Foreign-Native Wage Differentials and the Role of Visa Regime in Japan: Evidence from the Linked Employer-Employee Data, 2020-2023 [§]

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Abstract

In this study, using newly available linked employer-employee data, we document foreign-native wage differentials in Japan and examine to what extent these differentials can be explained by employee and workplace characteristics. Our contribution is twofold. First, to facilitate international comparison, we closely follow the method of Hermansen et al. (2025), who investigate immigrant-native pay gaps in nine high-income western countries. Second, taking advantage of Japan's tightly structured visa regime, we analyze how visa policies shape the selection and allocation of foreign workers and impact their economic integration.

Our main findings are as follows: (1) while there is a substantial foreign-native wage gap of 28% when we simply compare average wages, once we control for employee attributes (geographic region, sex, age, and education), the gap shrinks to 16%, and when we further control for workplace characteristics (occupation, establishment, tenure, and employment status), the wage disadvantage for foreign workers disappears entirely; (2) compared to the western countries in Hermansen et al. (2025), while the structure of foreign-native wage gap is broadly similar, across-establishment sorting and within-establishment task segregation (as opposed to industry and occupational segregation) plays more important role in Japan; (3) when we examine the foreign-native wage gap in Japan by visa category, starkly different patterns of wage convergence emerge, yet despite these differences, when all factors are controlled for, the foreign wage disadvantage becomes negligible in all visa categories.

Our results show that both employee and workplace characteristics differ substantially not only between native and foreign workers but also among foreign workers across visa categories in Japan, implying highly segmented labor markets. Yet, at the same time, we observe near complete wage convergence between observably equivalent native and foreign workers in equivalent career track and task assignment. Given that Japan's visa regime has been formed largely in response to labor shortages, we conjecture that such "demand-driven" policy has led to a high degree of wage convergence, but at the cost of substantial labor market segmentation. In other words, Japan's visa system likely plays a central role in shaping the observed patterns of economic integration.

JEL Code: J15, J31, J71

Keywords: wage inequality, immigration policy, economic integration

1 Introduction

Economic integration of immigrants has been a central issue in many societies. Recent studies have found substantial and persistent earnings gap between immigrants and natives in high income countries (OECD, 2025; Lehrer and Rawling, 2025; Rho and Sanders, 2021). In general, immigrant-native wage differentials can be decomposed into between-job wage differences (i.e., immigrants and natives are matched to different jobs) and within-job wage inequality (i.e., immigrants and natives are paid differently within the same job) (Hermansen et al., 2025). Between-job wage differences arise typically when immigrants sort into certain industries, occupations, or employers. Such sorting may occur due, for example, to assortative matching between human capital and job quality or higher job search costs for immigrants. Within-job wage inequality may result from employers' differential treatment of immigrants and natives, due possibly to their actual or perceived difference in initial human capital or career concerns. To design an effective policy to promote economic integration, it is essential to understand the mechanism behind immigrant-native wage differentials.

Among high income countries, Japan has been perceived as one of the lowest immigration countries. However, to mitigate the labor shortage, the Japanese government has been expanding its gates to accept foreign workers through various policy reforms in recent decades (Oishi, 2021). As a result, the population of foreign workers in Japan—both skilled and unskilled—has grown rapidly since the late 2000s, from fewer than 500,000 in 2008 to more than 2 million in 2023. In 2025, the number of foreign workers in Japan recorded a historic high of 2.6 million, representing 4.2% of total employment.[1] Despite the growing importance of foreign workers in the Japanese economy, we know relatively little about their economic conditions due to the lack of data (for notable exceptions, see Korekawa (2023) and Nagayoshi (2024)).

In this study, using newly available linked employer-employee data for 2020–2023, we investigate foreign-native wage differentials and labor market segmentation in Japan. Our objective is twofold. First, to facilitate international comparison, we closely follow the method of Hermansen et al. (2025), who investigate immigrant-native pay gaps in nine high income countries in Western Europe and North America, and examine to what extent foreign-native wage gap in Japan can be explained by employee and employer characteristics. Furthermore, taking advantage of detailed data that include individual-

[1] The number of foreign workers are from *Notification of Employment Status of Foreign Nationals* by by the Ministry of Health, Labor, and Welfare (MHLW). In this statistics, because the number of foreign workers is based on the number of employment contracts held by foreign workers where a foreign worker with multiple contracts are counted multiple times, it is likely to be an overestimate (see Hashimoto and Kambayashi (2019)).

level human resource management (HRM) variables, we make in-depth exploration of within-job wage inequality. Second, as our data also includes foreign workers' visa information, we analyze how Japan's tightly structured visa regime (which functions as de facto immigration policy) shape the selection and allocation of foreign workers and impact their economic integration.

Our findings can be summarized in the following three points. First, while there is a substantial foreign-native wage gap of -0.324 log points (or -27.7%) when total hourly wages are compared, once we control for employee attributes (residential region, sex, age, and education), the gap shrinks to -0.177 log points (or -16.2%). When we further control for workplace characteristics (occupation, establishment, tenure, and employment status), the wage disadvantage for foreign workers disappears entirely. This result is in sharp contrast with the sizable gender wage gap of -0.147 log points (or -13.7%) that remains even after controlling for all observable factors.

Second, compared to the results of Hermansen et al. (2025), the overall structure of foreign-native wage differentials in Japan is broadly similar to that in the nine western countries. Yet, there are some notable differences. Most importantly, while occupational segregation is the most important factor behind the foreign-native wage gap in the western countries, our evidence suggests that sorting into establishments as well as within-establishment task segregation are important factors in Japan.

