0645***	0.0150	0.0157	0.0001	-0.0071
Marriage related attributes						
Marriage	0.0540	0.1213***	0.0246	0.0959***	0.0873***	0.1400***
Children	0.0813**	0.0984***	0.0204	0.1111***	0.1051***	0.1021***
Spouse housework	-0.0008	-0.0297	-0.0278	0.0419**	-0.0094	0.0194
Spouse other work	0.0136	-0.0062	0.0046	-0.0102	-0.0362	0.0095
Spouse non-regular work	0.0051	-0.0117	0.0178	0.0142	0.0012	0.0028
Spouse regular work	0.0443	0.1340***	0.0019	0.0824***	0.0733**	0.1351***

* p<0.1; ** p<0.05; *** p<0.01. The sample data include only working individuals under the age of 60.

Table 4 The correlation between Big Five personality traits and Individual Attributes of Female (Cont.)

	Neuroticism		Openness to Experience	
	Data 1	Data 2	Data 1	Data 2
Big Five personality traits				
Extraversion				
Agreeableness				
Conscientiousness				
Neuroticism	1.0000	1.0000		
Openness to Experience	-0.0961***	-0.2489***	1.0000	1.0000

	Neuroticism		Openness to Experience	
	Data 1	Data 2	Data 1	Data 2
Individual attributes				
Annual income	-0.1015***	-0.0960***	0.0924***	0.1035***
Age	-0.0902***	-0.2629***	-0.0421	0.0913***
Educational attributes				
Years of education	-0.0156	-0.0677***	0.0479	0.0891***
Junior high school	0.0240	0.0393	0.0017	-0.0167
High school	-0.0069	0.0579***	-0.0553*	-0.0681***
Vocational school	0.0096	-0.0302	0.0380	0.0017
University	-0.0062	-0.0087	0.0131	0.0311
Graduate school	-0.0278	-0.0542**	0.0533	0.0792***
Working attributes				
Potential work experience	-0.0824**	-0.2407***	-0.0485	0.0729***
Tenure	-0.0693**	-0.1275***	-0.0044	0.0559***
Weekly work hours	-0.0365	0.0513**	0.0572*	0.0007
Regular work	-0.0331	0.0482**	0.0496	0.0350
Smoking				
Smoking	0.0399	-0.0102	0.0040	0.0300
Marriage related attributes				
Marriage	-0.0317	-0.1577***	-0.0200	-0.0197
Children	-0.0284	-0.1701***	-0.0351	-0.0519**
Spouse housework	-0.0220	-0.0236	-0.0213	-0.0299
Spouse other work	0.0304	-0.0352*	0.0323	-0.0074
Spouse non-regular work	-0.0268	-0.0382*	-0.0061	-0.0310
Spouse regular work	-0.0151	-0.1371***	-0.0161	-0.0009

* p<0.1; ** p<0.05; *** p<0.01.
The sample data include only working individuals under the age of 60.

annual income, marriage, children, and spouse regular work. Appendix Table 4 is the estimation results of simple linear regression of each Big-Five personality trait on annual income, years of education, smoking and marriage for females. The results for the two datasets are similar in Table 4.

Concerning the relationship between the Big-Five personality traits and smoking, relations are positive between Extraversion and smoking for both males and females, but no statistically significant relationships are observed between other personality traits and smoking. This indicates the Big-Five personality traits have low potential for explaining the factors of unobservable individual heterogeneity. On the other hand, the relationship between the Big-Five personality traits and marriage-related attributes seems to be stronger than the relationship with smoking. Almost all Big-Five personality traits have statistically significant positive or negative correlations with marriage status, especially for males. Though there is variability among spouse working status, the Big-Five personality traits are the likely factors of unobservable individual heterogeneity when explaining wage differences between married males who have full-time housewives and other males in Chapter 3.

Through these results, it is obvious that the relationship between the Big-Five personality traits and individual attributes seems to be different for Data 1 and 2. This can be deemed to imply that the Big-Five personality traits in Data 1 represent a different personality from the Big-Five personality traits in Data 2. Next, we focus on annual income and review how the differences in the two datasets observed in the estimations of the income equation after controlling for other factors,

affect income.

4.4.2 Effect of the Big-Five personality traits on Annual Income

In accordance with the work of Lee and Ohtake (2014), we estimated the equation that respectively treats annual income as a dependent measure. In doing so, we sought to compare the effects of Big-Five personality traits (derived from different inventories) on economic outcomes.

The estimation model is expressed as follows:

$$\ln(Annual\ Income_i) = \alpha + \beta_1 BFPT_i + X_i\beta_2 + v_i$$

where $Annual\ Income_i$ represents a median value of annual income categories; $BFPT_i$ depicts Big-Five personality traits normalized and scaled to take values between 0 and 1; X_i is a vector of individual attributes (e.g., individual educational background, weekly working hours, potential years of work experience, tenure). Because of mandatory retirement in Japan, income declines rapidly after 60 years of age. As such, the sample data include only working individuals under the age of 60. The random variable v_i is an error term.

Table 5 summarizes the estimation results of the income equation.

Specifically, these results show the Big-Five personality traits except Agreeableness to be similar across the two datasets. Clear differences between the datasets in terms of income emerge only with respect to Agreeableness. For the pooled samples, there is a significant negative relationship between Agreeableness

Table 5 Results with IPW

Explained Variable:	Male		Female	
Log Annual income	Data 1	Data 2	Data 1	Data 2
Extraversion	0.176	0.306	0.160	0.261
	(0.091)*	(0.073)***	(0.082)*	(0.087)***
Agreeableness	0.069	-0.075	0.024	-0.189
	(0.122)	(0.095)	(0.128)	(0.107)*
Conscientiousness	0.343	0.477	0.220	0.025
	(0.088)***	(0.092)***	(0.106)**	(0.107)
Neuroticism	-0.220	-0.351	-0.181	-0.144
	(0.113)*	(0.089)***	(0.106)*	(0.100)
Openness to Experience	-0.080	-0.169	0.018	0.171
	(0.102)	(0.079)**	(0.106)	(0.090)*
High school	0.102	0.267	0.051	-0.028
	(0.097)	(0.070)***	(0.080)	(0.115)
Vocational school	0.158	0.285	0.214	0.029
	(0.107)	(0.072)***	(0.084)**	(0.114)
University	0.399	0.567	0.288	0.208
	(0.099)***	(0.069)***	(0.091)***	(0.115)*
Graduate school	0.621	0.827	0.521	0.345
	(0.147)***	(0.073)***	(0.234)**	(0.127)***
Weekly working hours	0.004	0.009	0.019	0.018
	(0.002)*	(0.001)***	(0.002)***	(0.001)***
Potential work experience	0.037	0.048	0.001	0.010
	(0.010)***	(0.004)***	(0.009)	(0.004)**
$(Potential\ work\ experience)^2$	-0.001	-0.001	-0.000	-0.000
	(0.000)***	(0.000)***	(0.000)	(0.000)***
Tenure	0.032	0.031	0.029	0.033
	(0.008)***	(0.004)***	(0.007)***	(0.005)***
$(Tenure)^2$	-0.000	-0.000	-0.000	-0.000
	(0.000)*	(0.000)**	(0.000)	(0.000)
Constant term	4.684	4.324	4.156	4.337
	(0.203)***	(0.128)***	(0.223)***	(0.160)***
R^2	0.35	0.39	0.41	0.40
N	984	3,840	915	2,198

* p<0.1; ** p<0.05; *** p<0.01. Standard error is noted in brackets.

and income for Data 2 respondents. The only significant effect is among Data 2 female respondents (and this relationship is only marginally significant). Regarding other personality traits, the results show Extraversion and Conscientiousness to be positively related to annual income and Neuroticism to be negatively related to annual income. The effect of Openness to Experience among males and females is opposite, negative for males and positive for females, and statistically insignificantly in Data 1. Comparing the impact, the results show stronger positive or negative effects in Data 2 than in Data 1 for males, whereas only Extraversion and Openness to Experience have stronger effects in Data 2 for females.

These results suggest that there are differences between the two datasets in terms of both the impacts and directions of the effects of the Big-Five personality traits on annual income. We found that the relationships between Agreeableness and annual income differ across datasets.[51] Given these findings, a question emerges: what is driving these differences?

