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Minimum Wages and Labour Market Dynamics: Evidence from Japan

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Abstract

This paper investigates how the minimum wage affects the wage and labour dynamics of non-regular workers in Japan. While there is little disagreement that the minimum wage raises hourly wages, the previous literature has not yet reached consistent agreement about the impact on employment and little is known about how the labour market is adjusted. This paper estimated three equation models to analyse the impact on hourly wage, job separation, and new hire, respectively. The results suggest three points: (1) positive effect on hourly wages, (2) little evidence for a job-separation increase, and (3) negative and heterogeneous impact on new hiring. These findings imply that the minimum-wage policy is effective to raise the wage of low-paid workers, but policy makers should account for the heterogeneous impact of the minimum-wage revisions after the pandemic to avoid huge job losses.

JEL Classification Numbers: J08, J21, J31, J38
Key words: Minimum Wage; Employment; Japan

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1. Introduction

Does a minimum-wage hike increase the wage of workers and reduce employment? This has for decades been a central issue for not only economists but also policy makers, and there is little agreement among economists regarding the impact on employment. While a number of studies have addressed the negative impact (see, e.g., Neumark and Shirley (2021)), other researchers also report little evidence of the adverse impact (see, e.g., Card and Krueger (1995)). In addition, little is known about how employment is adjusted after minimum-wage hikes from the previous literature. If the minimum wage increases job losses, it is necessary for policy makers to understand how the labour market responds in order to take appropriate actions. For example, if a hike causes job separations, the provision of unemployment insurance may be an effective approach, and if a impact hinders new hiring, mismatch-resolution policies should be conducted. Recently, from the point of view of protecting low-paid workers and reducing the gap between rich and poor, there has been an increasing interest in minimum wages all over the world.

The situation is the same in Japan. The Japanese regional minimum wages are set up in each of the 47 prefectures and are revised once a year based on several factors such as economic conditions and wage levels in the regions. Because of the high amount of increases in the recent years, there has been an increase in interest in how a minimum-wage increase affects employment, and there has been an increase of literature in this field. Nevertheless, a consistent conclusion has not been reached yet and little attention has been paid to the labour dynamics; most of the previous literature only focuses on employment rate and pays little attention to the impact on job separation or new employment. Additionally, the recent literature focuses on the data mainly in the 2000s, and there is little research which examines the recent Japanese labour market. Therefore, more research is needed to promote the evidence-based policy making (EBPM) in Japan.

This paper aims to analyse the recent labour market dynamics in Japan while providing evidence with latest data to contribute the discussion and appropriate decision making for public policies. To provide evidence and policy implication, I use individual-level panel data for the period 2015-2019 and evaluate the effect of minimum-wage hikes on hourly wage, job separation, and new hiring of non-regular workers. Since the proportion of non-regular workers whose wages are close to the minimum wage is higher than that of regular workers, and temporal adjustment of employment is implemented mainly with non-regular workers due to the inflexibility of regular employment in Japan, this paper focuses on the wages and dynamics of non-regular employment.

Using the variation of prefecture-level minimum wage, I estimate three equation models.

I find three key implications: (1) a minimum-wage hike has a positive effect on hourly wages for non-regular workers, specifically female workers, (2) this study does not find robust evidence that a minimum-wage hike causes job separation, and (3) a significant negative impact on new hiring and the possibility of a heterogeneous impact is reported. Therefore, policy makers should concentrate on increasing new recruitment such as reducing the labour-market mismatch, and consider the heterogeneity of local labour markets for the revisions of minimum wages.

The paper proceeds as follows. First, Section 2 discusses the literature relating to minimum-wage hike' impacts on employment in the United States and in Japan. Second, I present some theoretical background, neoclassical models and monopsony models in Section 3. Third, I describe the institutional details of the Japanese minimum-wage system and the data used in this paper in Section 4. After that, Section 5 and Section 6 provide the detailed empirical framework and the main regression results, respectively. Finally, Section 7 covers the conclusions from the study.

2. Literature Review

Whereas there is little disagreement that the minimum wage raises the wages of low-wage workers, it is still controversial whether a minimum wage has negative impact on employment or not. Therefore, this section focuses on the reviews of the existing literature concerning the effect on employment in the U. S. and in Japan to clarify the stance of this paper. As Neumark and Wascher (2008) said, "How minimum wages affect employment has been the most prominent issue with respect to the evaluation of minimum-wage policies, and indeed one of the most researched topics in economics." (Neumark and Wascher 2008: 37), this topic has been researched for a long time, and the empirical evidence is voluminous in the U.S.. The literature has also been accumulated in Japan recently, but consensus about the impact on employment has not yet been reached. Furthermore, there is little discussion about how the labour market is adjusted after a hike.

A very large body of research on the impact of the minimum wage on employment exists in the U.S.. This theme has been a controversial issue for decades in labour economics, and empirical evidence has been accumulated since the 1980s. There is some consensus about the effect of minimum wages on the labour market. One is that employment will be reduced if minimum wages are raised in the neoclassical competitive model. And it is also well-known that a minimum-wage hike does not necessarily reduce employment under the monopsony labour market. Therefore,

whether a minimum-wage hike has adverse employment effect or not has long been a central issue for labour economists and policy makers, and complete agreement has not achieved yet (Neumark and Shirely 2021).

Card and Krueger (1994) showed in their seminal paper that the rise in the minimum wage in April 1992 did not have negative effect on employment by using a survey of fast-food restaurants in New Jersey and Pennsylvania. Furthermore, Card and Krueger (1995) provided evidence against the prediction that higher minimum wages reduce jobs for low-wage workers from some policy experiments, and they claimed that it is very unlikely that the minimum wage has a large, negative employment effect. However, some critics say that their works focus only on limited industries (see, e.g., Neumark and Wascher 2000), and thus I use data from all industries in this paper.

In contrast, Neumark and Wascher (1995) used a panel data on states to estimate the effects on the employment rate of teenagers, and they found that minimum wages increase the probability of being unemployed. In addition, Neumark and Wascher (2008) conduct wide survey research for the literature not only in the U.S. but also in other advanced countries and developing countries, and refute such opinions of no impact. They point out that there is a large amount of literature which reveals negative employment effects and the low-wage labour market can be reasonably approximated by the neoclassical competitive model. The evidence of unemployment can more likely be seen when focusing on the low-skilled workers who are most affected by the minimum-wage hike, and I adopt this approach here. Furthermore, Neumark and Shirley (2021) cover latest literature, and they summarize their conclusion with the four key points; “(i) there is a clear preponderance of negative estimates in the literature; (ii) this evidence is stronger for teens and young adults as well as the less-educated; (iii) the evidence from studies of directly-affected workers points even more strongly to negative employment effects; and (iv) the evidence from studies of low-wage industries is less one-sided” (Neumark and Shirley 2021: abstract).

In addition to the two types of markets, competitive labour market and monopsony labour market discussed above, theoretical framework to analyse the impact of minimum wages in labour markets with heterogeneity has been accumulated (see, e.g., Manning 2003, and Neumark and Wascher 2008). Manning (2021a) also surveys previous literature and insists the link between higher minimum wages and higher labour costs are weaker than previously thought, and that the employment effect of minimum wages is elusive because of imperfect competition. These studies mean that a careful interpretation of the empirical research is necessary to understand how

minimum wages affect employment.

After reviewing the evidence in the U.S., I move to look at the previous research in Japan. Matsuta (2020) conducted a survey of articles for evidence in Japan and meta-analysed 18 articles. 11 of 18 papers discussed the effect on wage and employment, respectively. In his study, all of 11 papers which analysed the impact on wage report positive effect. On the other hand, different results exist for the impact on employment: 7 of 11 papers report negative effects on employment, while the remaining 4 papers report either no effect or identified both positive and negative effects[1].

For instance, Kawaguchi and Mori (2021) report negative impact. They analysed the impact of the revision of the Minimum Wage Act in 2007, which required the government to set the minimum wage indexed to the local cost of living. The aim of this revision was to close the gap between the amount of welfare benefits and the earnings of full-time minimum-wage workers within five years, and they used this revision as a natural experiment to handle the policy endogeneity. They find that the increase in the minimum wage reduced the employment rate of less-educated young men aged 19-24. Okudaira et al. (2019) also analysed the impact on employment with the revision of the Minimum Wage Act in 2007. They highlight the heterogeneity of the labour market, and estimated the manufacturing sector's surplus between each plant's value of marginal product of labour and wage rate. Their finding is that the quantitative impact of a minimum-wage hike is significant to the plants which have little surplus, and that if a labour market is monopsony and firms have the power to determine wage, the minimum-wage increases have little unemployment effect. Namely, they point out that the impact is heterogeneous and depends on the structure of the local economies.

