The Impact of Workers' Collective Voice on Union and Nonunion Wages: Theory and Evidence from Japan

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The Impact of Workers' Collective Voice on Union and Nonunion Wages: Theory and Evidence from Japan

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Abstract

We examine how workers' collective voice affects union and nonunion wages both theoretically and empirically. We develop a simple union model with a social insurance system and show that, due to two counteracting forces in bargaining, higher bargaining power raises both union and nonunion wages when ex-ante bargaining power is low but lowers them when it is sufficiently high. Using Japanese household-level data, we document an inverted U-shaped relationship between bargaining power and wages for both groups. Applying entropy balancing, we confirm that union wages are maximized at about 70 percent bargaining power, compared with 44 percent for nonunion wages. Given Japan's current level of about 25 percent, stronger bargaining power and a rising societal willingness to improve working conditions are likely to benefit union members and also nonunion members once under union coverage.

Keywords: Collective Voice; Union Wages; Nonunion Wages; Bargaining Power; Japan
JEL Classification: J31, J51

1. Introduction

How does workers' collective voice affect union and nonunion wages? To answer this question both theoretically and empirically, we first develop a simple union model with a social insurance system and show that, due to two counteracting forces in bargaining, higher bargaining power *raises* both union and nonunion wages when ex-ante bargaining power is low but *lowers* them when it is sufficiently high. We then use Japanese household-level data and document an inverted U-shaped relationship between bargaining power and wages for both groups. Applying entropy balancing, we confirm that union wages are maximized at

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about 70 percent bargaining power, compared with 44 percent for nonunion wages. Given Japan's current level of 25 percent, *stronger bargaining power and a rising societal willingness to improve working conditions are likely to increase union wages.* Our results further suggest that *workers currently outside unions may experience comparable wage gains under union coverage.*[1]

Figure 1 plots our measure of union bargaining power—the industry-level unionization rate—and average annual labor income (a proxy for wages) for union and nonunion workers from 2004 to 2022. The former displays a clear downward trend until 2018, albeit with a slight bounce-back since 2019, indicating an erosion of collective voice. This long-run decline raises the question of whether union membership in Japan still fulfills its core function of protecting members' wages. Consistent with this concern, union wages also exhibit a persistent *downward* trend relative to those of nonunion workers. Although several studies (e.g., Saito et al., 2024) show that unions continue to reduce *wage inequality* in Japan, a narrowing of inequality driven by declining *union* wages cannot be interpreted as evidence that unions *protect* their members. It therefore remains unclear how the long-run decline and recent bounce-back of collective voice affect members' wage *levels*.

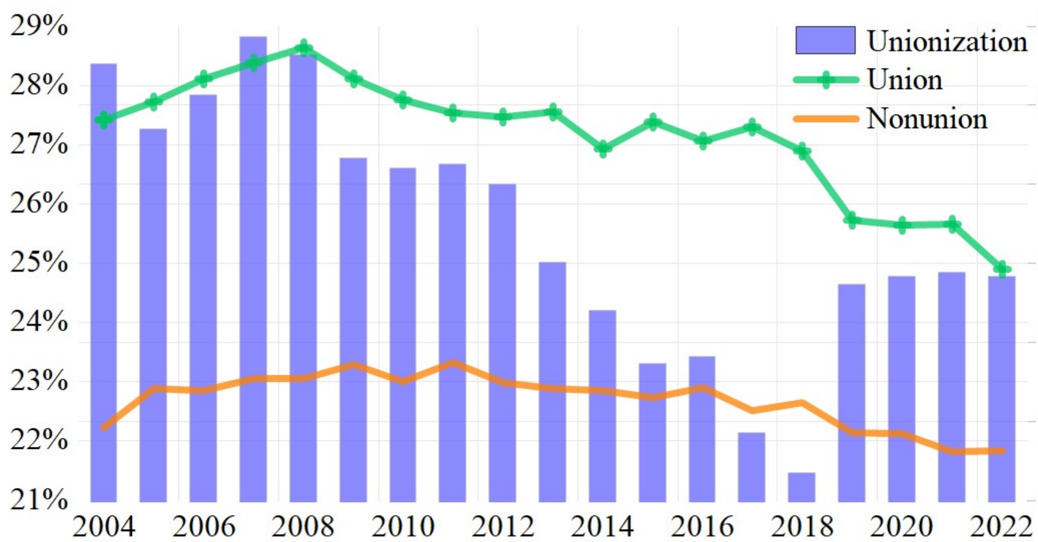

Figure 1: Industry-level unionization rate and average annual labor income for union and nonunion workers in Japan, 2004–2022 (in 10,000 JPY). The unionization rate is computed as the share of union members among all workers employed in the same industry. Source: Japan Household Panel Survey (JHPS/KHPS).

To address this question both theoretically and empirically, we first develop a simple model of trade unions with a social insurance system. While much of the literature since

[1] In this paper, we use the terms "collective voice" and "bargaining power" interchangeably, as stronger workers' collective voice is likely to translate into greater bargaining power in wage negotiations.

Freeman (1980) has focused on wage *inequality*, we *separately* analyze union and nonunion wage *levels* to uncover the mechanisms behind the wage patterns shown in Figure 1. Our model demonstrates that, due to two opposing forces in the bargaining process—a positive wage effect of greater union bargaining power and a negative effect arising from the social insurance system—stronger bargaining power, such as International Workers' Day (May Day) activities or the annual *Shunto* wage negotiations in Japan, can either *raise or lower* union wages and generate spillover effects on nonunion wages, whose direction is likewise *indeterminate*.[2] We show analytically that the sign of these effects depends on the *ex-ante level of bargaining power*: when ex-ante bargaining power is low, an increase raises both wages; when it is high, a further increase lowers both.