We believe there are two possible reasons the databases differ along the lines described above. First, it is possible that some of the items in the Big-Five personality inventory somehow may be problematic, thereby causing variance across the two datasets. Second, our method of quantifying the Big-Five personality traits from the items in the index may have been problematic. In the following sections, we explore these possibilities. First, we estimate the direct effects of each individual item on the outcome variables to determine whether they were problematic.

[51] Appendix Table 5 shows the estimation results using another IPW estimated along the lines of sex, age, educational background, income level, weekly working hours, and occupation and industry information. The results are similar to those presented in Table 5.

Second, rather than use the Big-Five scores obtained by adding up individual item scores, we use the first principal component obtained via a principal component analysis to identify the leading causes of the differences between the two datasets.

4.4.3 Item Effects

One source of variation in the effects intrinsic to each dataset is the possible differences in the effects of individual items on outcome measures within the two datasets. As described in Footnote 48, measurement of the Big-Five personality traits involved the use of forward- and reverse-coded items in both datasets. For example, two items formed the Extraversion index in Data 1. While one of these items was straightforward and directly related to Extraversion (i.e., "Extraverted, Enthusiastic"), the other was oppositely related to Extraversion (i.e., "Reserved, Quiet") and required reverse-coding. Similar issues characterized Data 2; measurement of Extraversion in Data 2 involved five straightforward questions ("I am talkative," "I am energetic," "I am quite enthusiastic," "I am aggressive," and "I am outgoing") and three reverse-coded questions ("I am conservative," "I am a quiet person," and "I am bashful").

To calculate the overall scores for each of the Big-Five personality traits, we simply took their unweighted average. If every item accurately captured the personal traits to which they were geared, items in both datasets should have exerted similar effects on corresponding outcomes. Different effect sizes for similar items suggest that the items were not measuring the same construct, and therefore cap-

tured different aspects of personalities. This, in turn, could yield different effects of the Big-Five on the aforementioned outcomes across the two datasets.

Table 6 summarizes the results of the analyses geared towards testing these possibilities. In each part, values in the first row indicate the results from Table 5. Sentences wish asterisk indicate that the items were reverse-coded.

Table 6 Results of Each Inventory with IPW

	Data 1			Data 2	
Outcome variable: Annual income	Male	Female	Outcome variable: Annual income	Male	Female
1. Extraversion					
Extraversion (Table 5)	0.032	0.028	Extraversion (Table 5)	0.023	0.020
	(0.016)**	(0.014)**		(0.006)***	(0.007)***
Extraverted, Enthusiastic	-0.049	0.017	I am talkative.	-0.066	-0.035
	(0.105)	(0.089)		(0.046)	(0.061)
Reserved, Quiet *	0.220	0.157	I am conservative. *	0.055	0.140
	(0.104)**	(0.097)		(0.055)	(0.073)*
			I am energetic.	0.048	0.010
				(0.062)	(0.074)
			I am quite enthusiastic.	-0.031	0.013
				(0.060)	(0.074)
			I am a quiet person. *	0.102	0.052
				(0.058)*	(0.068)
			I am aggressive.	0.142	0.014
				(0.058)**	(0.071)
			I am bashful. *	-0.059	0.058
				(0.057)	(0.068)
			I am outgoing.	0.081	-0.017
				(0.055)	(0.069)
R^2	0.36	0.41	R2	0.41	0.42
N	984	915	N	3,840	2,198

* p<0.1; ** p<0.05; *** p<0.01. Standard error is noted in brackets.
For all estimations, educational background, weekly working hours, years of work experience and its square, and tenure and its square are controlled.

Table 6 Results of Each Inventory with IPW (Cont.)

	Data 1			Data 2	
Outcome variable: Annual income	Male	Female	Outcome variable: Annual income	Male	Female
2. Agreeableness					
Agreeableness (Table 5)	0.009	0.002	Agreeableness (Table 5)	-0.005	-0.010
	(0.017)	(0.018)		(0.006)	(0.007)
Critical, Quarrelsome *	0.058	0.099	I find faults in others. *	-0.002	0.024
	(0.096)	(0.104)		(0.049)	(0.059)
Sympathetic, Warm	0.088	-0.076	I am kind to others.	0.008	-0.030
	(0.113)	(0.129)		(0.062)	(0.083)
			I tend to argue with others. *	0.071	-0.074
				(0.050)	(0.065)
			I have a forgiving nature.	0.049	0.016
				(0.046)	(0.056)
			I am trustworthy.	-0.071	0.130
				(0.072)	(0.081)
			I am stuck up. *	-0.070	-0.149
				(0.058)	(0.072)**
			I am thoughtful and kind.	-0.157	0.039
				(0.069)**	(0.095)
			I am rude to others. *	0.048	0.036
				(0.055)	(0.061)
			I like to cooperate with others.	0.028	-0.015
				(0.064)	(0.069)
R^2	0.36	0.41	R2	0.41	0.42
N	984	915	N	3,840	2,198

* p<0.1; ** p<0.05; *** p<0.01. Standard error is noted in brackets.
For all estimations, educational background, weekly working hours, years of work experience and its square, and tenure and its square are controlled.

Table 6 Results of Each Inventory with IPW (Cont.)

	Data 1			Data 2	
Outcome variable: Annual income	Male	Female	Outcome variable: Annual income	Male	Female
3. Conscientiousness					
Conscientiousness (Table 5)	0.053	0.034	Conscientiousness (Table 5)	0.035	0.002
	(0.014)***	(0.016)**		(0.006)***	(0.007)
Dependable, Self-Disciplined	0.213	0.121	I am a perfectionist when it comes to work.	-0.028	-0.135
	(0.091)**	(0.110)		(0.053)	(0.065)**
Disorganized, Careless *	0.148	0.098	I am a bit careless. *	0.050	-0.065
	(0.079)*	(0.080)		(0.052)	(0.061)
			I am a trusted worker.	0.246	0.124
				(0.065)***	(0.082)
			I am emotionally insecure. *	0.003	0.031
				(0.057)	(0.070)
			I tend to be lazy. *	0.051	-0.020
				(0.051)	(0.058)
			I carry out my work until it is completed.	0.010	0.031
				(0.064)	(0.077)
			I deal with matters efficiently.	0.020	0.029
				(0.059)	(0.070)
			I carry out my plans.	0.107	-0.057
				(0.055)*	(0.065)
			I have problems in concentrating. *	-0.082	-0.017
				(0.054)	(0.065)
R^2	0.36	0.41	R2	0.41	0.42
N	984	915	N	3,840	2,198

* p<0.1; ** p<0.05; *** p<0.01. Standard error is noted in brackets.
For all estimations, educational background, weekly working hours, years of work experience and its square, and tenure and its square are controlled.

Table 6 Results of Each Inventory with IPW (Cont.)

	Data 1			Data 2	
Outcome variable: Annual income	Male	Female	Outcome variable: Annual income	Male	Female
4. Neuroticism					
Neuroticism (Table 5)	-0.032	-0.028	Neuroticism (Table 5)	-0.028	-0.009
	(0.017)*	(0.016)*		(0.007)***	(0.007)
Anxious, Easily upset	-0.125	-0.052	I lack energy.	-0.059	0.027
	(0.091)	(0.095)		(0.054)	(0.067)
Calm, Emotionally stable *	-0.077	-0.114	I am easygoing. *	-0.045	-0.091
	(0.107)	(0.106)		(0.055)	(0.064)
			I become nervous easily.	-0.015	-0.086
				(0.054)	(0.062)
			I worry about many things.	0.012	-0.105
				(0.050)	(0.059)*
			I am emotionally secure. *	-0.140	0.087
				(0.061)**	(0.076)
			I am moody.	0.005	0.023
				(0.051)	(0.056)
			I remain calm even in stressful situations. *	-0.103	-0.063
				(0.058)*	(0.060)
			I am a nervous person.	-0.109	0.103
				(0.050)**	(0.056)*
R^2	0.36	0.41	R2	0.41	0.42
N	984	915	N	3,840	2,198

* p<0.1; ** p<0.05; *** p<0.01. Standard error is noted in brackets.
For all estimations, educational background, weekly working hours, years of work experience and its square, and tenure and its square are controlled.