Third, when we linearly decompose foreign-native wage differentials by visa category, starkly different patterns of wage convergence emerge, due to systematic visa-based differences in the human capital and workplace characteristics of foreign workers. Despite these differences, once we control for all observable characteristics, the wage disadvantage for foreign workers becomes small or zero in all visa categories.

Our results show that both employee attributes and workplace characteristics differ substantially not only *between* native and foreign workers, but also *among* foreign workers across visa categories in Japan, implying highly segmented labor markets. Yet, at the same time, we observe near complete wage convergence between observably equivalent native and foreign workers after controlling for within-establishment career track and task assignments (proxied by tenure and employment status).

Given that the visa regime in Japan has been formed largely in response to employers' labor demands to mitigate domestic labor shortages (Liu-Farrer, 2020; Oishi, 2021), we conjecture that this demand-driven selection and allocation mechanism has led to a high degree of wage convergence (after controlling for all observable factors), but at the cost of highly segmented labor markets. In other words, Japan's tightly structured visa system likely plays a central role in shaping the observed

patterns of economic integration.

In addition to providing an international comparison, this study contributes to the literature in two main ways. First, our findings indicate that within-establishment foreign-native wage differentials between observably equivalent foreign and native employees can be explained by differences in HRM (i.e., career track and task assignment). Preceding studies (e.g., Gerard et al., 2021; Pendakur and Woodcock, 2010) have shown that a significant portion of wage disadvantages for immigrants and ethnic minorities can be explained by between-firm sorting in which employer-side selection plays an important role. Furthermore, Aydemir and Skuterud (2008) examine foreign-native differences in task assignments using within-firm occupation-level differences. In our analysis, we go one step further and use individual-level HRM controls that enable us to identify differences in task assignments within the same occupation within the same firm.

Second, to our knowledge, this is the first study to document the systematic differences in foreign-native wage gap across visa categories using the national sample of foreign and native workers. While preceding studies have focused on a specific group of immigrants to examine a specific immigration policy (e.g., the analysis of the H1-B visa program by Borjas (2026)), our analysis covers the entire labor markets.[2] Moreover, our study indicates that a visa regime has a profound impact on foreign-native wage differentials as they shape matching between employers and foreign workers by imposing eligibility requirements and mobility restrictions. It shows that sorting of foreign workers across establishments reflects, not only workers' search behavior and firms' recruitment methods (as recognized by Aydemir and Skuterud (2008)), but also national visa policies, providing a new and important policy implication.

2 Demographic and Institutional Background

In recent decades, Japan's labor market has undergone a profound transformation. Between 1995 and 2024, due to a rapidly aging population, the working-age population (aged 15 to 64) fell by 13 million, representing a 15.5% decline.[3] Despite this large demographic contraction, total employment has remained relatively stable, as the number of employed working-age individuals declined only by 1.6 million (a 2.8% decline). Two major mitigating factors are the increase in labor force participation

[2] Using the same wage survey data as this study, Korekawa (2023) and Nagayoshi (2024) examine foreign-native wage differentials in Japan, where the former focuses on gender wage gap and the latter uses the sample of male workers holding specific visa types.

[3] By contrast, in 1995-2024, the working-age population grew by about 24.3% in the U.S. and remained stable in the 27 member countries of the European Union (OECD Statistics).

of women and the rise of foreign workers. In particular, the employment rate of working-age women in Japan increased sharply from 56.5% in 1995 to 74.2% in 2024.[4] Despite a decline in the working-age female population, the number of employed women increased by 2.4 million, reflecting the strength of this participation surge. Such increase notwithstanding, persistent labor shortages in Japan led to an increased demand for foreign workers.

2.1 Admission of Foreign Workers in Japan

It is important to note that admission policies for foreign workers in Japan have been highly selective: the government has actively sought after skilled workers, but it has been extremely cautious in admitting unskilled workers. In recent decades, however, to address chronic labor shortage due to the demographic contraction, the government has been expanding the admission policies incrementally for both skilled and unskilled labor through various reforms (Oishi, 2021). As a result, Japan recorded the fastest growth in its foreign resident population among G7 countries since the late 2000s. In 2025, the number of foreign workers reached 2.6 million, accounting for 4.2% of total employment in Japan.[5]

The Immigration Control and Refugee Recognition Act (ICRRA) sets the legal framework for the admission of foreign workers in Japan.[6] The ICRRA currently defines 27 types of "status of residence," which is a legal classification issued to a foreign national residing in Japan that specifies permitted activities and a permitted period of stay. Following the common usage, we refer to "status of residence" also as "visa" throughout this paper.

For skilled labor, the Japanese government has held open and proactive admission policies since the 1960s. When admitting skilled workers, the government issues work visa to individuals with post-secondary education (or equivalent professional skills), have received a job offer from a company in Japan related to designated "professional and technical" fields, and are expected to receive a salary comparable to that of the locals. Since the 2000s, in response to growing demand for IT engineers and other skilled professionals, measures such as the relaxation of eligibility requirements of existing visa types and the creation of new visa types in the designated fields have been implemented, leading to a sharp increase in skilled foreign workers in Japan.

For unskilled labor, instead of issuing work visa to admit them directly, the government has

[4] By contrast, the female employment rate in the U.S. rose only slightly from 65.8% in 1995 to 67.5% in 2024. By 2024, Japan's female employment rate had reached levels comparable to those in Germany (74.1%), Denmark (74.5%), and other Northern European countries.

[5] *Notification of Employment Status of Foreign Nationals* by MHLW; see also footnote 1.