To evaluate these mechanisms empirically, we use Japanese household-level data from 2004 to 2022. We confirm an inverted U-shaped relationship between bargaining power and both union and nonunion wages. To address self-selection bias arising from endogenous union membership, we apply entropy balancing (Hainmueller, 2012). Our robust estimates indicate that the wage curve for union workers is flatter than that for nonunion workers. Consequently, the bargaining-power level that maximizes union wages (about 70 percent) is substantially higher than that for nonunion wages (about 44 percent). As long as collective voice is not excessively strong, union membership protects members either *by cushioning wage declines or by increasing wages* in response to changes in collective voice. These findings suggest that, under current conditions in Japan, *there remains significant scope for stronger collective voice to benefit union members and workers currently outside unions once under union coverage.*

The closest to ours is Chao and Ee (2024). They develop a two-sector model with a perfectly competitive sector and an oligopolistic sector with unions. Incorporating business dynamism, they show that greater unionization raises unskilled wages while reducing skilled wages, thereby narrowing wage inequality, and they confirm this relationship using panel data from 63 countries over 2004–2018. In contrast, we focus on how workers' collective voice affects the *levels* of union and nonunion wages rather than on relative wage *inequality* across skill groups. Moreover, our household-level evidence also sheds new light on Japan, where the wage effects of workers' collective voice remain underexplored.

Another closely related study is de Pinto and Lingens (2019a). They develop a two-sector union model with firm heterogeneity á la Melitz (2003).[3] They analytically examine how unionization costs affect cutoff productivity, wage *inequality*, and welfare. While they numerically find an inverted-U relationship between unionization costs and the model-implied Gini index, our focus differs: we analyze how workers' collective voice affects wage *levels* and test these predictions empirically using Japanese household-level data. Thus, our

[2]Rosen (1969) was the first to document spillover effects of union wages using data for 59 U.S. industries. More recent studies, such as Denice and Rosenfeld (2018), also find positive spillover effects using U.S. CPS data from 1977–2015. Although our focus is not directly on the spillover itself, our model provides a theoretical mechanism through which such effects can arise.

[3]See Oswald (1985) and Sanner (2006) for earlier theoretical analyses with homogeneous firms. See also Montagna and Nocco (2013), de Pinto and Michaelis (2016), de Pinto and Lingens (2019b), and Nishiyama et al. (2025) for related models that incorporate firm heterogeneity in other contexts.

contribution is both theoretical and empirical.

More broadly, by separately analyzing union and nonunion wage levels and emphasizing the importance of the ex-ante level of collective voice, we derive and test predictions that would be absent in an inequality-focused framework. Recent developments—including cases in which firms have fully accepted union wage demands and increasing wage negotiations involving not only regular but also non-regular workers—suggest *renewed momentum* in labor relations. If sustained, such movements and the broader societal willingness to improve working conditions may represent an important opportunity for raising the wage levels of union members and also current nonunion members once under union coverage. Our paper is unique in that we derive these results both theoretically and empirically by focusing on how workers' collective voice affects union and nonunion wages.

Our paper is organized as follows. Section 2 presents our model. Section 3 conducts the empirical analysis using Japanese household-level data. Section 4 concludes.

2. The Model

In this section, we develop a simple model of trade unions and a social insurance system designed to capture the specialized production structure characteristic of Japanese industry. The model is constructed to generate testable predictions and to guide the interpretation of the empirical results in Section 3. Accordingly, we keep the framework as simple as possible.

The production of the final good X requires nonunion workers N and intermediate goods Y. Intermediate goods are produced by symmetric, monopolistically competitive unionized firms that employ union workers H. We choose X as the numéraire.

We assume full employment for nonunion workers in the final-goods sector, while allowing for unemployment among union workers in the intermediate-goods sector. The endowments of nonunion and union workers are denoted by $\bar{N}$ and $\bar{H}$, respectively. Unemployment benefits are financed equally by workers and firms.[4] Derivations involving some algebra are provided in an online appendix.

2.1. Final-goods firms

Final-goods firms minimize costs $PY + wN$ subject to the production technology $X = Y^{\frac{1}{2}}N^{\frac{1}{2}}$, where aggregate demand $X > 1$ is exogenously given. Under perfect competition, this yields

$$Y = \left(\frac{w}{P}\right)^{\frac{1}{2}} X, \quad N = \left(\frac{w}{P}\right)^{-\frac{1}{2}} X, \tag{1}$$

where $w \in (0, 1)$ is the wage of nonunion workers and $P \in (0, 1)$ the price of intermediate goods.

[4] For union models incorporating unemployment benefits, see Oswald (1982), Kreiner and Whitta-Jacobsen (2002), and Fanti and Gori (2011).

Y is the Blanchard and Giavazzi (2003) aggregator, $Y = \left(M^{\rho-1}\int_{i\in M} y(i)^{\rho}di\right)^{1/\rho}$, and demand for each variety i is derived as

$$y(i) = \left(\frac{p(i)}{P}\right)^{-\sigma}\frac{Y}{M}, \quad \sigma = \frac{1}{1-\rho} > 1, \tag{2}$$

where σ is the elasticity of substitution across varieties, $p(i)$ the price of variety i, and M is the number of intermediate-goods firms or varieties, as we assume each variety can only be produced by a single firm. The corresponding price index is $P = \left(M^{-1}\int_{i\in M} p(i)^{1-\sigma}di\right)^{\frac{1}{1-\sigma}}$.

