RIETI Policy Discussion Paper Series 19-P-015

# Minimum Wages and Productivity: Evidence from Japan

**MORIKAWA, Masayuki**
RIETI

Research Institute of Economy, Trade & Industry, IAA
The Research Institute of Economy, Trade and Industry
https://www.rieti.go.jp/en/

RIETI Policy Discussion Paper 19-P-015
September 2019

# Minimum Wages and Productivity: Evidence from Japan*

Morikawa, Masayuki (RIETI)

Abstract

The main objectives of a minimum wage are to ensure that low-wage workers have appropriate earnings and to reduce inequality. However, there is an active debate as to whether minimum wages improve productivity. This study presents evidence on the relationship between minimum wages and productivity using regional and firm-level panel data for Japan, where statutory minimum wages are determined at the prefecture-level and revised annually. The estimation results do not reveal evidence that an increase in minimum wages improves productivity.

Keywords: minimum wage, labor productivity, TFP, Kaitz index
JEL Classifications: D24, J31, R12



* I would like to thank Shinya Inukai, Naomi Kodama, Keisuke Kondo, Yoko Konishi, Kazuo Yamaguchi, Makoto Yano, Yin Ting, and the seminar participants at RIETI for their helpful comments and suggestions. Any errors are my own. I would like to thank the Ministry of Economy, Trade and Industry for providing the micro data from the Basic Survey of Japanese Business Structure and Activities used in this study. This research is supported by the JSPS Grants-in-Aid for Scientific Research (16H06322, 18H00858).

Minimum Wages and Productivity: Evidence from Japan

## 1. Introduction

The main objectives of setting a minimum wage are to ensure that low-wage workers have appropriate earnings and to reduce inequality. However, recently, the role of minimum wages in improving productivity is under active debate. This study aims to present evidence on the relationship between minimum wages and productivity using regional and firm-level panel data for Japan, where statutory minimum wages are determined at the prefecture-level.

Numerous studies examine the impact of minimum wages on employment, although the literature has not yet reached a consensus (see Manning, 2016 and Neumark, 2017, 2018, for recent surveys).[1] One possible reason behind the insignificant effect of minimum wages on employment, among other things, is firms' efforts to improve productivity to avoid a negative impact on their employment. Several studies analyze this productivity-enhancing effect (within-firm effect) of the introduction of national minimum wages in the UK (e.g., Draca *et al*., 2011; Georgiadis, 2013; Riley and Bondibene, 2017), but the results are mixed. In addition, since labor market institutions differ by country, it is difficult to draw general conclusions from studies on the national minimum wages in the UK only.

Another possible mechanism through which minimum wages improve aggregate productivity is the reallocation effect through the exit of unproductive low-wage firms that cannot survive under the wage cost pressure. Machin and Wilson (2004) and Draca *et al*. (2011) for the UK and Aaronson *et al*. (2018) for the US conduct representative studies exploring this possibility. Aaronson *et al*. (2018) provide evidence supporting the reallocation channel, but Machin and Wilson (2004) and Draca *et al*. (2011) do not find evidence of increasing exits of low-wage firms after the introduction of a national minimum wage. In short, minimum wages may improve aggregate productivity through the within-firm and reallocation effects, but the empirical evidence is limited and the conclusions are diverse.

In Japan, minimum wages rose continuously during the last decade. Minimum wages in Japan

---

[1] Empirical studies on the impact of minimum wages on employment in Japan include those by Kawaguchi and Mori (2009) and Kambayashi *et al*. (2013), both of which find a small negative effect on employment.

are determined at the regional level and there is a significant variation among prefectures.[2] For example, in 2018, the highest minimum wage (985 yen in Tokyo) was about 30% higher than the lowest wage (761 yen in Kagoshima). **Figure 1** depicts the means and standard deviations of the minimum wages within the prefectures during the last two decades. The figure indicates an increasing trend in the mean minimum wages and expanding dispersion of minimum wages among regions, particularly since 2007.[3] By exploiting the regional and time-series variations of minimum wages, this study presents evidence on the relationship between minimum wages and productivity. The analysis uses prefecture- and firm-level panel data. The key finding of this study is that we detect no positive impact of an increase in minimum wages on productivity. If anything, we observe a small negative impact on labor productivity at the firm level.