[6] The ICRRA also stipulates the system of refugee recognition. The number of accepted refugees has remained small (no more than 300 refugees per year) in Japan, however.

long relied on alternative means such as granting work permission to non-work visa holders (e.g., international students and ethnic Japanese). Under the pressure of increasing labor shortage, the government has added admission channels in a piecemeal fashion since the 1980s, but it was not until 2010 that it began issuing work visa to unskilled workers.[7] As a result, unskilled workers belong to multiple visa categories (e.g., work visa, non-work residence-status visa, and non-work student visa).

Figure 1 shows changes in the number of foreign workers from 2011 to 2024 by visa categories: foreign workers holding (1) residence-status visa (covering both skilled and unskilled workers), (2) highly skilled work visa, (3) unskilled work visa, and (4) student visa (covering mostly unskilled workers).[8] The number of workers has grown monotonically in all categories except for the COVID-19 period. Most notably, the number of both highly-skilled and unskilled work-visa holders has been rising sharply since the late 2010s, driven by successive visa policy reforms.

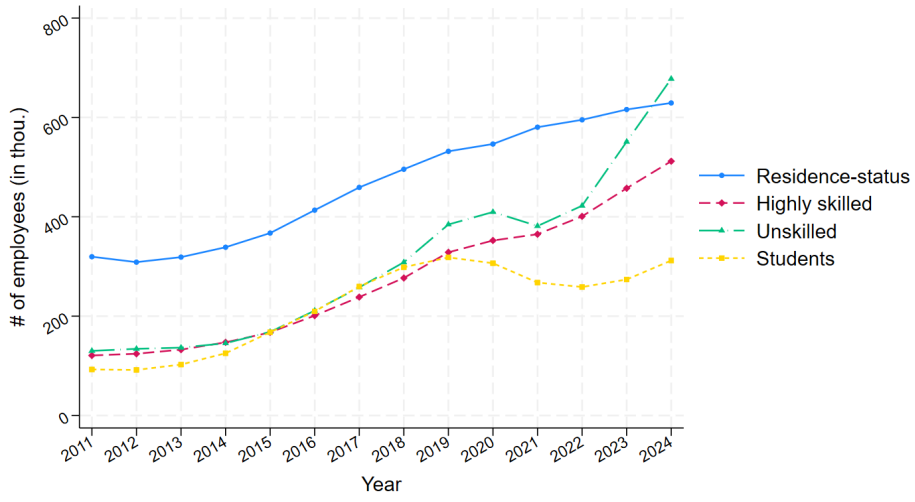


Figure 1: Number of Foreign Workers by Visa Categories, 2011-2024

Source: Notification of Employment Status of Foreign Nationals.

Notes: This figure shows the number of foreign workers holding (1) non-work residence-status visas, (2) highly skilled work visas, (3) unskilled work visas, and (4) non-work student visas.

[7] There are four distinct channels through which Japan has accepted unskilled labor: (1) the acceptance of descendants of Japanese emigrants (called *Nikkeijin* or ethnic Japanese) by issuing them non-work "long-term residence" visa starting in 1990, (2) the acceptance of temporary workers by issuing them non-work "technical intern" visa under the Technical Intern Training Program (TITP) established in 1993, which began initially as non-work "trainee" visa in 1990 and was subsequently reorganized into work visa in 2010 (thereby issuing work visa to unskilled workers for the first time), (3) the acceptance of "specified skill workers" (SSW) by issuing them work visa starting in 2019 as an extension of the TITP, and (4) the acceptance of foreign students by issuing them non-work "student" visa for which official notices in the 1980s clarified that students were permitted to work part-time off campus.

[8] For the precise definition of each visa category, see Section 5.

3 Data

3.1 Basic Survey on Wage Structure, 2020-2023

It has been difficult to analyze the economic conditions of foreign workers in Japan due to the lack of data (see Hashimoto and Kambayashi (2019) and Hashimoto (2026) for a survey of available data and their limitations). This situation improved greatly in 2019, as the Japanese government began to collect information on individuals' status of residence in the Basic Survey on Wage Structure (BSWS), one of the most extensive and trusted wage surveys in Japan. Although we are unable to observe the nationality of workers in BSWS data, we can identify foreign workers and their visa type from their status of residence.

The BSWS is a cross-sectional survey conducted by the Ministry of Health, Labor, and Welfare (MHLW) in June every year. Using a two-stage stratified sampling design, the survey collects individual wage information for about 1.2 million workers each year. In the first stage, nearly 80 thousand non-farm establishments with at least five employees are sampled (with response rates of 70–80%). In the second stage, the sampling rate for workers within an establishment is determined by industry and establishment size. For example, the rate is 1/90 for manufacturing establishments with 15,000 or more employees, while the rate is 100% for any establishments with 30 or fewer employees. Establishments are required to provide a copy of the payroll records of the sampled employees that include the monthly payments in June, the annual bonuses of the previous year, and the actual hours worked in June. Because of this design, the BSWS provides nationally representative employer-employee linked data with accurate wage information. It also includes a sufficient number of foreign workers due to its large sample size. It must be noted, however, that the BSWS does not cover establishments with fewer than five employees and excludes certain industries such as agriculture and fisheries. Another limitation is that it is not possible to follow the same worker across years.

The BSWS collects information also on individual workers' age, sex, education, residency status (equivalent to visa type), occupation, employment status, contract term, and tenure. Even though residency status became available in 2019, because education and occupation became available for all employees only from 2020, we use the pooled cross-sectional data from 2020 to 2023 in the following empirical analysis. We also restrict our sample to workers aged 65 years old or below to avoid complications arising from post-mandatory retirement behaviors.