2.2. Intermediate-goods firms

There is a continuum of intermediate-goods firms indexed by i. Each firm maximizes profits $\pi(i) = p(i)y(i) - vh(i) - f - tvh(i)/2$ subject to (2) and the production technology

$$h(i) = y(i), \tag{3}$$

where v denotes the wage of union workers, $h(i)$ the number of employed union workers, and $f > 0$ a fixed cost measured in units of currency. $t \in (0,1)$ represents the payroll tax rate, so $tvh(i)/2$ represents the firm's contribution to social insurance.

The optimal pricing rule is

$$p(i) = \left(1 + \frac{t}{2}\right)\frac{v}{\rho}. \tag{4}$$

As prices are the same for all intermediate goods, we set $p(i) = p$ for all i.

2.3. Wage bargaining

Union wages are determined through Nash bargaining between the trade union and firm managers. The union's expected net surplus is $(v - u(b))\int_{i\in M} h(i)di$, where aggregation arises because bargaining takes place at the industry level; $b > 0$ denotes the per-capita unemployment benefit, and $u(b)$ represents the utility derived from unemployment.[5] We assume $u'(b) > 0$, where the prime denotes the first derivative, and $\lim_{b\to 0} u(b) = 0$.

[5]Formally, union workers derive utility both from their wage when employed and from unemployment benefits when unemployed. Thus, the trade union's expected net surplus can be expressed as

$$v\int_{i\in M} h(i)di + u(b)\left(\bar{H} - \int_{i\in M} h(i)di\right) = v\int_{i\in M} h(i)di - u(b)\int_{i\in M} h(i)di + \bar{H}u(b),$$

where $\int_{i\in M} h(i)di$ is the total number of employed union workers and $\bar{H} - \int_{i\in M} h(i)di$ is the number of unemployed union workers. Since $\bar{H}$ and $u(b)$ are taken as given at the time of negotiation, maximizing the above expression reduces to choosing the union wage v that maximizes the union's expected net surplus

$$v\int_{i\in M} h(i)di - u(b)\int_{i\in M} h(i)di,$$

as presented in the text.

Firms' expected surplus is $\int_{i\in M}\pi(i)di$, with a threat point of $-\int_{i\in M} f di$, reflecting the irreversibility of fixed costs. Assuming that neither party observes equilibrium outcomes at the time of negotiation, the Nash bargaining solution selects v to maximize

$$\left((v-u(b))\int_{i\in M} h(i)di\right)^{\theta}\left(\int_{i\in M}(\pi(i)-(-f))\,di\right)^{1-\theta},$$

where $\theta \in (0,1)$ denotes union bargaining power, or the strength of collective voice. Solving yields (see Appendix A)

$$v=\left(1+\frac{\theta}{\sigma-1}\right)u(b). \tag{5}$$

2.4. Aggregation

In equilibrium, as $p(i)=p$, the price index satisfies

$$P=p. \tag{6}$$

Demand for each variety in (2) simplifies to

$$y(i)=\frac{Y}{M}. \tag{7}$$

The number of firms is determined by the zero-profit condition together with (4) and (7):

$$M=\frac{1}{\sigma-1}\left(1+\frac{t}{2}\right)\frac{Y}{f}v. \tag{8}$$

The nonunion labor market clears:

$$N=\bar{N}. \tag{9}$$

Finally, combining (1) and (9) yields

$$w=P\left(\frac{X}{\bar{N}}\right)^{2}, \tag{10}$$

and

$$Y=\frac{X^2}{\bar{N}}. \tag{11}$$

2.5. Government

We assume a balanced budget, whereby all social insurance revenues—collected equally from workers and firms—finance unemployment benefits:

$$\frac{1}{2}tv\int_{i\in M} h(i)di+\frac{1}{2}tv\int_{i\in M} h(i)di=\left(\bar{H}-\int_{i\in M} h(i)di\right)b.$$

Substituting (3), (7), and (11) into this equation and rearranging yields the per-capita unemployment benefit,

$$b = \Gamma v, \quad \Gamma \equiv \frac{t}{\bar{H}\bar{N}X^{-2} - 1}. \tag{12}$$

For $0 < b < v$, we require $\Gamma \in (0, 1)$, which holds if

$$(1 + t)X^2 < \bar{H}\bar{N}. \tag{13}$$

This condition is likely satisfied when labor endowments are sufficiently large.

Taking stock, the equilibrium is characterized by seven equations—(1), (4), (5), (6), (8), (9), and (12)—that jointly determine the eight endogenous variables w, v, p, P, M, N, Y, and b. Although there are eight unknowns, (1) endogenously determines both N and Y, so the system is closed.

2.6. Comparative Statics

Having characterized the equilibrium, we now examine how stronger collective voice θ—think of May Day or *Shunto*—affects union and nonunion wages. We first derive analytical results and then provide intuition. These predictions are evaluated empirically using Japanese data in Section 3.

To begin, consider the union wage. Combining (5) and (12) yields

$$v = \left(1 + \frac{\theta}{\sigma - 1}\right) u(\Gamma v), \tag{14}$$

where $\Gamma \in (0, 1)$ by (13). Differentiating (14) gives[6]

$$\frac{dv}{d\theta} = \frac{u(\Gamma v)}{(\sigma - 1)\left(1 - \underbrace{\left(1 + \frac{\theta}{\sigma - 1}\right)}_{(>1)} \underbrace{u'(\Gamma v)}_{(+)} \underbrace{\Gamma}_{(+)}\right)} \gtrless 0. \tag{15}$$

Since $u(\Gamma v) > 0$ and $\sigma - 1 > 0$, we have

$$\frac{dv}{d\theta} \gtrless 0 \Leftrightarrow \theta \lesseqgtr (\sigma - 1)\left(\frac{1}{u'(\Gamma v)\Gamma} - 1\right). \tag{16}$$

Thus, stronger bargaining power can either *raise or lower* union wages, depending on the *ex-ante level of* θ.