In contrast, Higuchi (2013) reported that there is no evidence of negative impact of a minimum-wage hike on employment for non-regular workers. He estimated a job separation function and a new hire function with a panel data, and found that a minimum-wage increase does not hinder non-regular workers' employment. He argued that Japanese labour market can be considered as monopsonistic rather than competitive. But Kawaguchi and Mori (2021) note the possibility that the impact might not be precisely estimated because of the limited sample size.

As we discussed above, this topic is still controversial and it seems that little consistent conclusion about the effect on employment has been reached in Japan. These papers mainly

[1] When comparing the numbers, it is necessary to consider the publication bias. Andrews and Kasy (2019) notes that studies reporting significant negative effects tend to be published.

discussed with data of the 2000s, and there is little empirical evidence which uses recent data. Therefore, in this study I examine the impact with recent and sufficient data. In addition, the previous literature focused mainly on the change of employment rate, and only a few papers have looked at the path where employment is adjusted in the labour market dynamics both in the U.S. and Japan.

3. Theoretical Background

This section reviews the background theory of the effect of minimum wages on employment. There is little dispute that raising minimum wages increases the wages of low-paid workers. However, as Manning (2013) pointed out, “Perhaps the most controversial aspect of the economics of the minimum wage is its effect on employment” (Manning 2013: 338), the impact on employment has been discussed empirically and theoretically between economists for a long time. Neumark and Wascher (2008) cover comprehensive explanation of the theory from both the neoclassical and the monopsony perspectives. For more information, I refer the reader to Neumark and Wascher (2008).

3.1. Neoclassical Models

The neoclassical competitive model in textbooks is simple and straightforward. First, start with competitive labour market with one type of labour and goods market assuming that goods are produced with labour and capital. The equilibrium wage is determined by the labour demand and supply. If the minimum wage is set above the equilibrium wage, then the cost of production increases, leading to a reduction of production demand, which is called the scale effect. The high minimum wage also leads to the substitution effect, namely, labour is substituted by capital. Therefore, the labour demand becomes smaller than labour supply, causing unemployment and the labour market is inefficient.

One extension of this simple model is two-sector model: workers are covered by the minimum wage in one sector but not in another sector. Welch (1976) assumed that individuals who cannot get jobs in the covered sector move to the uncovered sector and work. In this model, the minimum-wage hike decreases employment in the covered sector but the unemployment is absorbed into the uncovered sector. Gramlich (1976) and Mincer (1976) provided other versions of two-sector models. In their models, workers who lose their jobs in the covered sector remain in that sector as

unemployed people at first. Then they compare the expected wage in the covered sector and equilibrium wage in the uncovered sector and decide whether to move. After the adjustment, the absorption power of the uncovered sector is weaker than that of Welch's model. Their extended models imply little negative impact on employment, but as the Japanese minimum-wage system covers almost all sectors and thus this paper does not adopt these models.

Another extension is an introduction of heterogeneous labour force. Assuming that there are two types of labour force: high-skilled labour and low-skilled labour, the increase in minimum wages will increase the demand of skilled workers and reduce that of less-skilled labour whose wage is affected directly. Then the overall employment effect is negative and the impact is stronger for less-skilled labour if it is a substitute for capital. Therefore, it is important to check the differences in impact by background such as education level.

Finally, Neumark and Wascher (2008) make two important points to evaluate the effect of minimum wages in the context of neoclassical models. One is to consider the general equilibrium effect and use data which includes all industries. The other one that time lag in the adjustment of labour force should be considered as Hamermesh (1995) noted.

3.2. Monopsony Models

In contrast to the neoclassical models, monopsony models assume that an individual firm has market power to determine wages. In the standard textbook, the monopsony model assumes that the monopsony firm is the only one employer and that all workers are homogeneous. The firm sets wages at the point where the marginal cost equals the marginal revenue product of labour to maximize its profit. Then the wage is lower than market equilibrium wage and leads to less employment. In this case, a minimum-wage hike increases employment and reduces welfare loss.

Monopsony models are also extended to apply to the real economy. Bhaskar and To (1999) developed a monopsonistic competition model where many firms compete for workers but they have monopsony power. Because of non-pecuniary differences such as preference for work-place, firms need to set higher wages to attract workers and it leads to less employment than in the perfect competitive labour market. Then, a small increase in the minimum wage can raise employment. However, they also noted that while a minimum-wage hike raises employment for one firm, it also causes firm exit, therefore, it is ambiguous whether a minimum-wage hike increases or reduces employment in this model. Burdett and Mortensen (1998) also extended monopsony model from

the job search theory framework. Their models assumed that workers have imperfect information of job opportunity and a limited number of job offers are posted in the labour market, and assumed that individuals accept job offers when the offered wages are higher than their reservation wages. Then, low wages cause job losses and make it difficult to hire new workers, leading to less overall employment than that of perfect competitive market. Therefore, a minimum-wage hike can increase employment by reducing job search frictions. However, Manning (2013) showed simulations which suggest that a low-level minimum wage does not necessarily have positive effect of employment in an oligopsonistic labour market. Therefore, as Neumark and Wascher (2008) pointed out, “a careful empirical approach is needed to understand how minimum wages affect employment” (Neumark and Wascher 2008: 57).

4. Institutional Details

4.1. Minimum Wage in Japan

This section shows the Japanese minimum-wage system. The minimum wages can be divided into two types in Japan. One is the regional minimum wage, which is set for 47 prefectures respectively and applies to all workers in each prefecture. The other is the industrial minimum wage, which applies to workers in specific industries in specific regions. Since the proportion of workers covered by the industrial minimum wage is lower than that of the regional minimum wage, and it is in the process of being abolished, this paper focuses only on the regional minimum wage.

Compared to the U.S., the Japanese minimum wages are determined more centrally and mechanically. The regional minimum wages are determined according to the following process. First, the Central Minimum Wage Council proposes a "guideline" for minimum-wage increases every June or July. The Central Minimum Wage Council consists of the representatives of public interest (academics), the employers' representatives, and the workers' representatives. This council discusses and decides the guideline with some reference such as recent economic data, wage distribution, welfare benefits, and the previous increase of the minimum wages. In general, there are large gap of increase amount between the claim by the employers' representatives and that by the workers' representatives. Therefore, the suggestion by the representatives of public interest plays an important role to decide the increase amount. The increase level of the minimum wages in the guideline varies for four regional blocks, classified according to wage levels and other

factors such as prices. Second, in response to the guideline, the minimum wage councils of each prefecture deliberate on the issue and make final decisions reflecting local labour-market conditions. Finally, the new minimum wages are applied in autumn. This guideline system was established in 1978 with the aim of equalizing the regional minimum wages throughout the country. Therefore, in the deliberations of the local minimum wage councils in each prefecture, the guideline of the Central Minimum Wage Council has a decisive influence.

It is well known that the level of the minimum wages in Japan is relatively low compared with other advanced countries. For example, according to the OECD. Stats, the Japanese minimum wage (the national weighted average) is 8.2 USD (902 JPY) in 2020 while that of the U.K. is 11.1 USD, 12.2 USD in France, and 12.0 USD in Germany, respectively[2]. Recently, the minimum wage has been regarded as the key policy tool to increase wages and to reduce inequalities between rich and poor, and urban regions and rural areas under the government budget constraint in Japan. From 2003[3] to 2012 the average increase rate of the minimum wage was around 1%. At the end of 2012, the Liberal Democratic Party was back in power and the Prime Minister Abe at the time launched new policy framework called Abenomics to defeat the deflation and revitalize the Japanese economy. In Abenomics, raising wages has been identified as an urgent issue to be addressed, and several wage policies had been implemented such as subsidies and tax reforms for small to medium enterprises (SMEs). In November 2015, Abe requested around 3% increase of the minimum wage at the Council on Economic and Fiscal Policy. Following that, the Government of Japan decided to aim the national weighted average of 1,000 JPY in the Basic Policy on Economic and Fiscal Management and Reform 2016. As a result, the minimum wage increased significantly from 798 JPY to 823 JPY by 3.1% in 2016, and the growth rate kept over 3% from 2016 to 2019 regardless of economic conditions[4] (Figure 1). However, in 2020, the upward momentum stopped due to the pandemic, and the minimum wage increased only from 901 JPY to 902 JPY (by 0.1%) to take account of SMEs in financial difficulty. This contrasts with other advanced countries which continued to raise the minimum wage under the pandemic. After that, the Prime Minister Suga decided to return to the upward momentum in the next year, and the Government of Japan declares

[2] OECD. Stats also provides the comparative data of the minimum wages relative to average wages of full-time workers and the Japanese minimum-wage level is lower than those of the other G7 countries except the U.S..
[3] In 2002, the guideline was standardised to an hourly wage.
[4] In addition, with a view to closing the wage gap between urban and rural areas, the increasing rate is higher in rural prefectures than that in urban prefecture. For instance, the average growth rate from 2016 to 2019 in Okinawa prefecture is 3.4% while that in Tokyo is 2.8%.

that they work to raise the national weighted average of the minimum wage to 1,000 JPY as soon as possible in the Basic Policy on Economic and Fiscal Management and Reform 2021. Therefore, there are many concerns that raising the minimum wage will increase additional costs and put pressure on the business of SMEs which are damaged by the pandemic when the convergence of infections and economic recovery are still uncertain.