The rest of this paper proceeds as follows. Section 2 explains the data used and the method of analysis in this study. Section 3 reports the estimation results and Section 4 concludes with the implications of our findings.

## 2. Data and Methodology

We apply a standard panel regression model to the relationships between prefecture-level minimum wages and (1) the labor productivity (LP) of the prefectures and (2) the labor productivity and total factor productivity (TFP) of firms. Following prior studies on the impact of minimum wages, we divide the nominal minimum wages by the mean wages in the prefectures (denoted as MW) and use this as the main variable, which is a variant of the Kaitz index. We use this index because we should evaluate the severity of minimum wages for employers relative to the prevailing wages in the local labor markets. We source the mean wages by prefecture from the Basic Survey on Wage Structure published annually by the Ministry of Health, Labor and Welfare.

In the prefecture-level analysis, we calculate LP from the Annual Report on Prefectural Accounts (Economic and Social Research Institute, Cabinet Office) for the fiscal years from 2006 to 2015. We selected this sample period simply because the data based on the 2008 System of National Accounts are currently available only for these years. We divide the real gross prefectural

---

[2] Japan has 47 prefectures.
[3] In 2007, the Minimum Wage Act was revised to ensure a balance with welfare benefits.

products by the number of individuals working in the prefecture and convert this into the natural logarithm for use as the measure of LP.

The baseline estimation method is a simple fixed-effects model (equation (1)), where the index of MW defined above is the main explanatory variable. We use the prefecture fixed-effects ($\gamma_p$), year fixed-effects ($\lambda_t$), and LP in the previous year ($LP_{-1}$) as control variables (subscript $_p$ denotes prefecture).

$$LP_{pt} = \beta_0 + \beta_1 MW_{pt} + \beta_2 LP_{pt-1} + \gamma_p + \lambda_t + \varepsilon_{pt} \quad (1)$$

In addition to the baseline regression, to address a possible issue with endogeneity in MW, we conduct a dynamic panel regression (system GMM) for a robustness check.[4] In these prefecture-level regressions, the estimated coefficient for MW reflects both the productivity changes in individual firms (within-firm effect) and the reallocation effect through exits of inefficient firms.

In the firm-level analysis, we estimate the relationship between productivity of firms and the regional minimum wages for the firms' locations. We use micro data from the Basic Survey on Japanese Business Structure and Activities (BSJBSA) conducted by the Ministry of Economy, Trade and Industry for the fiscal years of 2001 to 2017 to construct firm-level panel data.

The BSJBSA contains the official statistics for all Japanese firms with 50 or more regular employees whose paid-up capital is 30 million yen or over that are engaged in the mining, manufacturing, electricity and gas, wholesale, retail, and selected service industries. Approximately 30,000 firms are surveyed every year. As the BSJBSA is a fundamental statistical survey designated as such by the Statistics Act, firms have an obligation to report. The BSJBSA contains key financial information about the respondent firms (e.g., sales, costs, profits, book value of capital), the number of employees, number of establishments, R&D expenditure, and so on. Empirical studies on productivity within Japanese firms frequently use the BSJBSA.

Since this study uses the prefecture-level MW as the main explanatory variable, it is inappropriate to use data on firms operating in multiple prefectures. Unfortunately, the BSJBSA does not identify the location of establishment of the firms, so we use data only for single-establishment firms (about 20% of the observations).

---

[4] We conduct the two-step estimation using STATA's xtabond2 command. We use the two- and three-year lagged values of the endogenous variables (LP and MW) in the estimation, although the result is essentially unchanged by using different lag lengths.