The intuition is as follows. An increase in θ raises the union's expected net surplus, tending to *increase* v. At the same time, a higher v increases social insurance contributions,

[6] Although v and b do not admit closed-form solutions, Appendix B establishes existence and uniqueness of a positive solution for v (and b).

raising the per-capita unemployment benefits b. Higher b enhances the utility of being unemployed, reducing the union's expected net surplus and *lowering* v. The overall effect is therefore indeterminate, depending on the relative strength of these two opposing forces.

When ex-ante bargaining power is low, even a small increase in θ substantially strengthens the first effect, so the direct bargaining effect dominates and union wages rise. When ex-ante bargaining power is high, the social insurance channel dominates and union wages fall. Thus, *whether stronger bargaining power raises or lowers union wages depends on the initial level of* θ.

Turning to nonunion wages, combining (4), (6), (9), and (10) yields

$$w = \left(\frac{X}{\bar{N}}\right)^2 \left(1 + \frac{t}{2}\right) \frac{v}{\rho},$$

which implies the existence of spillover effects from v to w, as documented by Rosen (1969) and Denice and Rosenfeld (2018).

Differentiation gives

$$\frac{dw}{d\theta} = \frac{w}{v} \underbrace{\frac{dv}{d\theta}}_{(?)} \gtrless 0. \tag{17}$$

Accordingly, stronger bargaining power also *raises or lowers* nonunion wages. Intuitively, changes in union bargaining power alter the union wage v, which changes the labor cost of intermediate-goods firms. This, in turn, affects the price of each variety $p(i)$ and thus the price index P. Final-goods firms therefore face a change in the procurement cost of intermediate goods. As a result, by cost minimization of final-goods firms, the optimal input choices Y and N adjust (see (1)). This change in N causes nonunion wages w to respond to clear the nonunion labor market. Since (17) implies that the initial response of w is proportional to that of v, nonunion wages rise when ex-ante θ is low and fall when it is high.

Our theoretical insight that the effects of θ on both wages depend on its ex-ante level is new and absent from related models such as those of de Pinto and Lingens (2019a) and Chao and Ee (2024), thereby offering useful testable predictions for our empirical analysis.

Our findings of this section can be summarized as follows:

Proposition 1. *An increase in union bargaining power can raise or lower both union and nonunion wages, depending on the balance between the positive bargaining effect and the negative effect operating through the social insurance system. When ex-ante bargaining power is low, greater bargaining power raises both wages; when it is high, it lowers both.*

We next evaluate this theoretical prediction empirically using Japanese household-level data.

3. Empirical Estimation

This section empirically evaluates the model's predictions using Japanese household-level data.

3.1. Data

We use data from the *Japan Household Panel Survey* (JHPS/KHPS), a nationally representative longitudinal survey conducted annually since 2004.[7] The *Keio Household Panel Survey* (KHPS) is one of the few large-scale household panel datasets available for Japan. The initial wave covered approximately 4,000 households and 7,000 individuals, with 1,400 new households added in 2007 and 1,000 in 2012 to mitigate attrition. The *Japan Household Panel Survey* (JHPS) was launched in 2009 as a parallel survey of roughly 4,000 individuals nationwide, with expanded coverage of education, health, and household economic conditions. The two surveys were harmonized in 2014 as the JHPS/KHPS. The dataset provides rich longitudinal information suitable for analyzing household income dynamics and labor market outcomes in Japan. Importantly, it contains detailed information on union membership and individual income, allowing us to estimate how greater bargaining power affects both union and nonunion wages.

Our key variables are individual wages, union membership status, and the unionization rate of each worker's industry. We use annual workplace income—deflated by the Consumer Price Index (CPI)—as a proxy for union and nonunion wages, corresponding to v and w in Figure 1. Although our theoretical model focuses on wages, and hourly wages would therefore be conceptually preferable, the number of valid responses on weekly working hours is limited. We thus use annual labor income to preserve a sufficiently large sample for empirical analysis.

Union membership is defined as whether an individual belongs to a labor union, either within or outside the workplace. The industry-level unionization rate, shown in Figure 1, is computed as the share of unionized workers within an industry and serves as a proxy for bargaining power θ in our theoretical framework.[8] To ensure comparability and focus on workers directly affected by collective bargaining, we restrict the sample to individuals who held a nonmanagerial regular position at least once during the analysis period. We exclude managers, nonregular employees, the self-employed, and individuals who never held a nonmanagerial regular position.

Table 1 reports summary statistics for the main variables. Mean annual labor income is approximately 4.9 million yen. The average individual union membership rate is 28.4 percent, and the mean industry-level unionization rate is 27.7 percent.

[7] Further details are available on the website of the Panel Data Research Center at Keio University (`https://www.pdrc.keio.ac.jp/en/paneldata/datasets/jhpskhps/`).

[8] Industries in the dataset are classified into 17 categories following the standard industrial classification used in the survey: (1) Agriculture; (2) Fisheries, Forestry, and Aquaculture; (3) Mining; (4) Construction; (5) Manufacturing (including publishing and printing); (6) Wholesale and Retail Trade (including department stores and supermarkets); (7) Food and Accommodation Services; (8) Finance and Insurance; (9) Real Estate; (10) Transportation; (11) Information Services and Research; (12) Other Communications and Broadcasting Services (including telecommunications and internet services); (13) Electricity, Gas, Water, and Heat Supply; (14) Medical and Welfare Services; (15) Education and Learning Support; (16) Other Service Industries; and (17) Public Administration.