Table 6 Results of Each Inventory with IPW (Cont.)

	Data 1			Data 2	
Outcome variable: Annual income	Male	Female	Outcome variable: Annual income	Male	Female
5. Openness to Experience					
Openness to Experience (Table 5)	-0.012	0.003	Openness to Experience (Table 5)	-0.014	0.011
	(0.016)	(0.016)		(0.005)**	(0.006)*
Open to new Experiences, Complex	-0.066	-0.046	I come up with new ideas.	0.046	0.127
	(0.082)	(0.090)		(0.065)	(0.084)
Conventional, Uncreative *	0.011	0.096	I have a wide variety of interests.	-0.038	0.035
	(0.103)	(0.102)		(0.048)	(0.060)
			I am smart.	0.173	-0.033
				(0.052)***	(0.063)
			I have a good imagination.	-0.110	0.113
				(0.058)*	(0.061)*
			I am creative.	-0.101	-0.081
				(0.064)	(0.077)
			I value artistic and esthetic experiences.	-0.009	-0.084
				(0.052)	(0.064)
			I like uncomplicated work. *	0.223	0.153
				(0.044)***	(0.048)***
			I like to create my own ideas.	0.018	-0.160
				(0.069)	(0.080)**
			I have little interest in art. *	0.004	-0.046
				(0.040)	(0.053)
			I have artistic sense.	-0.171	0.084
				(0.048)***	(0.062)
R^2	0.36	0.41	R2	0.41	0.42
N	984	915	N	3,840	2,198

* p<0.1; ** p<0.05; *** p<0.01. Standard error is noted in brackets.
For all estimations, educational background, weekly working hours, years of work experience and its square, and tenure and its square are controlled.

As outlined in the previous section, the two datasets differed in terms of some of the relationships between the Big-Five traits and salient outcomes. For instance, the two datasets differed in terms of the relationship between Agreeableness and income.

In Table 6, the individual items geared towards measuring Agreeableness provide some insight into the construct. Among Data 1 respondents, all items were non-significant. There is a similar pattern among Data 2 respondents, where most effects are again non-significant. Only "I am stuck up" and "I am thoughtful and kind" have significant effects for males and females. Though non-significant, it is important to note that several items (e.g., "I tend to argue with others," "I am trustworthy," "I like to cooperate with others") have opposite signs than expected. Despite the ubiquity of the unexpected signs of the estimates, negative estimates seem to be more predictive of Agreeableness than positive estimates relative to the values listed in Data 1. These results suggest that Data 1 more effectively highlights the positive effects of these items on Agreeableness, and Data 2 more effectively captures the negative effects. This is likely due to differences in the items that comprise the two questionnaires.

These results suggest that variations in how the items are expressed induce greater deviations in the estimates for several personality traits in Data 2 relative to Data 1. Although Data 1 uses fewer items to measure personality traits than Data 2, each item in the former may be interpreted as having two meanings (e.g., "Critical" vs. "Quarrelsome"). This type of question may capture personality traits more accurately than the broader questions used for Data 2. Stated simply,

questions in Data 1 may capture personality more specifically and directly than questions in Data 2. Consider, for example, if a Data 1 respondent scored high on the "Critical, Quarrelsome" item. This respondent may have been indicating that he/she is more critical and quarrelsome rather than critical or quarrelsome. In contrast, the Data 2 item "I tend to argue with others" may appeal to those who are argumentative, but not those who are critical. In sum, questionnaire items used to compile Data 2 are of a greater variety than those in Data 1, suggesting that the items in the former capture more abstract personality traits than the latter.

4.4.4 Principal Component Analysis

The other possible genesis of differences between the two datasets related to the effects of the Big-Five personality traits concerns the method we used to quantify those traits. In short, it is possible that simply adding (or averaging) responses to individual items is not a useful approach. As mentioned in Footnote 48, to quantify the Big-Five scores, we simply took the post-normalization mean of the scores from the individual questions. In this section, we determine the principal component from each group of items related to the respective personality traits. We then use this principal component value as the respondent's score on that personality trait.

In Appendix Table 6, the values with asterisk show the contribution ratio for the first principal component. In Data 1, the first principal components accounted for between 66% and 80% of the variance in the Big-Five personality traits. This

ratio is much smaller in Data 2; in this dataset, the first principal components accounted for between 34% and 42% of the variance in the Big-Five personality traits. Although the contributions of the first principal components is less pronounced in Data 2 than Data 1, it is nonetheless valid to use only the first principal components for Data 2, due to observable differences between the first and second principal components.

Table 7 summarizes the results of the principal components analyses in relation to income.

The results outlined in Table 7 show the same tendencies as those in Table 5. There was a positive effect between Extraversion and Conscientiousness and annual income and a negative relationship between Neuroticism and annual income. Results related to Openness to Experience were similar to those in Table 5 (though smaller in magnitude). Taken together, these results indicate that differences between the two datasets with respect to Agreeableness are robust when the personality traits are determined via a principal components analysis. However, the differences become much smaller than in Table 5, indicating that the Big-Five personality traits in Data 2 capture a wider breadth of the personality than in Data 1, and thus supports our discussion in Section 4.4.3.

Although the estimates reported in Table 7 are smaller than those reported in Table 5, the directions of all effects are identical. Moreover, nearly all effects that were statistically significant in Table 5 emerged as significant in Table 7.

In sum, the estimation results that used the first principal components as indicators of Big-Five personality traits were similar to results that emerged from

Table 7 Results of First Principle Component with IPW

Explained Variable:	Male		Female	
Log Annual income	Data 1	Data 2	Data 1	Data 2
Extraversion	0.032	0.023	0.028	0.020
	(0.016)**	(0.006)***	(0.014)**	(0.007)***
Agreeableness	0.009	-0.005	0.002	-0.010
	(0.017)	(0.006)	(0.018)	(0.007)
Conscientiousness	0.053	0.035	0.034	0.002
	(0.014)***	(0.006)***	(0.016)**	(0.007)
Neuroticism	-0.032	-0.028	-0.028	-0.009
	(0.017)*	(0.007)***	(0.016)*	(0.007)
Openness to Experience	-0.012	-0.014	0.003	0.011
	(0.016)	(0.005)**	(0.016)	(0.006)*
High school	0.102	0.269	0.052	-0.029
	(0.097)	(0.070)***	(0.080)	(0.115)
Vocational school	0.158	0.286	0.215	0.029
	(0.107)	(0.072)***	(0.084)**	(0.114)
University	0.399	0.568	0.289	0.209
	(0.099)***	(0.069)***	(0.091)***	(0.115)*
Graduate school	0.621	0.829	0.521	0.346
	(0.147)***	(0.073)***	(0.234)**	(0.127)***
Weekly working hours	0.004	0.009	0.019	0.018
	(0.002)*	(0.001)***	(0.002)***	(0.001)***
Potential work experience	0.037	0.048	0.001	0.010
	(0.010)***	(0.004)***	(0.009)	(0.004)**
$(Potential\ work\ experience)^2$	-0.001	-0.001	-0.000	-0.000
	(0.000)***	(0.000)***	(0.000)	(0.000)***
Tenure	0.032	0.031	0.029	0.033
	(0.008)***	(0.004)***	(0.007)***	(0.005)***
$(Tenure)^2$	-0.000	-0.000	-0.000	-0.000
	(0.000)*	(0.000)**	(0.000)	(0.000)
Constant term	4.848	4.423	4.285	4.366
	(0.181)***	(0.081)***	(0.151)***	(0.123)***
R^2	0.35	0.39	0.41	0.40
N	984	3,840	915	2,198

* p<0.1; ** p<0.05; *** p<0.01. Standard error is noted in brackets.

using averaged scores. This lends credence to the computation of the Big-Five scores from indices (consistent with past research). This finding leads us to believe that few (if any) of the differences across the datasets are attributable to individual items in the Big-Five inventory.