3.2 Variable Definitions and Summary Statistics

To examine foreign-native wage differentials, we regress total hourly wage on a set of observable factors. Total hourly wage is defined as the sum of the monthly salary in June and the monthly value of annual bonus divided by the actual hours worked in June.[9]

For control variables, we distinguish employee attributes and workplace characteristics. Employee attributes (i.e., supply-side factors) consist of (1) geographical location (in 47 prefectures) and (2) human capital variables (age, sex, and final education in seven categories). Workplace characteristics consist of (1) industry (in 500 groups), (2) occupation (in 144 classifications), (3) establishment, and (4) within-establishment variations in human resource management (HRM). HRM variables consist of employment status (full-time or part-time, called standard or non-standard employee at the workplace),[10] contract term (fixed or indefinite contract duration), and tenure (the number of years employed in the current establishment). The industry, occupation, and establishment fixed effects are interpreted as capturing the role of employers, the demand-side factors that are emphasized in the recent literature as an important determinant of immigrants' outcomes (e.g., Damas de Matos (2017); Arellano-Bover and San (2020); Dostie et al. (2023)).

The summary statistics of the main variables in the pooled 2020-2023 data are presented in the upper panel of Appendix Table A1. In total, our sample consists of 4,971,778 workers in 170,719 establishments, and 61,009 (or 1.23%) of them are foreign workers.[11] According to Table A1, compared to native workers, foreign workers are less likely to be female (43.2% vs. 47.0%), substantially younger (32.7 vs. 42.5 years old), and less likely to hold a university degree or above (24.4% vs. 29.8%). Moreover, foreign workers have much shorter tenure (2.7 vs. 11.2 years), are more likely to be employed as non-standard employees (0.558 vs. 0.313), and are more likely to be under fixed-term contracts (0.699 vs. 0.216), indicating that foreign workers are overrepresented in the peripheral segment of Japanese labor markets. Accordingly, the average total hourly wage of foreign workers (1,666 JPY) is substantially lower than that of natives (2,265 JPY).

In Figure 2, we compare wage distributions of the two groups. It clearly shows that wages of

[9] The monthly values of the bonus is obtained by dividing the annual bonus of the previous year by 12. The actual hours worked are defined as the sum of the scheduled and overtime hours worked during the month. Therefore, the monthly salary includes the overtime and bonus payments, reflecting both temporary demand shock (overtime pay) and the incentive design of the firm (bonus).

[10] Standard employment corresponds to *seiki koyo* in Japanese, which is also called regular employment.

[11] The share of foreign workers in the BSWS data is smaller than the share from *Notification of Employment Status of Foreign Nationals*. Possible reasons include over-estimate in the *Notification* (see footnote 1) and under-representation in the BSWS data (due to its sample design and sampling method).

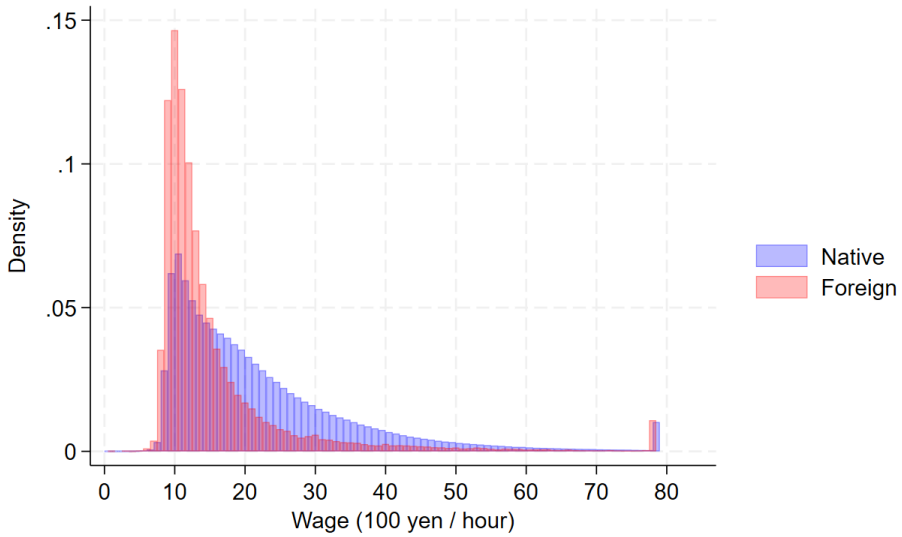


Figure 2: Wage Distributions of Native and Foreign Workers

Source: The pooled BSWS 2020-2023 data.

Notes: Distributions of total hourly wage are shown. Top 1% are top coded in this figure.

foreign workers are much more concentrated at the lower end than wages of native workers. The lowest wage levels are similar between foreign and native workers as they are bound by the statutory minimum wages (defined at the prefecture level). The wage distribution of the natives exhibits a substantially thicker upper tail, but the shares of top-coded workers (very well-paid workers) are roughly comparable between native and foreign workers, indicating large heterogeneity in foreign workers' wages. We explore such heterogeneity using visa categories in the subsequent section.

4 Main Empirical Analysis

Using harmonized linked employer–employee data from nine European and North American countries, Hermansen et al. (2025) decompose immigrant–native earnings gap into between-job pay differences and within-job pay inequality, where job is defined as a combination of occupation and establishment (i.e., doing the same job = being in the same occupation in the same establishment). They find that, after controlling for basic human characteristics, the limited access of immigrants to high-paying jobs is the main factor behind the observed immigrant–native earnings gap. From this observation, they conclude that, to promote economic integration, the government should shift policy focus from within-

job wage discrimination to structural impediments that sort immigrants into low-paying industry, occupation, and firms.