Table 1: Summary Statistics of Main Variables

Variable	Observations	Mean	Std. Dev.	Min	Max	Description
$Income_{ijt}$	33,479	488.932	244.518	26.178	1298.429	Annual labor income (in 10,000 JPY), used as a proxy for wages.
D_{ijt}	33,479	0.284	0.451	0	1	Dummy equal to 1 if the individual is a union member.
θ_{jt}	33,479	0.277	0.132	0	1	Industry-level unionization rate, measured as the share of unionized workers.

Notes: Income is deflated by the CPI by year. The sample is restricted to regular employees in nonmanagerial positions.

3.2. Estimation

Recall from Proposition 1 that when ex-ante bargaining power is low, greater bargaining power raises both union and nonunion wages, whereas when it is high, it lowers both. We first examine the overall shape of the wage–bargaining-power relationship and then explore heterogeneity between union and nonunion workers.

3.2.1. Shape

To examine whether the impact of bargaining power depends on its initial level, we estimate a quadratic specification in the industry-level unionization rate:

$$ln\omega_{ijt} = \alpha + \beta D_{ijt} + \gamma\theta_{jt} + \delta\theta_{jt}^2 + \zeta_i + \eta_t + \varepsilon_{ijt}, \tag{18}$$

where i indexes individuals, j industries, and t years.

The dependent variable, $ln\omega_{ijt}$, is the log of annual labor income. D_{ijt} is a dummy equal to one if the individual is a union member, and θ_{jt} is the industry-level unionization rate. ζ_i and η_t denote individual and year fixed effects. Consistent with the model, we expect $\gamma > 0$ and $\delta < 0$.

Table 2 reports the results. Column (1) excludes the quadratic term. β is positive and statistically significant at the 1 percent level, indicating that union workers earn higher labor income than nonunion workers. This finding is consistent with the well-documented union wage premium (e.g., Gittleman and Pierce 2007; Bhandari 2010; Gabriel and Schmitz 2014) and confirms its presence in Japan. γ is also positive and statistically significant at the 1 percent level, suggesting that stronger aggregate unionization is associated with higher wages.

Column (2) introduces the quadratic term. δ is negative and statistically significant at the 1 percent level. Together with positive γ, this implies an inverted U-shaped relationship between bargaining power and wages. This pattern is consistent with the model's prediction: when ex-ante bargaining power is low, increases in θ raise both wages, whereas when it is sufficiently high, further increases reduce them.

In light of our theoretical framework, the inverted U-shape may be interpreted as follows. When bargaining power is initially low, a marginal increase strengthens the bargaining effect and raises wages, with the negative social-insurance channel playing only a minor role. When bargaining power is already high, the negative effect operating through the social insurance

Table 2: Effect of Union Membership and Industry-Level Unionization on Log Income (Shape)

Variable	(1) OLS *ln Income*	(2) OLS *ln Income*
D_{ijt}	0.189***	0.189***
	(0.0179)	(0.0178)
θ_{jt}	0.615***	1.585***
	(0.0774)	(0.236)
θ_{jt}^2		-1.581***
		(0.339)
Year FE (2005–2022)	YES	YES
Constant	5.849***	5.733***
	(0.0299)	(0.0415)
Observations	33,479	33,479
Number of individuals	4,561	4,561
R^2	0.052	0.055

Notes: Robust standard errors in parentheses. $^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.1$

system dominates, resulting in declining wages. Therefore, the peak (θ^*) occurs where the positive and negative forces exactly offset each other.

We next examine whether the effects of bargaining power differ between union and nonunion workers.

3.2.2. Heterogeneity

To investigate heterogeneous effects, we augment the baseline specification with linear and quadratic interaction terms between union membership and bargaining power:

$$ln\omega_{ijt} = \alpha + \beta D_{ijt} + \gamma\theta_{jt} + \delta\theta_{jt}^2 + \tau(D_{ijt} \times \theta_{jt}) + \mu(D_{ijt} \times \theta_{jt}^2) + \zeta_i + \eta_t + \varepsilon_{ijt}, \qquad (19)$$

where if interaction coefficients (τ and μ) are statistically significant, it indicates that union and nonunion wages exhibit different distributions to bargaining power at the same level of unionization. The estimation results are reported in Table 3.

Column (1) introduces the linear interaction term. The coefficient τ is negative and statistically significant at the 10 percent level. Column (2) additionally includes the quadratic interaction term. Although the inverted U-shaped relationship identified earlier remains statistically significant at the 1 percent level, neither τ nor μ is statistically significant. These estimates therefore provide limited evidence of heterogeneous wage responses across union and nonunion workers.

A primary concern, however, is that union membership is a highly endogenous—rather than random—decision. Consequently, *self-selection bias* may contaminate the estimates, as observed characteristics may differ systematically between union and nonunion workers;

Table 3: Effect of Union Membership and Industry-Level Unionization on Log Income (Heterogeneity)

Variable	(1) OLS *ln Income*	(2) OLS *ln Income*	(3) EB *ln Income*	(4) EB *ln Income*
D_{ijt}	0.247***	0.253***	0.0949***	0.195***
	(0.0379)	(0.0669)	(0.0173)	(0.0611)
θ_{jt}	0.662***	1.656***	1.061***	1.444***
	(0.0854)	(0.289)	(0.270)	(0.349)
$D_{ijt} \times \theta_{jt}$	-0.190*	-0.387		-0.744**
	(0.106)	(0.409)		(0.373)
θ^2_{jt}		-1.681***	-1.020***	-1.659***
		(0.458)	(0.344)	(0.515)
$D_{ijt} \times \theta^2_{jt}$		0.488		1.157**
		(0.599)		(0.559)
Year FE (2005–2022)	YES	YES	YES	YES
Constant	5.841***	5.736***	5.923***	5.878***
	(0.0312)	(0.0463)	(0.0547)	(0.0604)
Observations	33,479	33,479	33,479	33,479
Number of individuals	4,561	4,561	4,561	4,561
R^2	0.053	0.055	0.713	0.713

Notes: Robust standard errors in parentheses. $^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.1$

that is, covariate moments may not be balanced across the two groups. To address this issue, we apply entropy balancing (Hainmueller, 2012), which reweights the control group (nonunion workers, $D = 0$) so that its covariate distribution matches that of the treatment group (union workers).