4.5 Conclusion

In this chapter, we have evaluated two questionnaires in their respective capacities to measure the effect of the Big-Five personality traits on economic outcome (income). The first questionnaire was a 10-item inventory developed by Gosling et al. (2003), and the second was a pervasively used 44-item inventory. To control for distribution differences across the two datasets produced by the administration of these two questionnaires, we used inverse probability weighting to estimate equations.

The results showed that the relationships between Extraversion, Conscientiousness, Neuroticism, and Openness to Experience and the outcome variables did not differ between the 10- and 44-item indices. In contrast, the relationship between Agreeableness and income was slightly different across the two datasets. To determine the source of this difference, we (a) calculated the effect of each item on income, and (b) identified the first principal components as proxies for the Big-Five personality traits. The results indicate that the differences between the two datasets with regard to the relationships between Agreeableness and income may derive from the ways in which the individual items are worded (and therefore, the

constructs they capture). Furthermore, our results show that the use of the first principal components is a viable method for estimating the relationships between the Big-Five and the outcome variables.

Through this chapter, we have shown that short questionnaires may be useful for saving time, as they yield the same results as longer questionnaires, but only for some personality traits under certain conditions. When using short measurement instruments in empirical economic research, it is important to interpret the findings carefully, especially those related to Agreeableness.

References

[1] Benet-Martinez, V. and O. P. John (1998) "Los Cinco Grandes across Cultures and Ethnic Groups: Multitrait Method Analyses of the Big Five in Spanish and English." *Journal of Personality and Social Psychology.* 75 (3), 729-750.

[2] Bowls, S., H. Gintis, and M. Osborne (2001) "The Determinants of Earnings: A Behavioral Approach." *Journal of Economic Literature.* 39 (4), 1137-1176.

[3] Costa P. T. Jr., and R. R. McCrae (1991) "Facet Scales for Agreeableness and Conscientiousness: A Revision of the NEO Personality Inventory." *Personality and Individual Differences.* 12 (9), 887-898.

[4] Costa P. T. Jr., and R. R. McCrae (1992) *Revised NEO Personality Inventory (NEO-PI-R) and NEO Five-Factor Inventory (NEO-FFI) professional manual.* Odessa, FL: Psychological Assessment Resources.

[5] Fletcher, J. M. (2013) "The Effects of Personality Traits on Adult Labor Market Outcomes: Evidence from Siblings." *Journal of Economic Behavior & Organization.* 89, 122-135.

[6] Goldberg, L.R. (1992) "The Development of Markers for the Big-Five Factor Structure." *Psychological Assessment.* 4 (1), 26-42.

[7] Gosling, S. D., P. J. Rentfrow, and W. B. Swann Jr. (2003) "A Very Brief Measure of the Big-Five Personality Domains." *Journal of Research in Personality.* 37, 504-528.

[8] Heckman, J. J. (2000) "Policies to Foster Human Capital." *Research in Economics.* 54 (1), 3-56.

[9] Heckman, J. J. and Y. Rubinstein (2001) "The Importance of Noncognitive Skills: Lessons from the GED Testing Program." *American Economic Review.* 91 (2), 145-149.

[10] Heckman, J. J., J. Stixrud, and S. Urzua (2006) "The Effects of Cognitive and Noncognitive Abilities on Labor Market Outcomes and Social Behavior." *Journal of Labour Economics.* 24 (3), 411-482.

[11] Heineck, G., and S. Anger (2010) "The Returns to Cognitive Abilities and Personality Traits in Germany." *Labour Economics.* 17, 535-546.

[12] John, O. P. and S. Srivastava (1999) "The Big-Five Trait Taxonomy; History, Measurement, and Theoretical Perspectives." L. A. Pervin and O. P. John (Eds.), Handbook of Personality: Theory and Research, 2, pp. 102-138, New York: Guiford Press.

[13] Lee, S. Y., and F. Ohtake (2014) "The Effects of Personality Traits and Behavioral Characteristics on Schooling, Earnings, and Career Promotion." RIETI Discussion Paper: 14-E-023.

[14] Mueller, G., and E. Plug (2006) "Estimating the Effect of Personality on Male and Female Earnings." *Industrial and Labor Relations Review.* 60 (1), 3-22.

[15] Nyhous, E. K., and E. Pons (2005) "The Effects of Personality on Earnings." *Journal of Economic Psychology.* 26, 363-384.

[16] Osborne-Groves, M. (2005) "How Important is Your Personality? Labor Market Returns to Personality for Women in the US and UK." *Journal of Economic Psychology.* 26, 827-841.

[17] Wooldridge, J. M. (2005) "Simple Solutions to the Initial Conditions Problem in Dynamic, Nonlinear Panel-Data Models with Unobserved Heterogeneity." *Journal of Applied Econometrics.* 20, 39-54.

5 Chapter 5 Conclusion

In this thesis, we used three sets of Japanese panel data to discuss the factors affecting wage determination. We found that labor market earnings are determined by not only years of schooling and work experience but also gender, race, region, and other observable and unobservable individual attributes. This thesis also accounted for behavioral factors such as smoking and life events such as intra-household specialization to identify factors contributing to wage disparities.

In Chapter 2, we use Japanese panel data (KHPS) to verify the hypothesis that smoking behavior reduced wage levels. In the analyses, we controlled for time-invariant individual heterogeneity, which previous studies failed to capture using two-year panel data and cross-sectional data. In addition, we examined IV estimations to control for time-variant individual heterogeneity and conducted robustness checks. The chapter also proved that wage differences can be attributed to individual unobservable heterogeneity, not smoking behavior. However, undeniably, smoking negatively affects labor productivity through health damages and causes changes in the wage level in the long run.

In Chapter 3, we applied the intra-household specialization hypothesis to identify the factors underpinning observed wage differences on the basis of marital status for Japanese men. Using Japanese panel data, we found that unobservable individual heterogeneity contributed to the wage gap based on males' marital status. Although we did not find clear evidence supporting the intra-household specialization hypothesis, the wage disparity between married and unmarried males

was obvious, thus indicating that intra-household specialization is not a factor determining wage in Japan. We suspect other factors such as personality traits, environment factors, and cultural characteristics lead to wage disparities based on marital status.

In Chapter 4, we focus on the Big-Five personality traits and compare the effects on economic outcomes using two types of questionnaires. Data 1 is examined using the 10-item questionnaire, as developed by Gosling et al. (2003), while Data 2 applied the widely used 44-item questionnaire. To control for distribution differences among the two datasets, we estimate equations adjusted by inverse probability weighting. One of the main findings of our analysis is that short questions save time for researchers and respondents and have a consistent effect on economic outcomes in comparison to the time-consuming yet widely used 44-item questionnaire; this, however, applies to selected personality traits, not all. When using short questions for economic empirical researches, it is imperative to pay careful attention to the interpretation of the results, especially in the case of Agreeableness.

Finally, future works should consider examining the relationship between wages and smoking, marriage, and individual unobservable individual. It is also necessary to use long-term panel data to verify the mechanisms underlying wage determination in Japan.