To facilitate international comparison, we closely follow their method and examine foreign-native wage differentials in Japan. In addition, taking advantage of more detailed information in the Japanese data, we also extend their method to provide more in-depth exploration of within-job wage inequality.

4.1 Empirical Specifications

To investigate the extent of foreign-native wage differentials in Japan, we use OLS to estimate the following equation in which we add each set of control variables sequentially:

$$log\ Wage_{irkojt} = \alpha + \beta Foreign_i + \tau_t + \zeta_r + \gamma X_i + \eta_k + \theta_o + \iota_j + \delta Z_{ij} + \epsilon_{irkojt} \tag{1}$$

where $Wage_{irkojt}$ is total hourly wage of employee i working in region r, industry k, occupation o, establishment j, in year t. $Foreign_i$ is an indicator variable that takes 1 if employee i is a foreign worker. Its coefficient β is our main parameter of interest: if β is negative (or positive) then foreign workers have wage disadvantage (or premium) compared to native workers. τ_t denotes survey year fixed effects (2020, 2021, 2022, or 2023). ζ_r is residential region fixed effects. X_i is a set of human capital attributes of employee i, consisting of age, age squared, female indicator, and education indicators. η_k is industry fixed effects, θ_o is occupation fixed effects, and ι_j is establishment fixed effects.[12] Z_{ij} is a set of variables that capture HRM variables (i.e. within-job controls) which consists of tenure, tenure squared, and indicator variables for part-time work, non-standard employment, and fixed-term contract. ϵ_{irkojt} is an error term where standard errors are clustered at the establishment level.

We depart from Hermansen et al. (2025)'s specification in three respects. First, to control for job, instead of including occupation-establishment fixed effects, we include occupation fixed effects and establishment fixed effects simultaneously (which is more conventional specification in labor economics). The results are not sensitive to the choice of these specifications as shown later. Second, to evaluate the marginal contribution of different sets of controls, we introduce them sequentially. Third, as within-job controls, we introduce a set of HRM variables (tenure and employment status) that capture differences in career track and task allocation across employees in the same occupation

[12] Because industry fixed effects are collinear with establishment fixed effects, η_k is omitted when ι_j is included. We cannot include employee fixed effects to implement AKM decomposition by Abowd et al. (1999) because our data is not employee panel data.

in the same establishment.[13]

4.2 Regression Results

In Figure 3, to show changes in foreign-native wage gap when control variables are added sequentially, we plot estimated coefficient $\hat{\beta}$ for each specification (in log points) with the 95% confidence interval. The width of the confidence interval indicates that each coefficient is highly precisely estimated. (Regression results are reported in Table A2. Distribution of residuals are shown in Figure A1.)

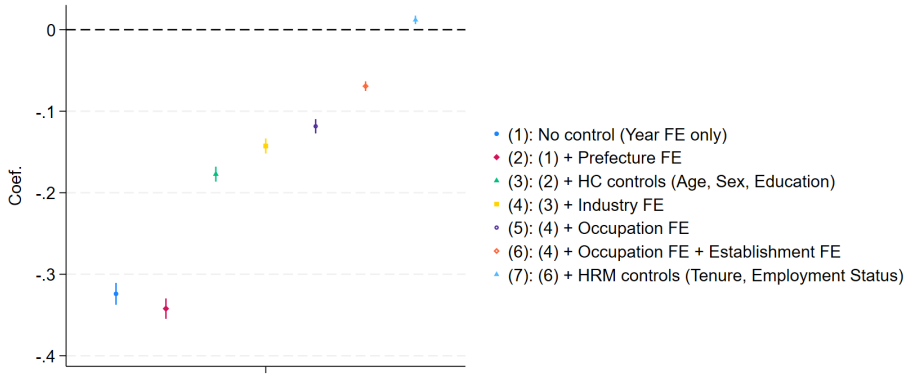


Figure 3: Foreign-Native Wage Gap in Japan

Source: The estimation results using the BSWS 2020-2023 pooled data reported in Table A2.

Notes: This figure shows the estimated foreign-native wage gap expressed in log points. Negative wage gap implies wage disadvantage for foreign workers. Wage is defined as total hourly wage including overtime pay and bonus. The 95% confidence intervals are based on the standard errors clustered at the establishment level.

As shown in Specification (1), the raw wage gap (controlling only for year fixed effects) is −0.324 log points, corresponding to a wage disadvantage of 27.7% for foreign workers. When geographical region is controlled in Specification (2), the wage gap widens a little to −0.342 log points (or −29.0%), but it is not statistically significantly different from the raw wage gap. When employees' human capital is added in Specification (3), then the gap narrows substantially to −0.177 log points (or −16.2%).

[13] Prior research suggests that foreign and native workers are systematically assigned to different tasks. Storm (2022) and Doi and Suzuki (2025) find that foreign workers are more likely to perform tasks with lower cognitive or supervisory contents. OECD (2025) documents that immigrants are disproportionately placed in lower-paying positions within firms and notes that any remaining within-job wage differentials may reflect differences in task assignments, responsibility, experience, or language proficiency (p.136). Taken together, these findings imply that foreign-native wage gap may persist even within the same job due to differential task assignments. However, prior studies on task segregation, such as Aydemir and Skuterud (2008), mainly exploit occupation- and/or firm-level variation (e.g., task scores defined at the occupation level), so task segregation is not cleanly distinguished from occupation or firm segregation. In this study, in addition to occupation and establishment fixed effects, we include individual-level HRM variables as more detailed proxies for task assignments.