In the firm-level analysis (equation (2)), LP and TFP are the dependent variable ($y_{ipt}$) and MW is the main explanatory variable. We add firm fixed-effects ($\gamma_i$), year fixed-effects ($\lambda_t$), the lagged value of the dependent variables ($y_{ipt-1}$), and firm size ($Size_{it}$: log number of employees) as control variables (subscript $_i$ denotes firm).[5]

$$y_{ipt} = \beta_0 + \beta_1 MW_{pt} + \beta_2 y_{ipt-1} + \beta_3 Size_{it} + \gamma_i + \lambda_t + \varepsilon_{ipt} \quad (2)$$

We calculate firms' LP; that is, value-added per hour, as the firms' value-added divided by the total hours worked and express the value in logarithm form, where value-added is the sum of the operating profit, rent, wages, depreciation, and paid tax. However, since data on working hours at the firm-level is unavailable in the BSJBSA, we use industry-level data on working hours from the Basic Survey on Wage Structure to estimate total hours worked. Specifically, we calculate the total hours of firms as the sum of the number of full-time employees multiplied by their (industry-level) working hours and the number of part-time employees multiplied by their (industry-level) working hours. We deflate the value-added by the price index taken from the National Accounts (Economic and Social Research Institute, Cabinet Office).

We calculate TFP as a cost-share-based index number using value-added, the book value of capital, total hours, and the cost shares of capital and labor. We compute the input (capital and labor) and output (value-added) of a representative firm in the base year (2001) as the geometric means of these values for all firms in the same three-digit industry, and the cost shares of labor and capital as the arithmetic means. We calculate the TFP for each firm in each year relative to the representative firm in the base year.[6] The total hours are the same as the denominator of LP. We deflate the value-added and the book value of capital by the price indices taken from the National Accounts.[7]

In addition to the productivity analysis, we estimate the same specification for profitability ($ROA_{it}$) and investments ($INV_{it}$). ROA is the current profit divided by total assets and INV is the

---

[5] Although we apply the system GMM estimator for the firm-level data set, since the result does not pass the AR(2) test and the Hansen test of over-identification, we report only the fixed-effects estimation results.

[6] For the cost-share-based TFP index, see, for example, Syverson (2011). Existing studies frequently apply this approach the BSJBSA data (e.g., Fukao and Kwon, 2006; Morikawa, 2015, 2019).

[7] The results are essentially unchanged if we use nominal LP and TFP.

tangible investment divided by the stock value of tangible assets at the end of the previous fiscal year. The purpose of these supplementary regressions is to detect whether firms absorb the increase in labor costs induced by the minimum wage hike by reducing profit or investment.[8] Obviously, in these firm-level regressions, the estimated coefficient for MW does not include the reallocation effect.

The impact of the minimum wages should be strong for firms with a large share of low-wage employees. Non-standard workers such as part-time and temporary workers generally receive lower wages than standard (full-time regular) workers do. To capture this heterogeneity, we add the interaction terms of MW with the ratio of non-standard employees as an additional explanatory variable (equation (3)).

$$y_{ipt} = \beta_0 + \beta_1 MW_{pt} + \beta_2 MW_{pt} * \text{Non-standard}_{it} + \beta_3 \text{Non-standard}_{it} + \beta_4 y_{ipt-1} + \beta_5 \text{Size}_{it} + \gamma_i + \lambda_t + \varepsilon_{ipt} \quad (3)$$

We should note that all of the flow variables in the data sets are those for fiscal years (from April to March). On the other hand, statutory minimum wages are revised annually, and are usually applied in early October.[9] In this study, we analyze the relationship between the annual MW set in October of the previous year and the productivity of the fiscal year starting from April of the current year. This means that the estimations account for approximately a six-month lag in the analysis of the impact of MW changes on productivity.

**Table 1** presents the summary statistics of the variables.

## 3. Results

Column (1) of **Table 2** reports the baseline fixed-effects estimation result for the prefecture-level data. The coefficient for MW is negative and statistically insignificant. The dynamic panel estimation result confirms the insignificant impact of the minimum wage on regional labor

---

[8] We also applied the equation to employment within firms, and the coefficient for MW was insignificant.

[9] Specifically, the start date of the revised minimum wages differs by prefecture. However, the difference in timing is less than a month.

productivity (column (2)).