Specifically, entropy balancing computes continuous unit weights x_i for nonunion workers by minimizing the Kullback-Leibler divergence relative to a set of uniform base weights q_i:

$$min_{x_i} \sum_{\{i|D=0\}} x_i log \frac{x_i}{q_i},$$

subject to predefined balance constraints that force the moments of the reweighted nonunion group to exactly match the corresponding target moments m_r of union workers:

$$\sum_{\{i|D=0\}} x_i c_{ri}(X_i) = m_r \quad \text{for} \quad r = 1, ..., R,$$

together with the normalization constraint $\sum_{\{i|D=0\}} x_i = 1$ and the nonnegativity condition $x_i \geq 0$. Here $c_{ri}(X)$ denotes the specified moment functions of the observed covariates X_i (e.g., means or variances), r indexes moment conditions, and R is the total number of balance constraints. Unlike traditional propensity score matching, entropy balancing guarantees exact matching of the specified moments in finite samples. Moreover, by keeping the new weights x_i as close as possible to the original base weights q_i, it preserves sample information and reduces model dependence in the subsequent wage estimation.

We balance gender, age, family size, firm size, and an indicator for expected job continuation (see Appendix C for the balancing test results)[9]. The entropy-balanced estimates are reported in columns (3) and (4) of Table 3. Column (3), which excludes interaction terms, confirms the inverted U-shaped relationship even after correcting for self-selection bias.

Column (4) presents our most important specification. Both the linear and quadratic interaction terms are now statistically significant at the 5 percent. Their joint significance indicates that, although wages exhibit an inverted U-shaped relationship with bargaining power for both groups, the *profiles differ* across union and nonunion workers. Union workers begin with a higher base wage, reflecting a positive intercept shift. Moreover, as the positive linear effect is smaller ($\gamma + \tau < \gamma$) and the negative quadratic effect is less steep ($|\delta + \mu| < |\delta|$) for union workers, their wage curve is substantially *flatter* than that of nonunion workers. As a result, union workers reach their peak wage at a much higher level of bargaining power (approximately 70 percent) than nonunion workers (approximately 44 percent), implying that the decline in wages sets in much later ($\theta_w^* = -\gamma/(2\delta) < \theta_v^* = -(\gamma + \tau)/(2(\delta + \mu))$).

3.3. Discussion

We now discuss the implications of our empirical results with the aid of Figure 2, which illustrates the findings based on the entropy-balancing estimates (column (4) of Table 3).

[9]The calculated weights exhibit no extreme outliers (maximum weight = 3.95) and achieve exact balance across all covariates, indicating a well-behaved weighting scheme.

Both v and w follow inverted U-shaped relationships with bargaining power θ. Given that the current level of θ is approximately 25 percent, three critical levels emerge: the current level θ^*_{2022}, the nonunion wage peak θ^*_w, and the union wage peak θ^*_v, with $\theta^*_{2022} < \theta^*_w < \theta^*_v$. These thresholds naturally divide the figure into four regions, labeled (i) through (iv).

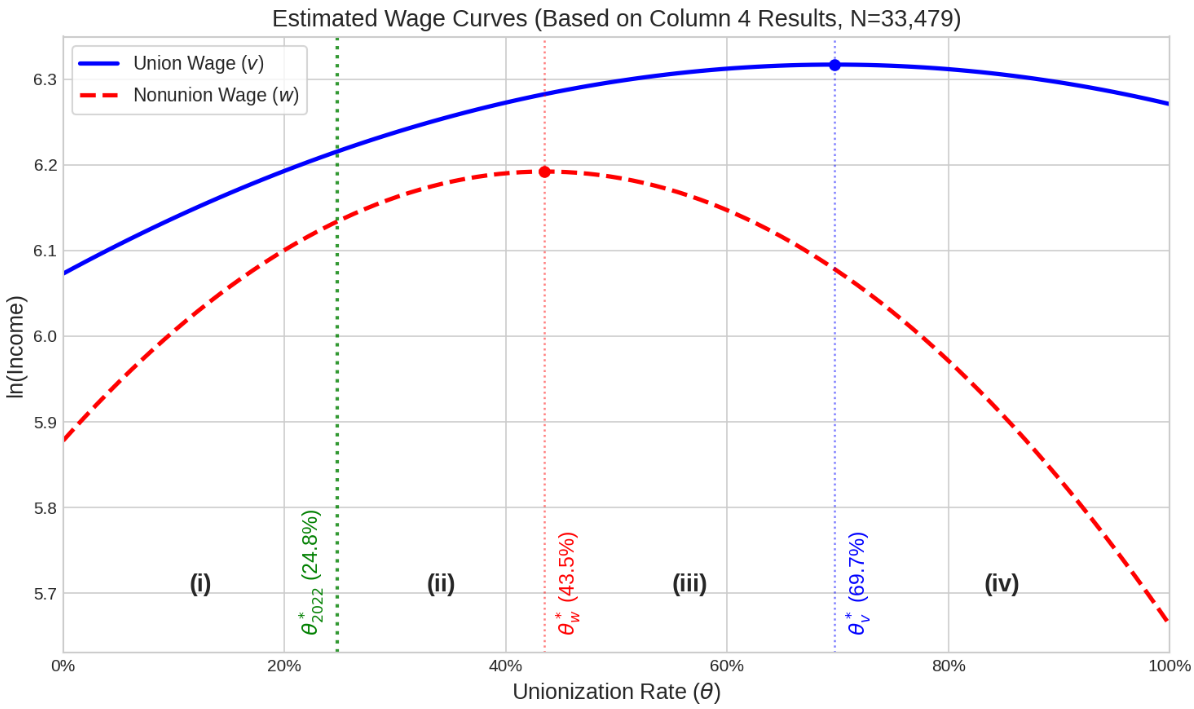

Figure 2: Predicted wage profiles for union and nonunion workers based on entropy-balanced estimates. The peak occurs at approximately 70% for union workers and 44% for nonunion workers.