This is consistent with the fact that foreign workers on average have lower human capital (i.e., much younger and less educated), and as such, the difference in human capital can explain a large share (42%) of the raw wage gap.

Next, we turn to workplace characteristics. When industry fixed effects are added in Specification (4), the wage gap narrows further to −0.143 log points (or −13.3%). Adding occupation fixed effects in Specification (5) reduces the gap further to −0.118 log points (or −11.1%) , and adding establishment fixed effects in Specification (6) reduces the gap further to −0.069 log points (or −6.7%) . That is, when we compare the observationally equivalent foreign and native workers with the same occupation in the same establishment (in the same job by Hermansen et al. (2025)'s definition), foreign workers still receive 6.7% lower wages than native workers.

Finally, when HRM variables are added in Specification (7), not only the foreign wage disadvantage is entirely eliminated, but we observe foreign *wage premium* of +0.012 log points (or +1.1%). That is, when we control for tenure and employment status in addition, the foreign-native wage disparity disappears, and if anything, foreign workers are paid slightly higher than native workers. As shown in Table A2, this result is in stark contrast with the case of gender wage gap: after controlling for all observable factors, gender wage gap remains to be −0.147 log points (or −13.7%).

To summarize, our results show that differences in employee attributes and workplace characteristics can entirely explain the large foreign–native wage gap of −28% observed in the data.[14] Among all factors, differences in human capital and HRM variables together account for roughly 70% of the foreign–native wage gap in Japan.

One concern with the OLS estimates is that, because foreign workers are relatively few in number, identification may rely on functional-form assumptions and extrapolation when the covariate distributions of foreign and native workers differ substantially. To address this concern, we also implement propensity score matching (PSM) that can mitigate limited common-support problems.[15] However, our preferred specification includes both establishment and occupation fixed effects, and many such cells contain no foreign workers, making matching within fixed-effect categories difficult (Abadie and Imbens, 2006). We thus implement PSM using a more parsimonious specification with individual controls and industry fixed effects. The PSM results are qualitatively similar to the OLS results,

[14] The results are robust to alternative specifications of establishment fixed effects (see Table A3).

[15] We cannot implement the decomposition by DiNardo et al. (1996) because their reweighting approach is sensitive to limited overlap in observable characteristics, which in our setting would make the counterfactual distribution unstable and poorly identified.

suggesting that our findings are not driven solely by extrapolation.[16]

4.3 International Comparison

Next, to provide direct comparison with Hermansen et al. (2025), we run regressions using exactly the same specifications as theirs. In their analysis, the baseline wage gap is set to be the one after controlling for employee attributes (geographical region, age, sex, and education), and thus the raw gap (with no control) is not reported. Furthermore, in their specifications, four sets of control variables (i.e., industry fixed effects, occupation fixed effects, establishment fixed effects, and job fixed effects defined as occupation×establishment fixed effects) are added, not cumulatively as in our specifications, but independently as a replacement of one another.

	Nine Western Countries		Japan	
	Remaining Wage Gap	Share Explained	Remaining Wage Gap	Share Explained
(a): No Control (Raw Wage Gap)	n.a.		-27.7%	
(b): (a) + Employee Attributes (Baseline Wage Gap)	-17.9%	0.00	-16.2%	0.00
(c): (b) + Industry FE	-13.0%	0.27	-13.2%	0.18
(d): (b) + Occupation FE	-8.6%	0.52	-13.8%	0.15
(e): (b) + Establishment FE	-8.9%	0.50	-6.5%	0.60
(f): (b) + Job FE (Occupation x Establishment FE)	-4.6%	0.74	-6.2%	0.62

Table 1: International Comparison of Foreign-Native Wage Gap

Sources: Hermansen et al. (2025) Supplementary Table 2 for nine western countries; Tables A2 and A3 for Japan.
Notes: In this table, wage gap is expressed in percentage (converted from the original log points). In each row of this table, a set of controls is replaced by the next set of controls, following the specifications of Hermansen et al. (2025).

Table 1 compares the overall results for the nine western countries (Canada, Denmark, France, Germany, Netherlands, Norway, Spain, Sweden, and the U.S.) reported in Hermansen et al. (2025) with our results for Japan. Detailed regression results are reported in Tables A2 and A3. Row (a) shows the raw wage gap (only for Japan). As shown in Row (b), the baseline foreign–native wage gap (controlling for employee attributes) is −0.197 log points (−17.9%) in the western countries and −0.177 log points (−16.2%) in Japan, indicating that the gap is somewhat smaller in Japan.

When industry fixed effects are added to the baseline specification (see Row (c)), the wage gap

[16] The PSM results are available from the authors upon request.

narrows from −17.9% to −13.0% in the western countries and from −16.2% to −13.2% in Japan. As shown in the second and forth columns entitled "Share Explained," industry segregation explains 27% of the baseline gap in the western countries and 18% of the baseline gap in Japan. When occupation fixed effects are added instead (see Row (d)), the wage gap declines to −8.6% in the western countries and to −13.8% in Japan. This indicates that occupation segregation explains more than half (52%) of the baseline gap in the western countries, compared with only 15% in Japan.