Accordingly, while policy need for the higher minimum wage exists to reduce inequality, there is no small concern about the impact on SMEs whose business situation has deteriorated by the pandemic and huge employment losses. Furthermore, in July 2021 the Central Minimum Wage Council decided the guideline for the 2021 revision and it suggested a nationally uniform increase by 28 JPY, which provoked a discussion. Therefore, there is demand for much evidence to analyse the policy side effect and to implement careful policy making in Japan.

4.2. Data

In this paper I used the Japanese Panel Study of Employment Dynamics (JPSED), Recruit Works Institute[5]. JPSED is a survey of approximately 50,000 men and women over 15 years old and it tracks their employment status, income, and job status as in December to identify the reality of employment and non-employment and its changes in Japan. Using data for the period 2015 - 2019, the following three models are estimated to examine the effects of the minimum wage on wage and employment loss in Japan. There are some other panel data available in Japan. For instance, the Keio Household Panel Survey (KHPS) also collects the employment status, the wage, and other detailed information for men and women aged 20 to 69 years old, and some papers exploited KHPS to analyse the impact of the minimum wage. However, the sample size is only about 4,000 and therefore it may be difficult to capture the employment change with the limited samples, because “the number of minimum-wage workers is as limited as 3% of all workers” (Kawaguchi and Mori 2021: 6).

There are 268,189 observations, including employed people (202,996) and unemployed people (65,193), in this data. Employed people are also divided in to three categories, regular workers (110,644), non-regular workers (66,851), and other (self-employed, domestic workers, nonresponse etc.) (25,501). In Japan, employed workers are often distinguished as regular workers

[5] The data was provided by the Social Science Japan Data Archive, Center for Social Research and Data Archives, Institute of Social Science, The University of Tokyo.

or non-regular workers, and it depends on the type of contract, namely permanent or fixed-term, while the minimum wage is applied to both types. This paper focuses on non-regular workers, because they are paid less and their labour market is more fluid than that of regular workers in Japan. Therefore, they are more susceptible to the minimum wage. Non-regular workers include part-time job workers, temporary workers, contract workers, etc.

- Employed: 202,996
  - Regular workers: 110,644
  - Non-regular workers: 66,851
  - Other: 25,501
- Unemployed: 65,193

I also collected prefecture level variable: the minimum wage from Minimum Wage Revisions by Region, the unemployment rate from the Labor Force Survey, the proportion of population aged 15-64 from the Population Estimates, and the Economy Watcher DI form the Economy Watchers Survey. Figure 2 shows the variation of the minimum wage by prefecture in 2019. We can notice significant difference between prefectures, especially huge gap between urban and rural regions. Therefore, in this paper, I use prefecture-level fixed effects models in order to control the heterogeneity by regions.

Table 1 represents the descriptive statistics for non-regular workers. We can see that the mean wage and age of female workers are lower than those of male workers, and female workers tend to be less educated. There are relatively large deviations in the family related dummies and less bias in the prefecture-level variables. A large number of nonresponses for hourly wages can be seen (nonresponse ratio: 58%), that may cause sample selection bias. But we can see the observed wages are concentrated near the minimum-wage level in Figure 3.

5. Empirical Approach

Section 5 shows the detailed empirical framework. Applying the estimation methods from Higuchi (2013), Neumark and Wascher (1992, 1995, 2007), and Allegretto et al. (2011), I analyse the effect on wage and employment dynamics with three equation models.

5.1. Effect on Hourly Wage

First, I analyse the effect of minimum-wage revisions on the hourly wage of non-regular workers. the goal of this estimation is to provide evidence to the following question: does an increase in the minimum wage raise the wages of non-regular workers? This paper uses the following estimation equation:

$$lnW_{ist} = \alpha lnMW_{st} + X'_{ist}\beta + \gamma_i + \delta_t + \varepsilon_{ist} \qquad (1)$$

In (1), the '*i,*' '*s*,' and '*t*' subscripts denote individuals, prefectures, and years, respectively. The dependent variable is the log of the hourly wages. Since prices in Japan were relatively stable over the period, I use wages in nominal terms. X'_{ist} is a vector of individual attributes, including age, age^2, and some dummies (gender, education, children, spouse, supporter, industry, and firm-size). With education dummies, I group the sample into four-parts, graduate from junior high school, graduate from high school, graduate from 2-year college or specialized high school, and graduate from university or graduate school. The children dummies show whether an individual has a child under 12 years old, and supporter dummies represent whether an individual is the main earner in his or her family. I also include prefecture-level variables (X'_{st}), namely unemployment rate, the proportion of population aged 15-64, and the Economy Watcher DI. The unemployment rate and the proportion of population aged 15-64 control labour demand and supply in the prefecture. The Economy Watcher Survey is a government statistic which monitors the economic trends in each region[6]. Even though the minimum wage was increased constantly about 3% by policy requirement in the estimation period, as Baskaya and Rubinstein (2012) pointed out, it is necessary to consider the policy endogeneity for policy evaluation. The minimum-wage hike is procyclical, and the increasing level tends to be large in the economic boom. Then, the effect on employment will be underestimated by the endogeneity. Therefore, I use the Economy Watcher DI as a proxy variable of regional GDP to relieve the policy endogeneity. $lnMW_{st}$ is the log of the prefecture-specific minimum wage, and α is my research interest. γ_i represents individual-level time-invariant fixed effects for fixed effects estimation. δ_t denotes time dummies and ε_{ist} is the error term. In addition to (1), I also estimate (2) to examine prefecture-level fixed effects with

[6] The detailed information of the Economy Watcher Survey is available in English through the web page of the Cabinet Office: https://www5.cao.go.jp/keizai3/watcher-e/index-e.html

clustering at the prefecture level[7].

$$lnW_{ist} = \alpha lnMW_{st} + X'_{ist}\beta + \gamma_s + \delta_t + \varepsilon_{ist} \qquad (2)$$

5.2. Effect on Employment Loss (Job Separation)

To clarify the following research question: whether a minimum-wage hike leads to employment loss through firing of existing employees or new recruitment reduction, I estimate a job separation function and a new hire function using OLS.

First, I estimate a job separation function. In this paper, I estimate the following regression model:

$$D^*_{ist} = \alpha \Delta MW_{st-1} + X'_{ist-1}\beta + \delta_t + \mu_{ist} \qquad (3)$$

Following the frameworks of Higuchi (2013), D^*_{ist} is a dummy variable. It is equal to 1 if the individual is a non-regular worker at *t* - 1 and is separated from his or her job at *t*, and is equal to 0 if he or she is a non-regular worker at the time period. Since new minimum wages are applied in autumn and it takes time for employers to adjust employment as a response to the new minimum wages, in this model, I use explanatory variables from one year ago to allow a time lag with reference to Meer and West (2016). ΔMW_{st-1} is the difference in the prefecture-specific minimum wage, It is reasonable that the decision about whether employers reduce employment or not would be based on the increasing costs. Therefore, this paper adopts the first-difference in the minimum wage as the independent variables. The sign of the coefficient of ΔMW_{st-1} is my research interest. If the sign is positive, it can be interpreted that a minimum-wage hike leads to a rise in the job separation of non-regular workers. $X'_{ist-1}$is a vector of individual attributes. δ_t represents year dummies and μ_{ist} is the error term. I also estimate a linear OLS model with individual-level time-invariant fixed effects γ_i (4) and with prefecture-fixed effects γ_s (5) as the robustness check[8].