A Appendix Tables

Appendix Table 1 Full Results of Table 5

	(1)	(2)	(3)	(4)	(5)	(6)
Model	OLS	OLS	OLS	FE	FE	FE
Explained Variable	ln (Wage)	ln (Wage)	ln (Wage)	ln (Wage)	ln (Wage)	ln (Wage)
Married	0.136	0.078	0.088	-0.070	-0.075	-0.069
	(0.045)***	(0.047)*	(0.044)**	(0.048)	(0.051)	(0.051)
Duration of varriage	0.009	0.009	0.007	-0.002	-0.001	-0.002
	(0.002)***	(0.002)***	(0.002)***	(0.004)	(0.004)	(0.004)
Children under 6 years old	-0.010	-0.043	-0.046	-0.010	-0.016	-0.015
	(0.026)	(0.027)	(0.026)*	(0.024)	(0.025)	(0.025)
Married × housewife		0.135	0.100		0.024	0.027
		(0.031)***	(0.028)***		(0.029)	(0.029)
Married × other non-worker		0.049	0.049		0.006	0.010
		(0.044)	(0.042)		(0.038)	(0.038)
Married × non-regular worker		0.040	0.019		-0.003	0.001
		(0.029)	(0.027)		(0.027)	(0.027)
Education years	0.046	0.045	0.028			
	(0.005)***	(0.005)***	(0.005)***			
Experience years	0.020	0.021	0.020	0.130	0.130	0.128
	(0.005)***	(0.005)***	(0.005)***	(0.039)***	(0.039)***	(0.039)***
$(Experience\ years)^2$	-0.047	-0.049	-0.044	-0.113	-0.113	-0.111
	(0.011)***	(0.011)***	(0.010)***	(0.015)***	(0.015)***	(0.015)***
Tenure	0.021	0.021	0.016	0.015	0.015	0.015
	(0.004)***	(0.004)***	(0.003)***	(0.004)***	(0.004)***	(0.004)***
$(Tenure)^2$	-0.005	-0.005	-0.007	-0.006	-0.006	-0.007
	(0.010)	(0.010)	(0.009)	(0.014)	(0.014)	(0.014)
Regular worker	-0.059	-0.056	-0.016	-0.077	-0.077	-0.071
	(0.059)	(0.059)	(0.055)	(0.040)*	(0.040)*	(0.040)*
Big city	0.071	0.063	0.067	-0.004	-0.005	-0.005
	(0.025)***	(0.025)**	(0.023)***	(0.046)	(0.046)	(0.046)
Company size			0.164			0.080
			(0.020)***			(0.026)***
Occupation						
Agriculture, forestry and fisheries			-0.095			0.048
			(0.164)			(0.251)
Mining			-0.341			-0.067
			(0.304)			(0.327)
R^2	0.26	0.26	0.31	0.05	0.05	0.05
N	7,412	7,412	7,412	7,412	7,412	7,412

* p<0.1; ** p<0.05; *** p<0.01. Standard error is noted in brackets.

Appendix Table 1 Full Results of Table 5 (Cont.)

	(1)	(2)	(3)	(4)	(5)	(6)
Model	OLS	OLS	OLS	FE	FE	FE
Explained Variable	ln (Wage)	ln (Wage)	ln (Wage)	ln (Wage)	ln (Wage)	ln (Wage)
Occupation						
Sales			0.026			-0.050
			(0.075)			(0.049)
Services			-0.164			-0.048
			(0.082)**			(0.054)
Management works			0.397			0.082
			(0.077)***			(0.048)*
Clercal works			0.180			0.035
			(0.072)**			(0.046)
Transportation and telecom works			-0.022			-0.000
			(0.078)			(0.058)
Field works			0.098			0.077
			(0.071)			(0.045)*
Information technology engineer			0.254			-0.060
			(0.083)***			(0.070)
Professional and technique works			0.238			0.039
			(0.075)***			(0.045)
Security			0.203			0.082
			(0.084)**			(0.100)
Year Dummy: 2005	0.033	0.035	0.067	-0.039	-0.038	-0.031
	(0.057)	(0.056)	(0.053)	(0.054)	(0.054)	(0.054)
Year Dummy: 2006	-0.004	-0.002	0.022	-0.133	-0.132	-0.121
	(0.058)	(0.057)	(0.054)	(0.084)	(0.084)	(0.084)
Year Dummy: 2007	0.014	0.016	0.041	-0.175	-0.174	-0.166
	(0.058)	(0.058)	(0.055)	(0.118)	(0.118)	(0.118)
Year Dummy: 2008	0.011	0.015	0.035	-0.244	-0.243	-0.234
	(0.056)	(0.055)	(0.052)	(0.154)	(0.154)	(0.154)
Year Dummy: 2009	0.046	0.050	0.074	-0.275	-0.273	-0.264
	(0.056)	(0.056)	(0.052)	(0.190)	(0.190)	(0.190)
Year Dummy: 2010	-0.015	-0.012	0.014	-0.397	-0.395	-0.383
	(0.057)	(0.057)	(0.053)	(0.226)*	(0.226)*	(0.227)*
Year Dummy: 2011	0.011	0.012	0.036	-0.438	-0.437	-0.425
	(0.059)	(0.058)	(0.055)	(0.263)*	(0.263)*	(0.263)
Year Dummy: 2012	0.005	0.006	0.031	-0.509	-0.508	-0.493
	(0.058)	(0.058)	(0.054)	(0.300)*	(0.300)*	(0.300)
Constant term	6.306	6.311	6.424	5.470	5.468	5.441
	(0.105)***	(0.104)***	(0.119)***	(0.734)***	(0.734)***	(0.736)***
R^2	0.26	0.26	0.31	0.05	0.05	0.05
N	7,412	7,412	7,412	7,412	7,412	7,412

* p<0.1; ** p<0.05; *** p<0.01. Standard error is noted in brackets.

Appendix Table 2 Full Results of Table 8

	(8)	(9)	(10)
Model	FD	FD	FD
Explained Variable	ln (Wage)	ln (Wage)	ln (Wage)
Married	-0.069	-0.055	-0.048
	(0.078)	(0.082)	(0.083)
Duration of marriage	0.004	0.005	0.005
	(0.005)	(0.005)	(0.005)
Children under 6 years old	-0.010	-0.015	-0.014
	(0.040)	(0.041)	(0.041)
Married × housewife		-0.013	-0.009
		(0.040)	(0.040)
Married × other non-worker		0.021	0.027
		(0.046)	(0.046)
Married × regular worker		-0.043	-0.039
		(0.034)	(0.034)
Education years	0.354	0.356	0.350
	(0.173)**	(0.173)**	(0.189)*
Experience years	0.267	0.270	0.271
	(0.091)***	(0.090)***	(0.090)***
$(Experience\ years)^2$	-0.083	-0.085	-0.084
	(0.029)***	(0.029)***	(0.029)***
Tenure	0.021	0.021	0.020
	(0.009)**	(0.009)**	(0.009)**
$(Tenure)^2$	-0.038	-0.037	-0.035
	(0.028)	(0.028)	(0.027)
Regular worker	-0.059	-0.059	-0.051
	(0.072)	(0.072)	(0.071)
Big city	-0.068	-0.070	-0.076
	(0.079)	(0.079)	(0.078)
Company size			0.080
			(0.035)**
Occupation:			
Agriculture, forestry and fisheries			0.049
			(0.185)
Mining			-0.280
			(0.213)
Sales			-0.010
			(0.079)
Services			-0.069
			(0.085)
R^2	0.01	0.01	0.02
N	5,070	5,070	5,070

* p<0.1; ** p<0.05; *** p<0.01. Standard error is noted in brackets.

Appendix Table 2 Full Results of Table 8 (Cont.)

	(8)	(9)	(10)
Model	FD	FD	FD
Explained Variable	ln (Wage)	ln (Wage)	ln (Wage)
Occupation:			
Management works			0.074
			(0.070)
Clercal works			0.049
			(0.070)
Transportation and telecom works			-0.015
			(0.081)
Field works			0.059
			(0.073)
Information technology engineer			-0.059
			(0.091)
Professional and technique works			0.050
			(0.068)
Security			0.110
			(0.106)
Year Dummy: 2005	-0.157	-0.157	-0.154
	(0.123)	(0.123)	(0.123)
Year Dummy: 2006	-0.387	-0.389	-0.393
	(0.206)*	(0.205)*	(0.206)*
Year Dummy: 2007	-0.565	-0.569	-0.580
	(0.294)*	(0.293)*	(0.293)**
Year Dummy: 2008	-0.756	-0.761	-0.778
	(0.378)**	(0.377)**	(0.376)**
Year Dummy: 2009	-0.913	-0.920	-0.945
	(0.464)**	(0.463)**	(0.462)**
Year Dummy: 2010	-1.154	-1.162	-1.192
	(0.551)**	(0.549)**	(0.548)**
Year Dummy: 2011	-1.312	-1.321	-1.360
	(0.638)**	(0.635)**	(0.634)**
Constant	-0.028	-0.029	-0.023
	(0.029)	(0.029)	(0.028)
R^2	0.01	0.01	0.02
N	5,070	5,070	5,070

* p<0.1; ** p<0.05; *** p<0.01. Standard error is noted in brackets.