We start with region (i), where the ex-ante level of θ is quite low and workers' collective voice is weak. As bargaining power declines with a falling unionization rate, region (i) can also be interpreted as a case of low unionization. Under this condition, suppose that from θ^*_{2022} the unionization rate continues to decline, as observed in Japan and many other countries. In this case, both wages decline. However, as the union wage curve is *flatter* than the nonunion wage curve, the reduction in w is quantitatively larger, whereas the decline in v is more *moderate*. In this sense, union membership in Japan functions as a *wage shield*: it mitigates wage losses for insiders (union workers).

Now consider the opposite direction, again starting from θ^*_{2022}. If bargaining power increases but remains below the nonunion peak—that is, $\theta^*_{2022} < \theta < \theta^*_w$ (region (ii))—*both* groups benefit from higher wages. Once bargaining power exceeds the nonunion peak but remains below the union peak—$\theta^*_w < \theta < \theta^*_v$ (region (iii))—further increases in bargaining power *reduce* nonunion wages while continuing to *raise* union wages. This *divergence* further highlights that union membership safeguards members by sustaining and even increasing their wages.

Finally, in region (iv), where bargaining power exceeds the union peak ($\theta > \theta_v^*$), additional increases in θ lead to declining wages for both groups, as in region (i). In light of our theoretical framework, this outcome can be interpreted as follows: when θ is already high, the positive wage effect of a marginal increase in θ is more than offset by the negative force associated with the social insurance system. Quantitatively, however, the current level of bargaining power (25 percent) remains *substantially* below the union wage peak (approximately 70 percent). Thus, region (iv) appears empirically *unlikely* in present-day Japan.

To summarize, *there remains considerable scope for stronger collective voice to raise union wages.* In this sense, labor movements and broader societal efforts to improve working conditions—such as May Day activities or the annual *Shunto* wage negotiations—may strengthen collective voice and thereby substantially benefit union members and also nonunion members once under union coverage.

Our findings of this section can be summarized as follows:

Proposition 2. *There exists an inverted U-shaped relationship between bargaining power and both union and nonunion wages. Estimates using entropy balancing indicate that this relationship is robust and that the wage curve for union workers is flatter than that for nonunion workers. Consequently, the bargaining-power level that maximizes union wages is substantially higher than that which maximizes nonunion wages. As long as bargaining power is not excessively high, union membership protects members either by cushioning wage declines or by increasing wages in response to changes in bargaining power. Given current conditions in Japan, there remains significant room for stronger collective voice to benefit union members and also nonunion members once under union coverage.*

4. Concluding Remarks

This paper has examined how workers' collective voice affects union and nonunion wages both theoretically and empirically. Our simple model shows that, due to two counteracting forces in the bargaining process, stronger bargaining power can either raise or lower both union and nonunion wages. The effects depend critically on the initial level of bargaining power.

Using Japanese household-level data and entropy balancing to address self-selection bias, we find strong empirical support for these predictions: both wages follow an inverted U-shaped relationship with bargaining power. We also confirm that the wage-maximizing level of bargaining power is substantially higher for union workers than for nonunion workers.

Given the current level of bargaining power in Japan, there remains substantial room for stronger collective voice to translate into higher wages or to cushion workers against wage declines. In our estimates, the current level of union bargaining power (about 25 percent) lies well below the wage-maximizing level for union workers (around 70 percent), suggesting considerable scope for wage gains before the negative effects predicted by the model emerge.

Recent developments—including cases in which firms have accepted union wage demands in full and expanding wage negotiations involving not only regular but also non-regular workers—suggest a *renewed momentum* in labor relations. Consistent with our findings, union membership may therefore continue to function as a *wage shield*, mitigating wage losses when collective voice weakens while allowing members to benefit when it strengthens. If sustained, such developments and the broader societal willingness to improve working conditions may represent an important opportunity for union members to enjoy higher wages and also for workers currently outside unions once under union coverage.

Appendix A: Nash Bargaining

To derive (5), use (2)–(4) and $\pi(i) = (1-\rho)p(i)y(i) - f$ to obtain:

$$\Lambda(v) \equiv \left((v - u(b)) \int_{i \in M} h(i) di\right)^{\theta} \left(\int_{i \in M} \pi(i) - (-f)\right)^{1-\theta} = \Omega v^{1-\theta-\sigma} \left(v - u(b)\right)^{\theta},$$

where $\Omega \equiv \sigma^{\theta-1} \rho^{\sigma-1+\theta} P^{\sigma} Y \left(1 + (t/2)\right)^{1-\theta-\sigma} > 0$.

Differentiating $\Lambda(v)$ with respect to v yields

$$\frac{\partial \Lambda(v)}{\partial v} = \Lambda(v) \left(\frac{1-\theta-\sigma}{v} + \frac{\theta}{v - u(b)}\right) = 0.$$

Solving for v gives $(1-\sigma)v = (1-\theta-\sigma)u(b)$, which, after rearranging, yields (5).