[7] It might also be possible to estimate with both infividual-level fixed effects (γ_i) and prefecture-level fixed effects (γ_s). However, due to the collinearity, I did not adopt that approach.
[8] Though pooled logit models and random effects logit models can also be used to estimate, I assume that unobservable variables are correlated with the individual specific effect, and thus adopt fixed effects models.

$$D^*_{ist} = \alpha \Delta MW_{st-1} + X'_{ist-1}\beta + \gamma_i + \delta_t + \mu_{ist} \quad (4)$$

$$D^*_{ist} = \alpha \Delta MW_{st-1} + X'_{ist-1}\beta + \gamma_s + \delta_t + \mu_{ist} \quad (5)$$

However, it can be argued that there is a drawback that this estimation cannot recognize job to job movement due to the data limitation, which may be major for non-regular workers moving to other non-regular jobs.

5.3. Effect on Employment Loss (New Hire)

Finally, I perform the following regression analysis to examine whether a minimum-wage increase leads to a reduction of new hiring:

$$Z^*_{ist} = \alpha \Delta MW_{st-1} + R'_{ist-1}\beta + \delta_t + \mu_{ist} \quad (6)$$

Once again following Higuchi (2013), I define Z^*_{ist} as another dummy variable, in this case corresponding to new hire dummies. It equals to 1 if the individual is unemployed or non-employed at $t-1$ and is hired as a non-regular worker at t, and equals to 0 if the individual is unemployed or non-employed at the time period. R'_{ist-1} is a vector of individual attributes which controls the individual's status and the regional economic condition in t-1. To control the characters of the job in t, I do not adopt a time lag for industry dummies and firm-size dummies. δ_t denotes year dummies and μ_{ist} is the error term. Similar to the job separation model, I also estimate OLS models including individual-level time-invariant fixed effects (γ_i), the prefecture-fixed effects (γ_s), and the prefecture-level heterogeneous time trends ($\gamma_s \times \delta_t$).

$$Z^*_{ist} = \alpha \Delta MW_{st-1} + R'_{ist-1}\beta + \gamma_i + \delta_t + \mu_{ist} \quad (7)$$

$$Z^*_{ist} = \alpha \Delta MW_{st-1} + R'_{ist-1}\beta + \gamma_s + \delta_t + \mu_{ist} \quad (8)$$

$$Z^*_{ist} = \alpha \Delta MW_{st-1} + R'_{ist-1}\beta + \gamma_s \times \delta_t + \mu_{ist} \quad (9)$$

If the sign of the coefficient of ΔMW_{st-1} is negative, it implies that a minimum-wage increase hinders new employment opportunities.

6. Estimation Results

6.1. Effect on Hourly Wage

Table 2 shows the estimation results about the effect of a minimum-wage increase on the hourly wage of non-regular workers. Columns (1) and (2) show the results with individual-fixed effects and prefecture-fixed effects, respectively. The results with pooled OLS and random effects are also shown in appendix A[9]. In this case, the coefficient of the log minimum wage of Column (1) is positive and statistically significant, which implies that a minimum-wage increase positively affects the hourly wages for non-regular workers. This result means that 1% increase in the minimum wage will increase the hourly wage of non-regular workers by approximately 0.76%. On the other hand, the result of Column (2), is not statistically significant. Though I omit the prefecture-level explanatory variables in order to relieve multicollinearity, we can find that the standard error clustered at the prefecture level becomes large. However, I also analyse a sub-group estimation of the prefecture-level fixed effects model, and Columns (3) and (4) show the results of the prefecture-level fixed effects estimations by gender. While the coefficient for male workers is not statistically significant, that for female workers is positive and statistically significant.

These results are consistent with Higuchi (2013). One possible reason is that, as Tachibanaki and Urakawa (2006) pointed out, the proportion of female workers whose wage is close to the minimum wage is greater than that of male workers. Therefore, by restricting the sample to women, the standard error is reduced and it made the result statistically significant.

6.2. Effect on Employment Loss (Job Separation)

To test the research question: whether a large minimum-wage hike causes employment loss, I estimate two types of the labour dynamics. Table 3 shows the effect on the job separation of non-regular workers with simple OLS. For all non-regular worker samples, the coefficient of the difference in the minimum wage is statistically significant in Column (1). This finding implies an increase in the minimum wage hinders job separation, which is the opposite of the expected result. In addition to Burdett and Mortensen (1998), one possible reason for the reverse effect is that a minimum-wage hike increases the wages of workers whose wages are close to the minimum wage

[9] However, the fixed effects model is selected by the Hausman test.

and it makes their reservation wages higher, preventing them from seeking new jobs. I also run subgroup estimations by gender, but the result of male workers in Column (3) on Table 3 is insignificant while that of female workers in Column (2) is significant. In addition, Table 4 shows the estimate results for samples under 30 years old, and similar results can be seen even when the samples are restricted to young people who are susceptible to the minimum-wage change. Only the result of young male workers is significant.

To check the robustness of the results, I run a prefecture-fixed effects OLS and an individual-fixed effects OLS[10], and Table 5 represents that the result of the prefecture-fixed effects model is negatively significant. But that of the individual-fixed effects model is insignificant and none of the gender-subgroup show significant effect, suggesting that I fail to find robust evidence that a high minimum wage changes job separation.

One possible explanation for these findings is that job separation generates turnover costs. As Rebitzer and Taylor (1995) explain with the well-known Shapiro-Stiglitz model; due to the turnover costs and monitoring costs, employers do not try to fire existing employees and hire lower-paid workers from the point of view of efficiency wage. The finding in this section may also be explained by the fact that it is relatively difficult to fire employees during the term of employment even though they are non-regular workers in Japan. Therefore, it is possible that employers absorb the impact of increase in the minimum wage not by increasing job separation but by reducing new recruits. Additionally, if the job separation effect is negative, it would cancel out the new hiring effect and reduce the overall effect, leading to make it more difficult to detect the overall effect.

6.3. Effect on Employment Loss (New Hire)

Finally, I analyse the impact on new hiring of non-regular workers[11]. Table 6 shows the regression results of simple OLS, and only the female workers show the weakly but significantly negative result. On the other hand, I estimate several fixed effects models as the robustness check and Table 7 indicates the significant results. Column (1) is the result of the individual-fixed effects OLS model, and Column (2) shows that of the prefecture-fixed effects OLS model. For all non-regular

[10] In addition, I also estimate a pooled logit model and a random effects model, but in both cases the results were significantly negative (see Appendix B).
[11] The results of logit models are shown in Appendix C.

workers samples (Columns (1) and (2)), the coefficients of the change in the minimum wage are significantly negative. I also estimate prefecture-fixed effects OLS by gender, and as seen in Columns (3) and (4) on Table 7. Column (3) represents the negative impact on new hiring for female workers, but I find no evidence for male workers in Column (4). This result implies that a high increase in the minimum wage may hinder the new hiring specifically for female workers. In addition, with reference to Allegretto et al. (2011) and Neumark et al. (2014), I also estimate prefecture-fixed effects OLS with prefecture-specific time trend to account for heterogeneous time trend in order to control more appropriately economic conditions which affect employment other than the change of the minimum wage. Table 8 shows the results: Column (1) includes year×prefecture dummies, Column (2) has year dummies and year×prefecture dummies, Column (3) contains prefecture dummies and year×prefecture dummies, and Column (4) holds year dummies, prefecture dummies, and year×prefecture dummies, respectively. All these approaches show statistically significant negative effects. Furthermore, I run the subgroup regressions of Column (3) and significant effects are shown in all samples, female workers, and male workers on Table 9. Column (4) represents the result for less-educated workers who graduate from junior high school or high school. Finally, I perform prefecture-fixed effects OLS with prefecture-specific time trend by regions, and the results are represented in Table 10. While the coefficient is statistically insignificant for the urban area, that for rural area is significantly negative.