**Table 3** presents the fixed-effects estimation results for firm-level data. When we use LP as the dependent variable, the coefficient for MW is negative and statistically significant at the 5% level (column (1)). The coefficient is negative but insignificant when we use TFP as the dependent variable (column (2)). The negative coefficients for MW are surprising, as we expected positive or insignificant coefficients. Although we do not have a definitive interpretation, a possible reason for the significantly negative coefficient in the LP estimation is the reduction in investments arising from suppressed profitability, as we report later. However, the impact is quantitatively small: a one standard deviation increase in minimum wages is associated with about a 0.7 percentage point lower LP.

Columns (3) and (4) of Table 3 report the regression results when we include the interaction term of MW and the ratio of non-standard employees. For LP, the coefficient on the interaction term is negative and significant at the 1% level, suggesting a large negative impact of MW for firms employing many low-wage workers. However, the coefficient on the interaction term is insignificant in the TFP estimation.

We provide the fixed-effects estimations to explain ROA and INV in **Table 4**. The coefficients for MW are negative and significant for both ROA and INV (Columns (1) and (2)). The negative impact of MW on firm profitability is consistent with prior findings by Draca *et al*. (2011) and Bell and Machin (2018). On the other hand, the negative association of MW with investment is in contrast with a prior study that finds a substitution of labor with capital in response to the minimum wage hike (Harasztosi and Lindner, 2019). A natural interpretation is that an increase in MW squeezes firm profit, and consequently, reduces their investment.

However, when we include the interaction term of MW with the ratio of non-standard employees (Columns (3) and (4)), the coefficient is negative but insignificant in the ROA estimation and is positive and marginally significant in the investment estimation. The profitability and investment of firms that are likely to be exposed to minimum wages do not necessarily face a severe effect from the minimum wage hike.

Although the relationship between MW and investment is inconclusive, the bottom line of the analysis is that we do not observe a positive impact of MW on productivity, at least in the short run.

## 4. Conclusion

Numerous studies investigate the impact of minimum wages on employment, but the impact on productivity has been understudied. This study presents evidence on the relationship between minimum wages and productivity using prefecture- and firm-level panel data in Japan, where minimum wages rose continuously during the last decade. Importantly, since statutory minimum wages in Japan are determined at the prefecture-level and are revised annually, we can use the regional and time-series variations to analyze the impact of minimum wages.

From the analysis, we do not find a positive impact of an increase in minimum wages on productivity. If anything, we see a small negative effect on labor productivity at the firm level. In addition, we find some evidence of negative impacts on profitability and investments. These results suggest that we should view the potential role of minimum wage hikes in improving productivity with caution.

**References**

Aaronson, Daniel, Eric Baird French, and Isaac Sorkin (2018), "Industry Dynamics and the Minimum Wage: A Putty-Clay Approach," *International Economic Review*, Vol. 59, No. 1, pp. 51–84.

Bell, Brian and Stephen Machin (2018), "Minimum Wages and Firm Value," *Journal of Labor Economics*, Vol. 36, No. 1, pp. 159–195.

Draca, Mirko, Stephen Machin, and John Van Reenen (2011), "Minimum Wages and Firm Profitability," *American Economic Journal: Applied Economics*, Vol. 3, No. 1, pp. 129–151.

Fukao, Kyoji and Hyeog Ug Kwon (2006), "Why Did Japan's TFP Growth Slowed Down in the Lost Decade? An Empirical Analysis Based on Firm-Level Data of Manufacturing Firms," *Japanese Economic Review*, Vol. 57, No. 2, pp. 195–228.

Georgiadis, Andreas (2013), "Efficiency Wages and the Economic Effects of the Minimum Wage: Evidence from a Low-Wage Labour Market," *Oxford Bulletin of Economics and Statistics*, Vol. 75, No. 6, pp. 962–979.

Harasztosi, Peter and Attila Lindner (2019), "Who Pays for the Minimum Wage?" *American Economic Review*, forthcoming.

Kambayashi, Ryo, Daiji Kawaguchi, and Ken Yamada (2013), "The Minimum Wage in a Deflationary Economy: The Japanese Experience, 1994-2003," *Labour Economics*, Vol. 24, October, pp. 264–276.