When establishment fixed effects are added instead (see Row (e)), the gap narrows to −8.9% in the western countries and to −6.5% in Japan. It shows that establishment-level segregation explains 50% of the baseline gap in the western countries and 60% of the baseline gap in Japan. Finally, when job fixed effects (defined as occupation×establishment fixed effects) are introduced instead (see Row (f)), the wage gap declines to −4.6% in the western countries and to −6.2% in Japan. It shows that job segregation explains 74% of the baseline gap in the western countries, compared to 62% in Japan.

Taken together, the overall structure of foreign-native wage differentials in Japan is broadly similar to that in the nine western countries. Yet, there are some notable differences. Most importantly, while occupational segregation is the most important factor that explains the foreign-native wage gap in the western countries, sorting into establishments is the most important factor in Japan. Furthermore, when the baseline wage gap is decomposed into between- and within-job wage differentials, compared to the western countries, within-job inequality has greater importance in Japan.

Hence, we now turn to explore mechanisms behind within-job wage inequality. In our data, as HRM variables, we observe tenure and detailed employment status (full-time or part-time, standard or nonstandard employment, indefinite or fixed-term contract). In Hermansen et al. (2025), they also observe tenure and some employment status (full-time or part-time) in most of their sample countries. In Table 2, we provide cross-country comparison of the extent to which within-job wage inequality is explained by these HRM variables.

As shown in Column (a), the magnitude of within-job wage gap varies across countries ranging from −9.4% in Canada to 0.0% in Sweden. When tenure is controlled in Column (b), the gap narrows substantially in all countries (except Sweden), where the share explained by tenure is the smallest in Japan (11%) and the largest in Spain (79%). This result indicates that in almost all countries foreign workers have shorter tenure compared to native workers in the same job, resulting in lower wages.

When part-time work is controlled instead in Column (c), the gap narrows in Canada by 7%, France by 4%, Netherlands by 21%, Norway by 6%, and Spain by 7%, whereas the gap *widens* in

	Within-Job Wage Inequality (a)	(a)+Tenure (b)	Share Explained (a)-(b)/(a)	(a)+Part-time (c)	Share Explained (a)-(c)/(a)	(a)+ HRM Variables (d)	Share Explained (a)-(d)/(a)
Canada	-9.4%	-5.9%	0.37	-8.8%	0.07	n.a.	
Denmark	-2.3%	-0.7%	0.69	-3.0%	-0.30	n.a.	
France	-6.7%	-5.5%	0.17	-6.4%	0.04	n.a.	
Germany	-5.3%	-2.8%	0.47	-5.3%	0.00	n.a.	
Netherlands	-5.1%	-1.3%	0.75	-4.0%	0.21	n.a.	
Norway	-3.4%	-2.2%	0.37	-3.2%	0.06	n.a.	
Spain	-7.0%	-1.5%	0.79	-6.6%	0.07	n.a.	
Sweden	0.0%	0.0%		n.a.		n.a.	
USA	-3.4%	-2.5%	0.28	-3.5%	-0.03	n.a.	
Nine Western Countries	-4.6%	n.a.		n.a.		n.a.	
Japan	-6.2%	-5.5%	0.11	-7.8%	-0.26	0.0%	1.00

Table 2: Cross-Country Comparison of Within-Job Wage Inequality

Sources: Hermansen et al. (2025) Supplementary Tables 38 and 39 for the nine western countries; Table A3 for Japan.
Notes: All wage gaps in Columns (a), (b), and (c) are expressed in % (converted from the original log points). Within-job wage inequality in Column (a) corresponds to Table 1 Specification (f). HRM practices in Column (d) includes tenure and indicators for part-time, non-standard employment, and fixed-term contract.

Denmark by 30%, the U.S. by 3%, and Japan by 26%. In the case of narrowing wage gap, it suggests that, compared to native workers in the same job, foreign workers are more likely to work part-time and receive lower hourly wages. In the case of Japan, the gap widens after controlling for part-time work, however. As shown in the next section, it is likely driven by Japan's visa policy that allocates a sizable number of foreign workers to unskilled full-time work with low wages, generating substantial foreign-native wage gap among full-time workers in the same job.

For Japan, when additional HRM variables (non-standard employment and fixed-term contract) are controlled in Column (d), within-job foreign wage disadvantage is entirely explained away. In other words, foreign and native workers in Japan are segregated by career track and task assignment within the same job, in accordance with their employment title and contract duration. Our analysis suggests the possibility that, if more detailed data on career tracks and task assignments are available in the western countries, within-job wage inequality in these countries may also be explained by these factors.

The main findings of this section are as follows. First, although the raw gap in total hourly wages between native and foreign workers is as large as 28%, 42% of that is explained by differences in employee attributes. Second, foreign wage disadvantage disappears entirely once workplace charac-

teristics (including HRM controls) are also taken into account, indicating that foreign–native wage differentials in Japan are attributable to observable differences. Moreover, while foreign–native wage gap in European and North American countries is closely associated with job segregation, our evidence indicates more important role of within-establishment task-based segregation in Japan.

5 Visa Category Decomposition

In this section, to explore the role of visa regime in shaping the patterns of economic integration of foreign workers, we classify foreign workers into four categories by their visa types and decompose foreign-native wage differentials by visa categories.