These results are different from Higuchi (2013), and one possible explanation for the difference is that I estimate with sufficient samples. As Kawaguchi and Mori (2021) pointed out, the impact might not be precisely estimated because of the small sample size. Therefore, we can find out the negative impacts by using plenty of datasets. In contrast, the results in this section consistent with Neumark and Shirley (2021). They note that in the literature negative estimates can be seen strongly in sub-group such as young and the less-educated people. In Japan, the female non-regular workers are relatively less educated and their wages are low compared with those of male workers. Table 1 represents that mean age of female workers is younger than that of male workers and female non-regular workers tend to be less educated in the JPSED dataset. Therefore, my research results point out that the impact of a minimum-wage hike may affect new employment heterogeneously. Additionally, the results in Table 9 suggest heterogeneous time trends by prefectures, and the results in Table 10 imply that a minimum-wage hike does not have negative impact on new hiring in urban area, but has adverse effect in local region. It is well known that

different regions have different industrial structures[12], and the economic confidence differs between industries (see, e.g., Cabinet Office 2018 and 2020). Therefore, the different results between the urban regions and rural regions may be caused by the different industrial structures between prefectures. And Okudaira et al. (2019) pointed out that the minimum-wage impact depends on the extent of surplus that firms face and firms' behavioural response is heterogeneous. Firms which have larger surplus do not significantly reduce employment, but a large employment reduction is observed with firms with less surplus, leading to the diversity of the response across local labour markets. So, the policy makers should account that rapid minimum-wage hikes may cause large unemployment especially in local areas.

7. Conclusion

The aim of this paper was to answer the following question: does a minimum-wage hike increase the wage of non-regular workers and reduce employment in Japan? This paper estimated three variations of the models which analysed the impact on hourly wage, job separation, and new hire. There is little dispute that the minimum wage raises hourly wages, but the previous literature has not reached consistent agreement whether a minimum-wage hike has adverse impact on employment or not. The results of this study suggest three points: (1) positive effect on hourly wages for non-regular workers, specifically female workers, (2) not robust evidence for the increase in job separation, and (3) negative and heterogeneous impact on new hiring.

The findings of this paper offer several important practical implications for policy makers. First, this paper found similar results to the previous literature regarding to the impact on hourly wages. The impact of 1% increase in the minimum wage is approximately 0.76% with the individual-fixed effects model. Furthermore, the estimation result also implies that the impact can be seen by focusing on the directly-affected workers. Therefore, the minimum-wage policy can be regarded as an effective policy to raise the wages of low-paid workers. Second, the hypothesis regarding the job separation is not supported, and this paper fails to find clear evidence of the expected impact. Namely, the minimum wage may not affect employment through job separation, or reduce the job separation by increasing workers' reservation wages. Third, while previous literature such as Higuchi (2013) reported no evidence, this paper found a negative impact on new

[12] For example, the share of service sector is higher in urban prefectures than in local prefectures, and large companies are concentrated in urban regions in Japan.

recruitment in several fixed effects estimations with a similar approach. One implication of this study is that the main causes of employment loss may be not increasing job separation, but hindering new recruitment. Therefore, policy makers should concentrate on supporting new recruits and reducing the mismatch in the labour market. Another implication is that the impact on new hiring is heterogeneous between the group and region. This paper also reveals that a clear negative impact can be seen by allowing heterogeneous time trend in each prefecture. This implies that detailed analysis for both the reginal economic condition and the economic structure in each prefecture is necessary for the revisions of the minimum wages to minimize the negative side effect. I suggest policy makers should look both at reducing the urban-rural wage gap and at the negative impact on employment in the rural areas. Given that this type of estimation research is still in its initial stage in Japan, further in-depth investigation should be pursued to add to the findings of the present studies. As Manning (2021b) points out, the existing literature does not really answer the question: "what is the level of the minimum wage that maximizes employment? In answering this question, it may be important to focus on heterogeneity in the impact of the minimum wage" (Manning 2021b: 12).

It is important to note that this study was implemented with relatively new data. JPSED was launched in 2016 and the time period is limited. Therefore, it is difficult to predict the long-term effect of minimum-wage hikes. In addition, in this study there is no discussion of job-to-job movement of non-regular workers due to the data limitation, this limitation must be borne in mind. There are also a number of implications of this empirical approach for future work. It would be interesting to see whether this kind of model could be used for the micro data from the administrative data to examine job-job movement and long-term impact. It would also be more interesting to develop a consistent approach to job separation and new hire, and to break down the overall employment effect into separation and hire effects.

In spite of these limitations, I believe that the conclusion could provide several policy implications and the evidence could be applied for EBPM in Japan. In the longer term, I hope that the results of these studies will be applied and incorporated into the rules for determining the minimum wages.

References

Allegretto, S.A., Dube, A. and Reich, M. (2011) 'Do Minimum Wages Really Reduce Teen Employment? Accounting for Heterogeneity and Selectivity in State Panel Data. Industrial Relations', *Journal of Economy and Society*, 50, pp. 205-240

Andrews, I. and Kasy, M. (2019) 'Identification of and Correction for Publication Bias', *American Economic Review*, 109 (8), pp.2766–2794

Baskaya, Y. S. and Rubinstein, Y. (2012) *Using federal minimum wages to identify the impact of minimum wages on employment and earnings across the US states*. Unpublished working paper

Bhaskar, V. and To, T. (1999) 'Minimum Wages for Ronald McDonald Monopsonies: a Theory of Monopsonistic Competition', *Economic Journal*, 109 (455), pp.190-203

Burdett, K. and Mortensen, D. (1998) 'Wage Differentials, Employer Size, and Unemployment', *International Economic Review*, 39(2), pp.257-273

Cabinet Office, Government of Japan (2018) Reginal Economy 2018. Available at: https://www5.cao.go.jp/j-j/cr/cr18/chr18_index-pdf.html (Accessed 12 July 2021) (In Japanese)

Cabinet Office, Government of Japan (2020) Reginal Economy 2019. Available at: https://www5.cao.go.jp/j-j/cr/cr19/chr19_index-pdf.html (Accessed 12 July 2021) (In Japanese)

Card, D. and Krueger, A, B. (1994) 'Minimum Wages and Employment: A Case Study of the Fast-Food Industry in New Jersey and Pennsylvania', *American Economic Review*, 84(4), pp. 772-793

Card, D. and Krueger, A, B. (1995) *Myth and Measurement*, Princeton University Press

Government of Japan (2016) *Basic Policy on Economic and Fiscal Management and Reform 2016.*Available at: https://www5.cao.go.jp/keizai-shimon/kaigi/cabinet/2016/2016_basicpolicies_en.pdf (Accessed 8 July 2021).

Government of Japan (2021) *Basic Policy on Economic and Fiscal Management and Reform 2021.*Available at: https://www5.cao.go.jp/keizai-shimon/kaigi/cabinet/2021/2021_basicpolicies_ja.pdf (Accessed 8 July 2021) (In Japanese)

Gramlich, E, W. (1976) 'Impact of Minimum Wages on Other Wages, Employment, and Family Incomes', *Brookings Papers on Economic Activity*, 7(2), pp. 409-462

Hamermesh, D, S. (1995) 'Myth and Measurement: The New Economics of the Minimum Wage:

Comment', *Industrial and Labor Relations Review*, 48(4), pp. 835– 838

Higuchi, Y. (2013) 'The dynamics of poverty and the promotion of transition from non-regular to regular employment in Japan: Economic effects of minimum wage revision and job training support', *Japanese Economic Review,* 64(2)*,* pp.147-200

Kawaguchi, D. and Mori, Y. (2021) 'Estimating the Effects of the Minimum Wage Using the Introduction of Indexation', *Journal of Economic Behavior and Organization*, 184, pp. 388-408

Manning, A. (2003) *Monopsony in Motion: Imperfect Competition in Labor Markets*, Princeton University Press

Manning, A. (2021a) 'The Elusive Employment Effect of the Minimum Wage', *Journal of Economic Perspectives*, 35 (1), pp. 3-26

Manning, A. (2021b) 'Monopsony in Labor Markets: A Review', *ILR Review*, 74(1), pp.3–26

Matsuta, S. (2020) *Saiteichingin No Hikiage No Eikyoubunseki-Seisakuchiken Ni Kansuru Database Sakusei No Teian-*.
Available at: https://www.tkfd.or.jp/research/detail.php?id=3347 (Accessed: 28 June 2021) (In Japanese).