Appendix Table 3 Full Results of Table 10

	(11)	(12)	(13)	(14)
Model	OLS	OLS	FE	FE
Explained Variable	ln (Wage)	ln (Wage)	ln (Wage)	ln (Wage)
The male proportion of housework hours per week	-0.152	-0.142	0.029	0.022
	(0.058)***	(0.055)***	(0.061)	(0.061)
Duration of marriage	0.008	0.006	0.006	0.006
	(0.003)**	(0.003)**	(0.007)	(0.007)
Children under 6 years old	-0.006	-0.009	-0.012	-0.011
	(0.030)	(0.029)	(0.032)	(0.032)
Education years	0.046	0.026		
	(0.006)***	(0.007)***		
Experience years	0.022	0.022	0.067	0.076
	(0.008)***	(0.007)***	(0.089)	(0.089)
$(Experience\ years)^2$	-0.051	-0.047	-0.106	-0.103
	(0.017)***	(0.015)***	(0.028)***	(0.028)***
Tenure	0.018	0.013	0.007	0.006
	(0.005)***	(0.005)***	(0.007)	(0.007)
$(Tenure)^2$	0.004	0.002	0.014	0.013
	(0.014)	(0.013)	(0.026)	(0.026)
Regular worker	0.002	0.031	0.066	0.064
	(0.071)	(0.067)	(0.080)	(0.080)
Big city	0.049	0.061	-0.093	-0.097
	(0.032)	(0.030)**	(0.078)	(0.078)
Company size		0.175		0.076
		(0.027)***		(0.038)**
Occupation				
Agriculture, forestry and fisheries		-0.021		
		(0.279)		
Sales		-0.109		-0.159
		(0.076)		(0.073)**
Services		-0.279		-0.189
		(0.094)***		(0.083)**
R^2	0.21	0.27	0.02	0.03
N	3,546	3,546	3,546	3,546

* p<0.1; ** p<0.05; *** p<0.01. Standard error is noted in brackets.
Occupation type (Agriculture, forestry and fisheries) is omitted in result (14) and occupation type (Mining) is omitted in results (12) and (14) because of collinearity.

Appendix Table 3 Full Results of Table 10 (Cont.)

	(11)	(12)	(13)	(14)
Model	OLS	OLS	FE	FE
Explained Variable	ln (Wage)	ln (Wage)	ln (Wage)	ln (Wage)
Occupation				
Management works		0.291		-0.016
		(0.086)***		(0.072)
Clercal works		0.043		-0.032
		(0.070)		(0.068)
Transportation and telecom works		-0.190		-0.128
		(0.081)**		(0.089)
Field works		-0.044		-0.036
		(0.071)		(0.067)
Information technology engineer		0.120		-0.151
		(0.080)		(0.101)
Professional and technique works		0.099		0.014
		(0.073)		(0.066)
Security		0.069		-0.239
		(0.090)		(0.163)
Year Dummy: 2005	0.077	0.104	0.127	0.121
	(0.075)	(0.071)	(0.113)	(0.113)
Year Dummy: 2006	0.029	0.055	0.071	0.064
	(0.074)	(0.071)	(0.184)	(0.184)
Year Dummy: 2007	0.054	0.081	0.103	0.084
	(0.078)	(0.074)	(0.264)	(0.265)
Year Dummy: 2008	0.048	0.068	0.068	0.039
	(0.074)	(0.070)	(0.347)	(0.347)
Year Dummy: 2009	0.079	0.108	0.095	0.054
	(0.075)	(0.071)	(0.431)	(0.432)
Year Dummy: 2010	0.009	0.046	-0.002	-0.049
	(0.078)	(0.074)	(0.516)	(0.517)
Year Dummy: 2011	0.037	0.067	0.022	-0.035
	(0.079)	(0.075)	(0.602)	(0.603)
Constant term	6.444	6.690	6.508	6.386
	(0.136)***	(0.149)***	(1.653)***	(1.657)***
R^2	0.21	0.27	0.02	0.03
N	3,546	3,546	3,546	3,546

* p<0.1; ** p<0.05; *** p<0.01. Standard error is noted in brackets.
Occupation type (Agriculture, forestry and fisheries) is omitted in result (14) and occupation type (Mining) is omitted in results (12) and (14) because of collinearity.

Appendix Table 4 Results by Age Groups

	(15)	(16)	(17)	(18)	(19)	(20)
Model	OLS	OLS	OLS	FE	FE	FE
Explained Variable	ln (Wage)	ln (Wage)	ln (Wage)	ln (Wage)	ln (Wage)	ln (Wage)
1. 20s						
Married	0.024	-0.031	-0.025	-0.229	-0.192	-0.207
	(0.093)	(0.121)	(0.116)	(0.145)	(0.195)	(0.197)
Duration of marriage	-0.006	-0.001	-0.003	-0.045	-0.040	-0.024
	(0.018)	(0.018)	(0.018)	(0.061)	(0.062)	(0.063)
Married × housewife		0.243	0.234		0.033	0.063
		(0.105)**	(0.101)**		(0.208)	(0.211)
R^2	0.13	0.14	0.17	0.16	0.16	0.18
N	725	725	725	725	725	725
2. 30s						
Married	0.097	0.070	0.056	0.017	0.001	-0.008
	(0.056)*	(0.058)	(0.056)	(0.090)	(0.095)	(0.095)
Duration of marriage	0.010	0.010	0.009	-0.009	-0.011	-0.010
	(0.005)**	(0.005)**	(0.005)**	(0.011)	(0.011)	(0.011)
Married × housewife		0.085	0.074		-0.024	-0.014
		(0.046)*	(0.044)*		(0.060)	(0.060)
R^2	0.14	0.14	0.17	0.05	0.05	0.06
N	1,987	1,987	1,987	1,987	1,987	1,987

* p<0.1; ** p<0.05; *** p<0.01. Standard error is noted in brackets.
Other explained variables contain interaction terms of married dummy and wife's working status (non-regular worker, other unemployment status except full-time housewife, regular work dummy, big city dummy, and year dummies in all estimations. Company size dummy and occupation dummies are only in estimations (17) and (20).

Appendix Table 4 Results by Age Groups (Cont.)

	(15)	(16)	(17)	(18)	(19)	(20)
Model	OLS	OLS	OLS	FE	FE	FE
Explained Variable	ln (Wage)	ln (Wage)	ln (Wage)	ln (Wage)	ln (Wage)	ln (Wage)
3. 40s						
Married	0.126	0.065	0.111	0.023	-0.013	-0.005
	(0.093)	(0.097)	(0.088)	(0.141)	(0.146)	(0.146)
Duration of marriage	0.007	0.008	0.005	0.011	0.010	0.008
	(0.005)	(0.005)	(0.004)	(0.010)	(0.010)	(0.010)
Married × housewife		0.128	0.089		0.046	0.046
		(0.054)**	(0.048)*		(0.056)	(0.056)
R^2	0.18	0.19	0.27	0.03	0.03	0.04
N	2,339	2,339	2,339	2,339	2,339	2,339
4. 50s						
Married	0.309	0.246	0.239	-0.032	-0.002	0.027
	(0.114)***	(0.121)**	(0.118)**	(0.186)	(0.188)	(0.188)
Duration of marriage	0.005	0.005	0.003	-0.005	-0.005	-0.006
	(0.003)	(0.003)	(0.003)	(0.008)	(0.008)	(0.008)
Married × housewife		0.153	0.118		0.060	0.059
		(0.048)***	(0.042)***		(0.050)	(0.050)
R^2	0.30	0.31	0.36	0.05	0.05	0.07
N	2,361	2,361	2,361	2,361	2,361	2,361

* p<0.1; ** p<0.05; *** p<0.01. Standard error is noted in brackets.
Other explained variables contain interaction terms of married dummy and wife's working status (non-regular worker, other unemployment status except full-time housewife, regular work dummy, big city dummy, and year dummies in all estimations. Company size dummy and occupation dummies are only in estimations (17) and (20).