Kawaguchi, Daiji and Yuko Mori (2009), "Is Minimum Wage an Effective Anti-poverty Policy in Japan?" *Pacific Economic Review*, Vol. 14, No. 4, pp. 532–554.

Machin, Stephen and Joan Wilson (2004), "Minimum Wages in a Low-Wage Labour Market: Care Homes in the UK," *Economic Journal*, Vol. 114, March, pp. C102–C109.

Manning, Alan (2016), "The Elusive Employment Effect of the Minimum Wage," CEP Discussion Paper, No. 1428.

Morikawa, Masayuki (2015), "Are Large Headquarters Unproductive?" *Journal of Economic Behavior & Organization*, Vol. 119, November, pp. 422–436.

Morikawa, Masayuki (2019), "Firm Heterogeneity and International Trade in Services," *The World Economy*, Vol. 42, No. 1, pp. 268–295.

Neumark, David (2017), "The Employment Effects of Minimum Wages: Some Questions We Need to Answer," NBER Working Paper, No. 23584.

Neumark, David (2018), "The Econometrics and Economics of the Employment Effects of Minimum Wages: Getting from Known Unknowns to Known Knowns," NBER Working Paper, No. 25043.

Riley, Rebecca and Chiara Rosazza Bondibene (2017), "Raising the Standard: Minimum Wages and Firm Productivity," *Labour Economics*, Vol. 44, January, pp. 27–50.

Syverson, Chad (2011), "What Determines Productivity?" *Journal of Economic Literature*, Vol. 49, No. 2, pp. 326–365.

Table 1. Summary Statistics.

A. Prefecture-level Data.

| | Mean | SD | SD (within) | N |
|---|---|---|---|---|
| MW | 0.3447 | 0.0296 | 0.0155 | 470 |
| LP | 6.5870 | 0.1294 | 0.0366 | 470 |

Notes: Figures compiled from the Prefectural Accounts for the period 2006-2015. LP (expressed in logarithm) is the real gross prefecture-level product divided by the number of workers in the prefecture.

B. Firm-level Data.

| | Mean | SD | SD (within) | N |
|---|---|---|---|---|
| MW | 0.3227 | 0.0386 | 0.0182 | 93,498 |
| LP | 1.0760 | 0.5871 | 0.2800 | 80,230 |
| TFP | −0.0735 | 0.5182 | 0.2860 | 79,254 |
| ROA | 0.0414 | 0.0879 | 0.0599 | 93,306 |
| INV | −2.4754 | 1.5979 | 1.0161 | 56,558 |
| Firm size | 4.7260 | 0.6527 | 0.1600 | 93,498 |
| Non-standard ratio | 0.1347 | 0.1972 | 0.0822 | 93,498 |

Notes: Figures compiled from data on single-establishment firms in the BSJBSA for the period 2001-2017.

Table 2. Minimum Wages and Labor Productivity (Prefecture Panel).

| | (1) FE | (2) System GMM |
|---|---|---|
| MW | −0.1574 | −0.3294 |
| | (0.1340) | (0.3662) |
| $LP_{-1}$ | 0.6283 *** | 0.8598 *** |
| | (0.0402) | (0.1238) |
| Year FE | yes | yes |
| Prefecture FE | yes | no |
| $R^2$ (within) | 0.7157 | |
| AR(1) test, p-value | | 0.000 |
| AR(2) test, p-value | | 0.691 |
| Hansen J, p-value | | 0.268 |
| Number of instruments | | 15 |
| Observations | 423 | 423 |

Notes: MW denotes the Kaitz index. Fixed-effects and system GMM estimations with standard errors in parentheses. *** indicates p<0.01.