Meer, J. and West, J. (2016) 'Effects of the Minimum Wage on Employment Dynamics', *Journal of Human Resources*, 51 (2), pp.500–522

Mincer, J. (1976). 'Unemployment Effects of Minimum Wages,' *Journal of Political Economy*, 84(4), pp.87-104

Neumark, D., Ian Salas, J. M. and Wascher, W. (2014) 'Revisiting the Minimum Wage—Employment Debate: Throwing Out the Baby with the Bathwater?', *Industrial and Labor Relations Review*, 67 (3), pp.608–648

Neumark, D. and Shirley, P. (2021) *Myth or measurement: What does the new minimum wage research say about minimum wages and job loss in the United States?*. NBER Working Paper, 28388

Neumark, D. and Wascher, W (1992) 'Employment Effects of Minimum and Subminimum Wages: Panel Data on State Minimum Wage Laws', *Industrial and Labor Relations Review*, 46 (1), pp.55–81

Neumark, D. and Wascher, W. (1995) 'Minimum Wage Effects on School and Work Transitions of Teenagers', *American Economic Review*, 85(2), pp. 244-249

Neumark, D. and Wascher, W. (2000) 'Minimum wages and employment: A case study of the fast-

food industry in New Jersey and Pennsylvania: Comment', *American Economic Review*, 90(5), pp. 1362-1396

Neumark, D. and Wascher, W. (2007) *Minimum Wages, the Earned Income Tax Credit, and Employment: Evidence from the Post-Welfare Reform Era.* IZA DP, 2610

Neumark, D. and Wascher, W. (2008) *Minimum Wages*. MIT Press

OECD.Stats *Minimum relative to average wages of full-time workers.* Available at: https://stats.oecd.org/Index.aspx?DataSetCode=MIN2AVE(Accessed: 28 June 2021)

OECD.Stats *Real minimum wages.* Available at: https://stats.oecd.org/index.aspx?DataSetCode=RMW (Accessed: 28 June 2021)

Okudaira, H., Takizawa, M. and Yamanouchi, K. (2019). 'Minimum wage effects across heterogeneous markets', *Labour Economics*, 59, pp. 110–122

Rebitzer, J, B. and Taylor, L, J. (1995) 'The Consequences of Minimum Wage Laws: Some New Theoretical Ideas', *Journal of Public Economics*, 56 (2), pp.245–255

Shapiro, C. and Stiglitz, J, E. (1984) 'Equilibrium Unemployment as a Worker Discipline Device', *American Economic Review*, 74 (3), pp.433–444

Tachibanaki, T. and K. Urakawa (2006) *Nihon No Hinkon Kenkyu*, Tokyo: Tokyo University Press. (In Japanese)

Welch, F. (1976) 'Minimum Wage Legislation in the United States.' in Ashenfelter, O. and Blum, J. (ed.) *Evaluating the Labor Market Effects of Social Programs*. Princeton, N.J.: Princeton University Press. pp. 1– 38

Figure 1: Trend of the Minimum Wage in Japan

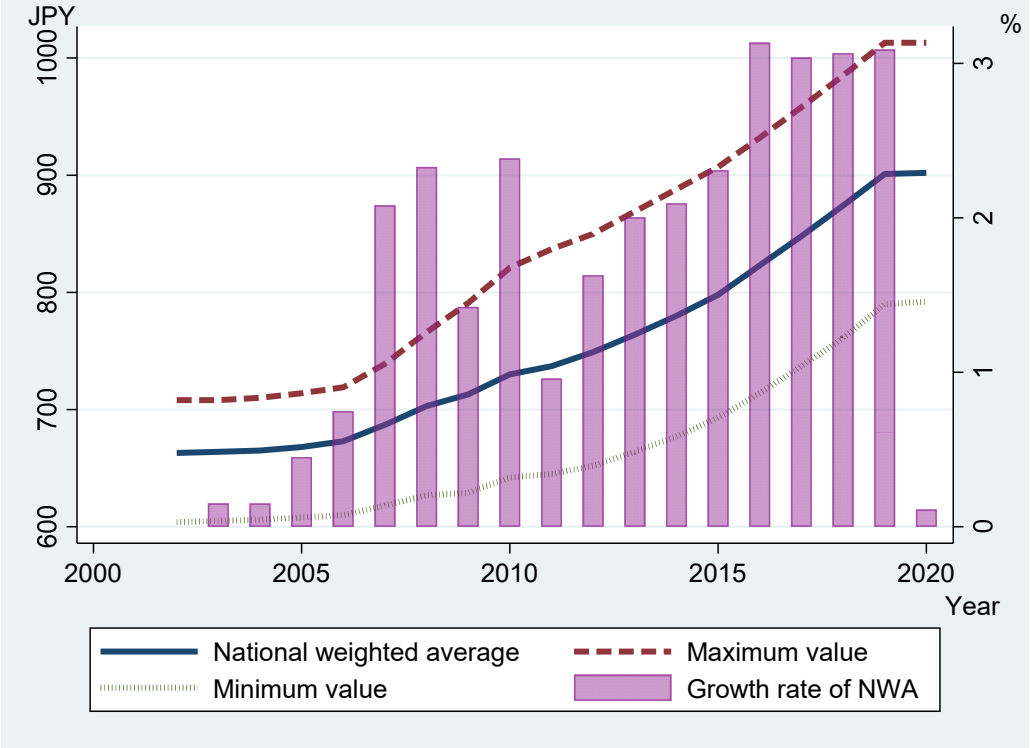


Figure 2: Minimum Wage by prefecture in 2019

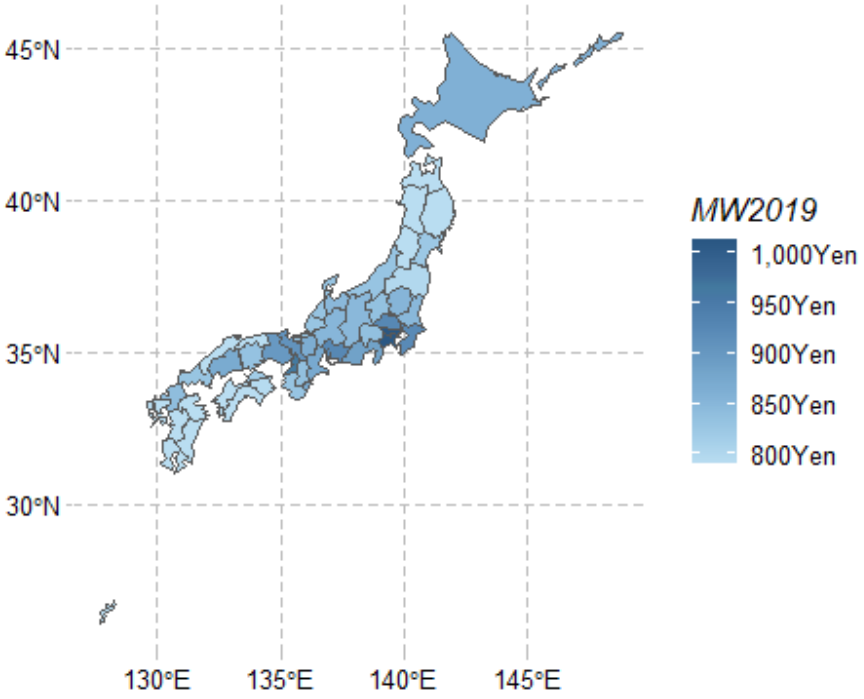
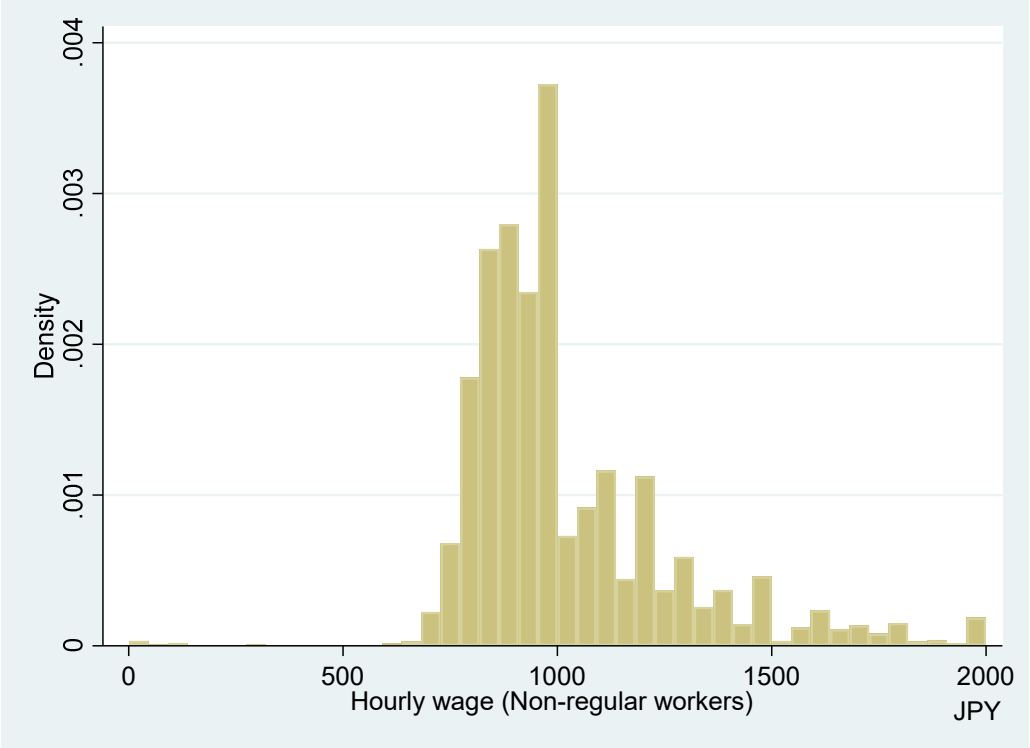


Figure 3: Wage Distribution



Note: Outlier value (>2,000) is omitted, but the number is only 751/28,036 (2.7%).