Appendix Table 1 Five- and 10-items constructed by Gosling et al. (2003) and 44-items

Five-items		
I see myself as:		Big-Five personality traits
1	Extraverted, enthusiastic.	Extraversion
2	Agreeable, kind.	Agreeableness
3	Dependable, organized.	Conscientiousness
4	Emotionally stable, calm.	Neuroticism, reverse-scored item
5	Open to experience, imaginative.	Openness to Experiences

10-items		
I see myself as:		Big-Five personality traits
1	Extraverted, enthusiastic.	Extraversion
2	Critical, quarrelsome.	Agreeableness, reverse-scored item
3	Dependable, self-disciplined.	Conscientiousness
4	Anxious, easily upset.	Neuroticism
5	Open to new experiences, complex.	Openness to Experiences
6	Reserved, quiet.	Extraversion, reverse-scored item
7	Sympathetic, warm.	Agreeableness
8	Disorganized, careless.	Conscientiousness, reverse-scored item
9	Calm, emotionally stable.	Neuroticism, reverse-scored item
10	Conventional, uncreative.	Openness to Experiences, reverse-scored item

Gosling et al. used the word "Emotional Stability" instead of "Neuroticism."
We use "Neuroticism" following Goldberg (1992).

Appendix Table 1 Five- and 10-items constructed by Gosling et al. (2003) and 44-items (Cont.)

44-items	
Extraversion	Agreeableness
1 I am talkative.	1 I find faults in others.
2 I am conservative.	2 I am kind to others.
3 I am energetic.	3 I tend to argue with others.
4 I am quite enthusiastic.	4 I have a forgiving nature.
5 I am a quiet person.	5 I am trustworthy.
6 I am aggressive.	6 I am stuck up.
7 I am bashful.	7 I am thoughtful and kind.
8 I am outgoing.	8 I am rude to others.
	9 I like to cooperate with others.
Conscientiousness	Neuroticism
1 I am a perfectionist when it comes to work.	1 I lack energy.
2 I am a bit careless.	2 I am easygoing.
3 I am a trusted worker.	3 I become nervous easily.
4 I am emotionally insecure.	4 I worry about many things.
5 I tend to be lazy.	5 I am emotionally secure.
6 I carry out my work until it is completed.	6 I am moody.
7 I deal with matters efficiently.	7 I remain calm even in stressful situations.
8 I carry out my plans.	8 I am a nervous person.
9 I have problems in concentrating.	
Openness to Experience	
1 I come up with new ideas.	
2 I have a wide variety of interests.	
3 I am smart.	
4 I have a good imagination.	
5 I am creative.	
6 I value artistic and esthetic experiences.	
7 I like uncomplicated work.	
8 I like to create my own ideas.	
9 I have little interest in art.	
10 I have artistic sense.	

Appendix Table 2 Descriptive Statistics with IPW
(adding Company Size, Occupation and Industry Information)

	Data 1		Data 2		Data 1		Data 2	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Explained variable								
Annual income (1,000 JPY)	524.64	11.88	542.29	5.24	235.98	6.61	241.93	4.09
Individual attributes								
Age	41.85	0.53	43.47	0.16	41.67	0.38	40.55	0.25
Junior high school	0.01	0.00	0.03	0.00	0.01	0.00	0.02	0.00
High school	0.24	0.01	0.25	0.01	0.31	0.02	0.33	0.01
Vocational school	0.11	0.01	0.13	0.01	0.37	0.02	0.32	0.01
University	0.53	0.02	0.50	0.01	0.29	0.02	0.30	0.01
Graduate school	0.11	0.02	0.08	0.00	0.02	0.01	0.03	0.00
Weekly work hours	46.05	0.94	44.31	0.20	32.60	0.57	34.39	0.32
Potential work experience	20.87	0.59	22.78	0.17	21.70	0.41	20.55	0.27
Tenure	14.35	0.48	13.27	0.18	8.06	0.28	7.37	0.19
Big Five personality traits								
Extraversion	0.48	0.01	0.44	0.00	0.54	0.01	0.47	0.00
Agreeableness	0.64	0.01	0.60	0.00	0.66	0.01	0.61	0.00
Conscientiousness	0.47	0.01	0.56	0.00	0.47	0.01	0.56	0.00
Neuroticism	0.49	0.01	0.50	0.00	0.52	0.01	0.51	0.00
Openness to Experience	0.50	0.01	0.51	0.00	0.47	0.01	0.50	0.00
N	983		3,840		893		2,198	
N with IPW	4,747		4,814		2,770		3,149	

Company size (equal to one if company size is more than 500 employees), seven occupation (Agriculture, forestry and fisheries; Files works; Sales; Services; Clerical works; Professional and technique works; Management works; and Other works are the reference group), eight industry information (Agriculture, forestry and fisheries; Construction; Manufacturing; Wholesale trade and retail trade; Finance, insurance and real estate; Transportation and telecommunications; Utilities; Services; and Other industries are the reference group) are controlled to make new IPW.

Appendix Table 3 Results of Simple Linear Regression of Each Big Five Personality Trait on Annual Income, Years of Education, Smoking and Marriage of Males

	Annual Income		Years of Education		Smoking		Marriage	
	Data 1	Data 2	Data 1	Data 2	Data 1	Data 2	Data 1	Data 2
Extraversion	113.215	302.854	-0.207	0.759	0.261	0.278	0.336	0.517
	(49.429)**	(37.820)***	(0.343)	(0.268)***	(0.085)***	(0.056)***	(0.087)***	(0.055)***
Constant term	456.991	409.667	14.938	14.360	0.233	0.195	0.548	0.434
	(27.199)***	(16.852)***	(0.195)***	(0.126)***	(0.045)***	(0.026)***	(0.050)***	(0.026)***
R^2	0.01	0.02	0.00	0.00	0.01	0.01	0.03	0.02

	Annual Income		Years of education		Smoking		Marriage	
	Data 1	Data 2	Data 1	Data 2	Data 1	Data 2	Data 1	Data 2
Agreeablenee	194.009	326.575	1.364	1.275	0.001	-0.075	0.258	0.241
	(62.950)***	(47.740)***	(0.459)***	(0.332)***	(0.118)	(0.068)	(0.132)*	(0.070)***
Constant term	387.253	347.800	13.955	13.933	0.360	0.362	0.546	0.516
	(40.958)***	(28.179)***	(0.311)***	(0.202)***	(0.078)***	(0.041)***	(0.088)***	(0.043)***
R^2	0.01	0.01	0.01	0.00	0.00	0.00	0.01	0.00

	Annual Income		Years of education		Smoking		Marriage	
	Data 1	Data 2	Data 1	Data 2	Data 1	Data 2	Data 1	Data 2
Conscientiousness	304.874	548.876	0.795	0.950	-0.183	0.073	0.437	0.593
	(53.645)***	(41.224)***	(0.370)**	(0.299)***	(0.101)*	(0.060)	(0.110)***	(0.060)***
Constant term	365.929	235.141	14.453	14.161	0.449	0.276	0.503	0.328
	(27.620)***	(22.551)***	(0.205)***	(0.170)***	(0.053)***	(0.034)***	(0.059)***	(0.035)***
R^2	0.04	0.05	0.00	0.00	0.00	0.00	0.03	0.03
N	984	3,840	984	3,840	982	3,840	982	3,840

* p<0.1; ** p<0.05; *** p<0.01. The sample data include only working individuals under the age of 60.

Appendix Table 3 Results of Simple Linear Regression of Each Big Five Personality Trait on Annual Income, Years of Education, Smoking and Marriage of Males (Cont.)

	Annual Income		Years of education		Smoking		Marriage	
	Data 1	Data 2	Data 1	Data 2	Data 1	Data 2	Data 1	Data 2
Neuroticism	-204.278	-587.156	-1.324	-1.778	0.143	-0.061	-0.323	-0.620
	(61.337)***	(42.558)***	(0.451)***	(0.307)***	(0.105)	(0.064)	(0.120)***	(0.063)***
Constant term	611.647	837.915	15.478	15.587	0.291	0.348	0.869	0.972
	(31.600)***	(23.088)***	(0.226)***	(0.158)***	(0.053)***	(0.033)***	(0.060)***	(0.032)***
R^2	0.02	0.05	0.01	0.01	0.00	0.00	0.02	0.03

	Annual Income		Years of education		Smoking		Marriage	
	Data 1	Data 2	Data 1	Data 2	Data 1	Data 2	Data 1	Data 2
Openness to Experience	72.475	326.879	-0.036	1.344	-0.082	0.029	0.012	0.218
	(57.951)	(38.950)***	(0.452)	(0.276)***	(0.104)	(0.057)	(0.116)	(0.057)***
Constant term	475.533	374.863	14.854	14.004	0.403	0.302	0.707	0.548
	(30.079)***	(19.699)***	(0.252)***	(0.147)***	(0.058)***	(0.030)***	(0.064)***	(0.031)***
R^2	0.00	0.02	0.00	0.01	0.00	0.00	0.00	0.00
N	984	3,840	984	3,840	982	3,840	982	3,840

* p<0.1; ** p<0.05; *** p<0.01. The sample data include only working individuals under the age of 60.