Table 3. Minimum Wages and Firm Productivity.

| | (1) LP | (2) TFP | (3) LP | (4) TFP |
|---|---|---|---|---|
| MW | −0.3754 ** | −0.1244 | −0.2266 | −0.0881 |
| | (0.1553) | (0.1618) | (0.1605) | (0.1674) |
| MW*Non-standard | | | −0.9818 *** | −0.2344 |
| | | | (0.2737) | (0.2859) |
| Non-standard | | | 0.5053 *** | 0.2096 ** |
| | | | (0.0932) | (0.0974) |
| $LP_{-1}/TFP_{-1}$ | yes | yes | yes | yes |
| Firm size | yes | yes | yes | yes |
| Year FE | yes | yes | yes | yes |
| Firm FE | yes | yes | yes | yes |
| Observations | 62,663 | 61,936 | 62,663 | 61,936 |
| $R^2$ (within) | 0.1260 | 0.1091 | 0.1286 | 0.1103 |

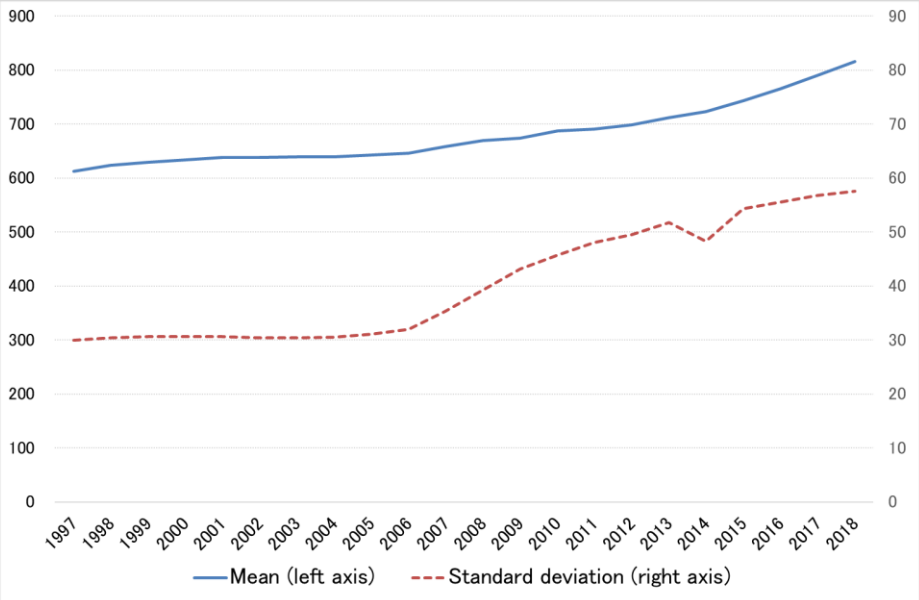
Notes: MW denotes the Kaitz index. Non-standard employees are the sum of part-time and temporary workers. Fixed-effects estimation with standard errors in parentheses. *** and ** indicate p<0.01 and p<0.05, respectively.

Table 4. Minimum Wages, Profitability, and Investments.

| | (1) ROA | (2) INV | (3) ROA | (4) INV |
|---|---|---|---|---|
| MW | −0.0895 *** | −1.7154 ** | −0.0862 *** | −2.0740 *** |
| | (0.0302) | (0.7322) | (0.0310) | (0.7566) |
| MW*Non-standard | | | −0.0229 | 2.6503 * |
| | | | (0.0515) | (1.4104) |
| Non-standard | | | 0.0117 | −0.8916 * |
| | | | (0.0174) | (0.4820) |
| $ROA_{-1}/INV_{-1}$ | yes | yes | yes | yes |
| Firm size | yes | yes | yes | yes |
| Year FE | yes | yes | yes | yes |
| Firm FE | yes | yes | yes | yes |
| Observations | 77,602 | 43,690 | 77,602 | 43,690 |
| $R^2$ (within) | 0.0941 | 0.0286 | 0.0942 | 0.0287 |

Notes: MW denotes the Kaitz index. INV is tangible investments divided by the stock value of tangible assets at the end of the previous year (expressed in logarithm). Non-standard employees are the sum of part-time and temporary workers. Fixed-effects estimation with standard errors in parentheses. ***, **, and * indicate p<0.01, p<0.05, and p<0.1, respectively.

Figure 1. Mean and Dispersion of Minimum Wages in Japan.




Note: The mean and the standard deviation (expressed in yen) are calculated from the hourly minimum wages in the 47 prefectures.