Table 1: Descriptive Statistics

		Non-regular worker					
		ALL		Female		Male	
Variables		Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.
Dependent Variables							
	Hourly wage	1229.71	2351.40	1213.20	2351.56	1267.63	2350.71
	Observations of hourly wage	28,036		19,529		8,507	
	Job separation dummies	0.17	0.37	0.15	0.35	0.20	0.40
	Observations of job separation	38,563		25,309		13,254	
	New hiring dummies	0.11	0.31	0.11	0.31	0.10	0.30
	Observations of new hiring	35,374		22,824		12,550	
Explanatory Variables							
	Age	44.39	15.74	43.60	14.28	45.86	18.06
Education dummies	Graduate from high school	0.37	0.48	0.37	0.48	0.37	0.48
	Graduate from 2-year college or specialized high school	0.34	0.48	0.40	0.49	0.24	0.43
	Graduate from university or graduate school	0.24	0.43	0.19	0.39	0.35	0.48
Family related dummies	Children (under 12 years old)	0.13	0.37	0.18	0.38	0.04	0.19
	Spouse	0.52	0.50	0.58	0.49	0.41	0.49
	Supporter	0.40	0.49	0.25	0.43	0.67	0.47
Prefecture-level variables	Minimum wage	850.20	81.41	848.87	81.51	852.69	81.18
	Unemployment rate	2.69	0.62	2.69	0.62	2.68	0.61
	Proportion of population 15-64	60.26	2.97	60.25	2.98	60.27	2.96
	Economy Watcher	47.69	3.08	47.69	3.09	47.67	3.06
	Observations	66,851		43,596		23,255	

Note: Table 1 represents the descriptive statistics for non-regular workers. The job separation dummies are equal to 1 if the individual is a non-regular worker at t - 1 and is separated from his or her job at t, and is equal to 0 if he or she is a non-regular worker at both t - 1 and t. The new hiring dummies equal to 1 if the individual is unemployed or non-employed at t – 1 and is hired as a non-regular worker at t, and equals to 0 if the individual is unemployed or non-employed at both t - 1 and t. Supporter dummies equal 1 if an individual is the main earner in the family.

Table 2: Hourly Wage

VARIABLES	(1) Fixed Effects All	(2) Fixed Effects All	(3) Fixed Effects Female	(4) Fixed Effects Male
lMW	0.759***	1.361	2.515**	-1.239
	(0.281)	(0.855)	(1.026)	(1.584)
Constant	2.148	-2.306	-9.973	15.03
	(1.948)	(5.711)	(6.853)	(10.59)
Observations	28,036	28,036	19,529	8,507
Number of individuals	15,775	-	-	-
Number of prefectures	-	47	47	47
Fixed Effects	Individual	Prefecture	Prefecture	Prefecture
R-squared	0.023	0.074	0.076	0.094

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Note: Table 2 shows the estimation results about the effect of a minimum-wage increase on the hourly wage. In addition to the above variables, explanatory variables include education dummies, age, age^2, gender dummies, spouse dummies, supporter dummies, children dummies, unemployment rate, proportion of population aged 15-64, Economy Watcher DI, firm-size dummies, industry-dummies, and year dummies. For Columns (2), (3), and (4), unemployment rate, proportion of population aged 15-64, and Economy Watcher DI are omitted due to multicollinearity. The standard errors are clustered at individual or prefecture level.

Table 3: Job Separation (OLS)

VARIABLES	(1) OLS All	(2) OLS Female	(3) OLS Male
L. ΔMW	-0.00598***	-0.00591**	-0.00485
	(0.00200)	(0.00236)	(0.00374)
Constant	0.714***	0.792***	0.653***
	(0.0861)	(0.105)	(0.154)
Observations	38,563	25,309	13,254
Fixed Effects	No	No	No
R-squared	0.042	0.041	0.043

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Note: Table 3 shows the effect on the job separation of non-regular workers with simple OLS. In addition to the above variables, explanatory variables include education dummies, age, age^2, gender dummies, spouse dummies, supporter dummies, children dummies, unemployment rate, proportion of population aged 15-64, Economy Watcher DI, firm-size dummies, industry-dummies, and year dummies.

Table 4: Job Separation (OLS, Young workers)

	(1) OLS	(2) OLS	(3) OLS
VARIABLES	Young All	Young female	Young male
L. ΔMW	-0.00913	-0.000820	-0.0239**
	(0.00616)	(0.00749)	(0.0110)
Constant	-0.946**	-0.380	-1.795**
	(0.422)	(0.533)	(0.711)
Observations	6,290	3,865	2,425
Fixed Effects	No	No	No
R-squared	0.040	0.044	0.065

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Note: Table 4 shows the estimate results about the job separation for young workers under 30 years old. In addition to the above variables, explanatory variables include education dummies, age, age^2, gender dummies, spouse dummies, supporter dummies, children dummies, unemployment rate, proportion of population aged 15-64, Economy Watcher DI, firm-size dummies, industry-dummies, and year dummies.

Table 5: Job Separation (Fixed Effects)

	(1) FE OLS	(2) FE OLS	(3) FE OLS	(4) FE OLS
VARIABLES	All	All	Female	Male
L. ΔMW	-0.00908**	-0.00450	-0.00262	-0.00839
	(0.00446)	(0.00408)	(0.00470)	(0.00792)
Constant	0.953***	1.643	2.514*	-1.573
	(0.0854)	(1.230)	(1.409)	(2.398)
Observations	38,563	38,563	25,309	13,254
Number of prefectures	47	-	-	-
Number of individuals	-	19,268	12,310	6,958
Fixed Effects	Prefecture	Individual	Individual	Individual
R-squared	0.044	0.054	0.051	0.083

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Note: Table 5 represents the results of the job separation effect with fixed effects models. In addition to the above variables, explanatory variables include education dummies, age, age^2, gender dummies, spouse dummies, supporter dummies, children dummies, unemployment rate, proportion of population aged 15-64, Economy Watcher DI, firm-size dummies, industry-dummies, and year dummies. For Column (1), unemployment rate, proportion of population aged 15-64, and Economy Watcher DI are omitted due to multicollinearity. The standard errors are clustered at individual or prefecture level.

Table 6: New Hire (OLS)

	(1) OLS	(2) OLS	(3) OLS
VARIABLES	All	Female	Male
L. ΔMW	-0.000651	-0.00176*	0.00109
	(0.000709)	(0.000917)	(0.00105)
Constant	-0.0316	-0.0607*	-0.00806
	(0.0295)	(0.0367)	(0.0441)
Observations	35,374	22,824	12,550
Fixed Effects	No	No	No
R-squared	0.827	0.822	0.858

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Note: Table 6 shows the effect on the new hire of non-regular workers with simple OLS. In addition to the above variables, explanatory variables include education dummies, age, age^2, gender dummies, spouse dummies, supporter dummies, children dummies, unemployment rate, proportion of population aged 15-64, Economy Watcher DI, firm-size dummies, industry-dummies, and year dummies.