Appendix Table 4 Results of Simple Linear Regression of Each Big Five Personality Trait on Annual Income, Years of Education, Smoking and Marriage of Females

	Annual Income		Years of Education		Smoking		Marriage	
	Data 1	Data 2	Data 1	Data 2	Data 1	Data 2	Data 1	Data 2
Extraversion	90.051	142.159	-0.073	0.660	0.175	0.167	0.190	0.390
	(28.116)***	(28.276)***	(0.298)	(0.297)**	(0.052)***	(0.063)***	(0.089)**	(0.076)***
Constant term	192.091	169.692	14.040	13.643	0.032	0.118	0.576	0.326
	(14.604)***	(12.620)***	(0.173)***	(0.146)***	(0.027)	(0.030)***	(0.053)***	(0.037)***
R^2	0.01	0.01	0.00	0.00	0.01	0.00	0.01	0.01

	Annual Income		Years of education		Smoking		Marriage	
	Data 1	Data 2	Data 1	Data 2	Data 1	Data 2	Data 1	Data 2
Agreeablenee	37.839	21.010	0.008	0.355	0.024	0.059	0.048	0.390
	(36.366)	(36.641)	(0.427)	(0.384)	(0.073)	(0.077)	(0.130)	(0.097)***
Constant term	215.768	223.452	13.995	13.736	0.111	0.160	0.647	0.271
	(24.940)***	(21.509)***	(0.301)***	(0.239)***	(0.049)**	(0.047)***	(0.089)***	(0.060)***
R^2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01

	Annual Income		Years of education		Smoking		Marriage	
	Data 1	Data 2	Data 1	Data 2	Data 1	Data 2	Data 1	Data 2
Conscientiousness	70.459	115.153	-0.621	1.023	0.013	-0.048	0.347	0.463
	(32.783)**	(32.730)***	(0.365)*	(0.340)***	(0.066)	(0.067)	(0.106)***	(0.085)***
Constant term	207.971	171.502	14.290	13.377	0.121	0.223	0.517	0.248
	(16.422)***	(17.790)***	(0.191)***	(0.196)***	(0.033)***	(0.039)***	(0.056)***	(0.049)***
R^2	0.01	0.01	0.00	0.00	0.00	0.00	0.02	0.01
N	915	2,198	915	2,198	912	2,198	911	2,198

* p<0.1; ** p<0.05; *** p<0.01. The sample data include only working individuals under the age of 60.

Appendix Table 4 Results of Simple Linear Regression of Each Big Five Personality Trait on Annual Income, Years of Education, Smoking and Marriage of Females (Cont.)

	Annual Income		Years of education		Smoking		Marriage	
	Data 1	Data 2	Data 1	Data 2	Data 1	Data 2	Data 1	Data 2
Neuroticism	-96.520	-122.057	0.047	-0.838	0.077	-0.030	-0.110	-0.558
	(36.032)***	(34.468)***	(0.383)	(0.343)**	(0.077)	(0.067)	(0.109)	(0.084)***
Constant term	291.607	298.587	13.976	14.380	0.087	0.212	0.736	0.794
	(19.816)***	(19.222)***	(0.209)***	(0.179)***	(0.040)**	(0.036)***	(0.059)***	(0.045)***
R^2	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.02
	Annual Income		Years of education		Smoking		Marriage	
	Data 1	Data 2	Data 1	Data 2	Data 1	Data 2	Data 1	Data 2
Openness to Experience	81.808	143.960	0.602	1.175	0.062	0.062	-0.088	-0.109
	(40.130)**	(30.698)***	(0.344)*	(0.287)***	(0.073)	(0.065)	(0.104)	(0.077)
Constant term	202.441	163.494	13.718	13.358	0.098	0.165	0.720	0.564
	(18.194)***	(14.810)***	(0.171)***	(0.150)***	(0.034)***	(0.034)***	(0.052)***	(0.040)***
R^2	0.01	0.01	0.00	0.01	0.00	0.00	0.00	0.00
N	915	2,198	915	2,198	912	2,198	911	2,198

* p<0.1; ** p<0.05; *** p<0.01. The sample data include only working individuals under the age of 60.

Appendix Table 5 Principal Component Analysis

	Data 1					Data 2			
Component	Eigenvalue	Difference	Proportion	Cumulative	Component	Eigenvalue	Difference	Proportion	Cumulative
1. Extraversion									
1st Component	1.59	1.19	0.8 *	0.8	1st Component	3.23	2	0.4 *	0.4
2nd Component	0.41		0.2	1	2nd Component	1.23	0.27	0.15	0.56
					3rd Component	0.96	0.17	0.12	0.68
					4th Component	0.79	0.2	0.1	0.78
					5th Component	0.59	0.16	0.07	0.85
					6th Component	0.43	0.03	0.05	0.9
					7th Component	0.39	0.01	0.05	0.95
					8th Component	0.38		0.05	1
2. Agreeableness									
1st Component	1.59	1.18	0.8 *	0.8	1st Component	3.1	1.56	0.34 *	0.34
2nd Component	0.41		0.21	1	2nd Component	1.54	0.7	0.17	0.52
					3rd Component	0.84	0.12	0.09	0.61
					4th Component	0.72	0.06	0.08	0.69
					5th Component	0.66	0.04	0.07	0.76
					6th Component	0.62	0.04	0.07	0.83
					7th Component	0.58	0.04	0.06	0.89
					8th Component	0.54	0.13	0.06	0.95
					9th Component	0.41		0.05	1
3. Conscientiousness									
1st Component	1.64	1.28	0.82 *	0.82	1st Component	3.58	2.17	0.4 *	0.4
2nd Component	0.36		0.18	1	2nd Component	1.42	0.67	0.16	0.56
					3rd Component	0.75	0.06	0.08	0.64
					4th Component	0.69	0.05	0.08	0.72
					5th Component	0.64	0.11	0.07	0.79
					6th Component	0.52	0.01	0.06	0.84
					7th Component	0.51	0.04	0.06	0.9
					8th Component	0.47	0.05	0.05	0.95
					9th Component	0.42		0.05	1
N	10,504				N	10,775			

Appendix Table 5 Principal Component Analysis (Cont.)

	Data 1					Data 2			
Component	Eigenvalue	Difference	Proportion	Cumulative	Component	Eigenvalue	Difference	Proportion	Cumulative
4. Neuroticism									
1st Component	1.31	0.62	0.66 *	0.66	1st Component	2.79	1.57	0.35 *	0.35
2nd Component	0.69		0.34	1	2nd Component	1.22	0.18	0.15	0.5
					3rd Component	1.05	0.25	0.13	0.63
					4th Component	0.8	0.07	0.1	0.73
					5th Component	0.73	0.2	0.09	0.82
					6th Component	0.53	0.04	0.07	0.89
					7th Component	0.49	0.09	0.06	0.95
					8th Component	0.4		0.05	1
5. Openness to experience									
1st Component	1.51	1.01	0.75 *	0.75	1st Component	4.15	2.89	0.42 *	0.42
2nd Component	0.49		0.25	1	2nd Component	1.27	0.29	0.13	0.54
					3rd Component	0.98	0.22	0.1	0.64
					4th Component	0.76	0.05	0.08	0.72
					5th Component	0.71	0.1	0.07	0.79
					6th Component	0.61	0.1	0.06	0.85
					7th Component	0.51	0.13	0.05	0.9
					8th Component	0.38	0.03	0.04	0.94
					9th Component	0.35	0.05	0.03	0.97
					10th Component	0.3		0.03	1
N	10,504				N	10,775			