Appendix B: Existence and Uniqueness of the Union Wage

This appendix proves the existence and uniqueness of the union wage v. From equations (5) and (12), define the following function that characterizes v:

$$\mathcal{V}(v) = v - \left(1 + \frac{\theta}{\sigma - 1}\right) u(\Gamma v). \tag{20}$$

Since $v > 0$, $1 + \theta(\sigma - 1)^{-1} > 0$, $\Gamma \in (0, 1)$, $u'(\Gamma v) > 0$, and $\lim_{v \to 0} u(\Gamma v) = 0$, the following properties hold:

$$\mathcal{V}'(v) = 1 - \left(1 + \frac{\theta}{\sigma - 1}\right) u'(\Gamma v)\Gamma \gtreqless 0, \tag{21}$$

$$\mathcal{V}''(v) = -\left(1 + \frac{\theta}{\sigma - 1}\right) u''(\Gamma v)\Gamma^2 \begin{cases} < 0 & \text{if } u''(\Gamma v) > 0, \\ > 0 & \text{if } u''(\Gamma v) < 0. \end{cases} \tag{22}$$

$$\lim_{v \to 0} \mathcal{V}(v) = 0. \tag{23}$$

Next, to examine $\lim_{v \to +\infty} \mathcal{V}(v)$, rewrite equation (20) as

$$\mathcal{V}(v) = v \left(1 - \left(1 + \frac{\theta}{\sigma - 1}\right) \frac{u(\Gamma v)}{v}\right).$$

Define $z = \Gamma v$. Focusing on the term $u(\Gamma v)/v$, we obtain

$$\lim_{v \to +\infty} \frac{u(\Gamma v)}{v} = \lim_{z \to +\infty} \Gamma \frac{u(z)}{z} = \Gamma \lim_{z \to +\infty} \frac{u(z)}{z} = \Gamma \lim_{z \to +\infty} u'(z),$$

where the last equality follows from L'Hôpital's rule. Thus, if $u(z)$ is convex ($u''(\Gamma v) > 0$), then $\Gamma \lim_{z \to +\infty} u'(z) = +\infty$, whereas if $u(z)$ is concave ($u''(\Gamma v) < 0$), then $\Gamma \lim_{z \to +\infty} u'(z) = 0$. Therefore,

$$\lim_{v \to +\infty} \mathcal{V}(v) = \lim_{v \to +\infty} v \left(1 - \left(1 + \frac{\theta}{\sigma - 1}\right) \frac{u(\Gamma v)}{v}\right) \begin{cases} = -\infty & \text{if } u''(\Gamma v) > 0, \\ = +\infty & \text{if } u''(\Gamma v) < 0. \end{cases} \tag{24}$$

From (21)–(24), the function $\mathcal{V}(v)$ can be illustrated as in Figure 3. As the function crosses the horizontal axis only once for both $u'' > 0$ and $u'' < 0$, this establishes the existence of a unique positive real solution $\tilde{v}$, regardless of whether $u(z)$ is convex or concave.

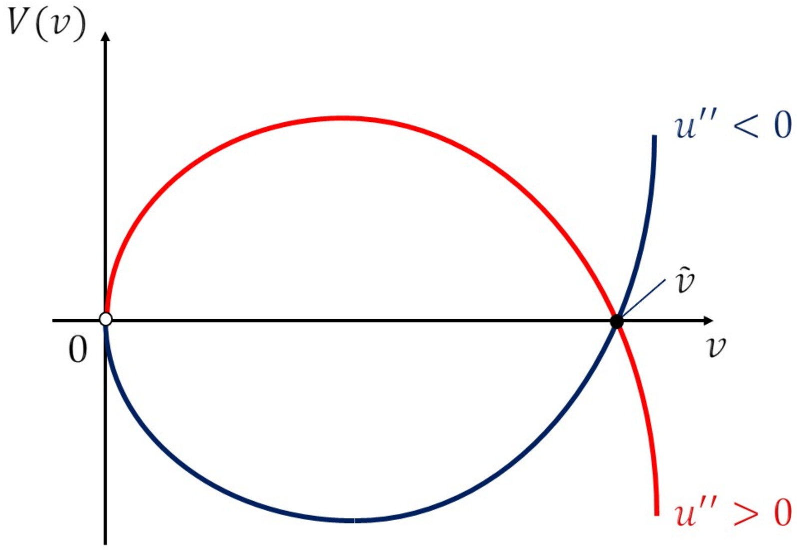

Figure 3: Existence and uniqueness of the union wage v.

Appendix C: Balancing Test Results

This appendix reports the covariate balancing test results prior to applying entropy balancing. Table 4 compares the mean values of the observed characteristics between nonunion and union workers. As it shows, before applying entropy balancing, significant differences exist between the treatment and control groups across most covariates, indicating substantial covariate imbalance and the need for a reweighting method to obtain unbiased causal estimates. These imbalances motivate the use of entropy balancing to reweight the control group so that the covariate moments match those of union workers.

Table 4: Balancing Test Results

	(1) Nonunion workers	(2) Union workers	(3) Difference in Means	(4) *p*-value
Gender	1.19	1.167	0.023	0.269
Age	52.746	46.726	6.020^{***}	0.000
Family size	3.152	3.338	-0.186^{*}	0.012
Firm size	3.242	4.346	-1.105^{***}	0.000
Job continuation	0.739	0.822	-0.083^{***}	0.000

Notes: Variables are defined as follows: gender (1=male, 2=female); job continuation (1 if the worker intends to stay at the current firm, 0 otherwise); and firm size (1=1–4 employees, 2=5–29, 3=30–99, 4=100–499, and 5=500 or more). $^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.1$

Conflict of Interest

The authors have declared no conflict of interest.

Data Availability Statement

The research data are not publicly available and therefore are not shared.

Generative AI Use

The authors have no disclosures to make regarding the use of generative AI.

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