Table 7: New Hire (Fixed Effect)

	(1) FE OLS	(2) FE OLS	(3) FE OLS	(4) FE OLS
VARIABLES	All	All	Female	Male
L. ΔMW	-0.00175*	-0.00282**	-0.00328**	-0.00112
	(0.00100)	(0.00119)	(0.00129)	(0.00212)
Constant	-0.171	0.0436**	0.0152	0.0437
	(0.400)	(0.0209)	(0.0215)	(0.0346)
Observations	35,374	35,374	22,824	12,550
Number of individuals	16,914	-	-	-
Number of prefectures	-	47	47	47
Fixed Effects	Individual	Prefecture	Prefecture	Prefecture
R-squared	0.855	0.827	0.823	0.858

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Note: Table 7 represents the results of the new-hiring effect with fixed effects models. In addition to the above variables, explanatory variables include education dummies, age, age^2, gender dummies, spouse dummies, supporter dummies, children dummies, unemployment rate, proportion of population aged 15-64, Economy Watcher DI, firm-size dummies, industry-dummies, and year dummies. For Column (2), (3), and (4), unemployment rate, proportion of population aged 15-64, and Economy Watcher DI are omitted due to multicollinearity. The standard errors are clustered at individual or prefecture level.

Table 8: New Hire (Prefecture-specific time trend)

VARIABLES	(1) FE OLS Y*P	(2) FE OLS Y+Y*P	(3) FE OLS P+Y*P	(4) FE OLS P+Y+Y*P
L. ΔMW	-0.00446***	-0.0460***	-0.00711***	-0.0534***
	(0.000313)	(0.0103)	(0.000469)	(0.0155)
Constant	0.0702***	0.734***	0.113***	0.854***
	(0.00747)	(0.164)	(0.00933)	(0.247)
Observations	35,374	35,374	35,374	35,374
Number of prefectures	47	47	47	47
Fixed Effects	No	No	Prefecture	Prefecture
R-squared	0.828	0.828	0.828	0.828

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Note: Table 8 represents the results of the prefecture-fixed effects OLS with prefecture-specific time trend. In addition to the above variables, explanatory variables include education dummies, age, age^2, gender dummies, spouse dummies, supporter dummies, children dummies, firm-size dummies, industry-dummies, and year dummies*prefecture dummies. The standard errors are clustered at prefecture level.

Table 9: New Hire (Prefecture-specific time trend)

VARIABLES	(1) FE OLS All	(2) FE OLS Female	(3) FE OLS Male	(4) FE OLS Less Educated All
L. ΔMW	-0.00711***	-0.00402***	-0.0104***	-0.00589***
	(0.000469)	(0.000669)	(0.000971)	(0.000688)
Constant	0.113***	0.0290**	0.182***	0.0845***
	(0.00933)	(0.0134)	(0.0205)	(0.0101)
Observations	35,374	22,824	12,550	15,875
Number of prefectures	47	47	47	47
Fixed Effects	Prefecture	Prefecture	Prefecture	Prefecture
R-squared	0.828	0.824	0.860	0.856

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Note: Table 9 represents the results of the prefecture-fixed effects OLS with prefecture-specific time trend by subgroup. In addition to the above variables, explanatory variables include education dummies, age, age^2, gender dummies, spouse dummies, supporter dummies, children dummies, firm-size dummies, industry-dummies, and year dummies*prefecture dummies. The standard errors are clustered at prefecture level.

Table 10: New Hire (Prefecture-specific time trend by regions)

	(1)	(2)
	FE OLS	FE OLS
VARIABLES	Urban Region	Rural Region
L. ΔMW	0.00126	-0.00535***
	(0.000760)	(0.000811)
Constant	0.157*	0.0782***
	(0.0637)	(0.0187)
Observations	15,537	4,515
Number of prefectures	6	16
Fixed Effects	Prefecture	Prefecture
R-squared	0.831	0.879

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Note: Table 10 represents the results of the prefecture-fixed effects OLS with prefecture-specific time trend by region. The urban region includes Tokyo, Kanagawa, Osaka, Aichi, Saitama, and Chiba. The rural region includes Fukushima, Oita, Yamagata, Ehime, Shimane, Tottori, Kumamoto, Nagasaki, Kochi, Iwate, Kagoshima, Saga, Aomori, Akita, Miyazaki, and Okinawa. In addition to the above variables, explanatory variables include education dummies, age, age^2, gender dummies, spouse dummies, supporter dummies, children dummies, firm-size dummies, industry-dummies, and year dummies*prefecture dummies. The standard errors are clustered at prefecture level.

Appendix A Effect on Hourly Wage

In this paper I also perform a pooled OLS and a random effects model to analyse the impact on hourly wages for non-regular workers. Table A shows the results. These results are statistically significant and they are similar to the individual-fixed effects, namely 1% rise in the minimum wage will lead to around 0.7% increase in hourly wage of non-regular workers.

Table A: Hourly Wage

VARIABLES	(1) Pooled OLS	(2) Random Effects
lMW	0.697***	0.703***
	(0.0647)	(0.0758)
Constant	1.769***	1.873***
	(0.355)	(0.400)
Observations	28,036	28,036
Number of individuals	-	15,775
R-squared	0.113	0.013

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Note: In addition to the above variables, explanatory variables include education dummies, age, age^2, gender dummies, spouse dummies, supporter dummies, children dummies, unemployment rate, proportion of population aged 15-64, Economy Watcher DI, firm-size dummies, industry-dummies, and year dummies. The standard errors in (1) are clustered at individual level.

Appendix B Effect on Employment Loss (Job Separation)

This paper also tries two non-linear models to examine the job separation: a pooled logit model and a random effects logit model. The logit models are derived with the following estimation equation:

$$D^*_{ist} = \alpha \Delta MW_{st-1} + X'_{ist-1}\beta + \gamma_i + \delta_t + \mu_{ist} \qquad \text{(B1)}$$

$$\begin{aligned} \Pr(D_{ist} = 1) &= \Pr(D^*_{ist} > 0) \\ &= \Pr(\mu_{ist} > -\alpha \Delta MW_{st-1} - X'_{ist-1}\beta - \gamma_i - \delta_t) \\ &= F(\alpha \Delta MW_{st-1} + X'_{ist-1}\beta + \gamma_i + \delta_t) \end{aligned} \qquad \text{(B2)}$$

Table B shows the estimation results of job separation. Like the prefecture-fixed effects OLS case in Table 5, we can see the results of the pooled logit model and the random effect model are significantly negative.

Table B: Job Separation

	(1)	(2)
VARIABLES	Pooled logit	RE logit
L. ΔMW	-0.0459***	-0.0569***
	(0.0154)	(0.0197)
Constant	1.786***	2.073***
	(0.626)	(0.799)
Observations	38,563	38,563
Number of individuals	-	19,268

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Note: In addition to the above variables, explanatory variables include education dummies, age, age^2, gender dummies, spouse dummies, supporter dummies, children dummies, unemployment rate, proportion of population aged 15-64, Economy Watcher DI, and year dummies. The standard errors in (1) are clustered at individual level.

Appendix C Effect on Employment Loss (New Hire)

This paper also runs two non-linear models to examine the new hiring: a pooled logit model and a random effects logit model. The logit models are derived with the following estimation equation:

$$Z^*_{ist} = \alpha \Delta MW_{st-1} + R'_{ist-1}\beta + \gamma_i + \delta_t + \mu_{ist} \qquad \text{(C1)}$$

$$\begin{aligned} \Pr(Z_{ist} = 1) &= \Pr(Z^*_{ist} > 0) \\ &= \Pr(\mu_{ist} > -\alpha \Delta MW_{st-1} - R'_{ist-1}\beta - \gamma_i - \delta_t) \\ &= F(\alpha \Delta MW_{st-1} + R'_{ist-1}\beta + \gamma_i + \delta_t) \qquad \text{(C2)} \end{aligned}$$

Table C shows the results of the pooled logit model and the random effects models. I find weak but statistically significant evidence of negative impact on new recruits in both models.

Table C: New Hire

VARIABLES	(1) Pooled logit	(2) RE logit
L. ΔMW	-0.0368*	-0.0726**
	(0.0193)	(0.0315)
Constant	-1.144	-2.324*
	(0.755)	(1.218)
Observations	35,374	35,374
Number of individuals	-	16,914

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Note: In addition to the above variables, explanatory variables include education dummies, age, age^2, gender dummies, spouse dummies, supporter dummies, children dummies, unemployment rate, proportion of population aged 15-64, Economy Watcher DI, firm-size dummies, industry-dummies, and year dummies. The standard errors in (1) are clustered at individual level.