5.1 Definitions of Visa Categories

As explained in Section 2, the ICRRA defines 27 types of status of residence or "visa types." The visa can be divided into *work* visa and *non-work* visa. The work visa can be divided further into *skilled* work visa and *unskilled* work visa, while the non-work visa consists of *residence-status* visa and the rest (including student visa). Using visa types, we classify foreign workers into the following four categories: (1) Residence-Status Workers, (2) Highly Skilled Workers, (3) Unskilled Workers, and (4) Students.[17]

Residence-Status Workers: This category consists of foreign workers who hold residence-status visa, i.e., the visa granted based on "personal status or position" where "personal status" refers to ties to Japanese nationals and "position" refers to other specified qualifications.[18] Residence-status workers is comprised of the following three groups: (i) spouses or children of Japanese nationals (including both skilled and unskilled workers), (ii) descendants of Japanese emigrants or *Nikkeijin* (consisting largely of unskilled workers in manufacturing industries), and (iii) those who transitioned from skilled work visa to permanent resident visa. Because residence-status visa requires no employer sponsorship and imposes no restrictions on type or place of work, they can freely choose an employer and an occupation (except for public service) in any industry.

In principle, the number of residence-status workers is determined by the supply side, i.e., the number of eligible foreign individuals. However, for *Nikkeijin*, labor demand is also an important

[17] Special permanent residents (individuals with ancestral origins in former Japanese colonies) and individuals with visa types of "temporary visitor," "diplomat," "official," "dependent," and "designated activities" are not included in the four visa categories.

[18] Residence-status visa consists of the following 4 visa types: "long-term resident," "permanent resident," "spouse or child of permanent resident," and "spouse or child of Japanese national."

factor, as their number increased sharply in the 1980s and then fell substantially after the burst of the bubble economy in the early 1990s.

Highly Skilled Workers: This category consists of foreign workers who hold highly skilled work visa, i.e., visa types associated with the designated "professional and technical" fields.[19] Each visa type is tied to specific activities, and to be eligible foreign individuals are required to have post-secondary education (or equivalent professional skills) and an employment contract with an employer in Japan that offers remuneration equal to or greater than that of a Japanese employee engaged in the same duties. In principle, highly skilled work visa is granted for a fixed period (typically five years), but can be renewed indefinitely as long as the requirements are met. Highly skilled workers can change jobs within the specified activities, but beyond these activities they must apply for change of visa type.

The number of highly skilled workers is determined largely by the supply of foreign professionals willing to work in Japan, but as it requires employer sponsorship it is also driven by the demand. In particular, in response to domestic labor shortages, the government has added new visa types, relaxed eligibility requirements for existing visa types, and introduced a point-based preferential treatment system (to facilitate expedited transition to permanent residency) since the early 2000s, which sharply increased the number of highly skilled workers.

Unskilled Workers: This category consists of foreign workers holding unskilled work visa, i.e., workers under the Technical Intern Training Program (TITP) and the Specified Skilled Worker (SSW).[20] Both TITP and SSW visa types limit employment to a designated employer and impose restrictions on workplace, occupational scope, and contract duration, as follows.

The stated purpose of TITP is to transfer skills from Japan to less developed countries by accepting interns. As such, it imposes rigorous requirements for both interns and employers. TITP interns are restricted to designated occupations and operations in designated industries (e.g., agriculture, construction, food manufacturing, and machinery). To apply for TITP, foreign individuals must be 18 years or older, have prior experience in the same occupation or operation, and have an employment contract with an employer in Japan that offers remuneration equal to or greater than that of a Japanese employee engaged in the same operation. Employers must submit a detailed training plan for each intern in advance for approval, appoint training and life supporting instructors at workplace, and

[19] Highly-skilled work visa consists of the following 15 visa types: "professor," "artist," "religious activities," "journalist," "highly skilled professional," "business manager," "legal/accounting services," "medical services," "researcher," "instructor," "engineer/specialist in humanities/international services," "intra-company transferee," "nursing care," "entertainer," and "skilled labor"). In the government statistics, "specified skilled worker" (SSW) is included in the highly skilled work visa, but given its educational and skill requirements, we categorize SSW as the unskilled work visa.

[20] Unskilled work visa consists of the following 2 visa types: "technical intern" and "specified skilled workers" (SSW).

provide appropriate housing for interns. Under TITP, the maximum period of stay is five years (no renewal permitted), and job changes are in principle prohibited. Upon completion, TITP interns can transition to SSW if they meet specified conditions, but otherwise must return to their home countries.

The SSW is explicitly designed to mitigate acute labor shortages in specific industries by accepting less skilled foreign workers. SSW workers are restricted to designated industrial fields, such as agriculture, construction, manufacturing, food service, and nursing care. To apply for SSW visa, foreign individuals must pass specified skills and language proficiency tests and have an employment contract with an employer in Japan that offers remuneration equal to or greater than that of a comparable Japanese employee. Employers of SSW workers must submit a support plan in advance that includes language support and housing assistance. Under SSW, workers are allowed to change jobs only within the same industrial field or occupation. For a large majority of SSW workers the maximum period of stay is limited to five years.

The number of TITP and SSW workers is largely determined by the demand side. Visa policies for unskilled workers have been shaped in response to labor shortages, particularly among small and medium-sized enterprises in rural areas, reflecting Japan's declining youth population, aversion to manual work, and the geographic concentration of native workers in urban areas. As the government has expanded eligible occupations and industries and extended the permitted stay duration for TITP and SSW workers, the number of unskilled foreign workers has increased rapidly since the 2000s.

Students: This category consists of foreign workers who hold the rest of (non-work and non-residence status) visa types, including student visas.[21] In principle, holders of these types of visa are not allowed to work; however, part-time employment is allowed with some restrictions. Most importantly, those with student visa can work up to 28 hours per week during academic terms and 40 hours per week during designated vacation periods. To be eligible for student visa, foreign individuals must be enrolled at an Japanese educational institution (including university, graduate school, junior college, vocational school, and designated Japanese language school) and maintain satisfactory academic performance. The period of stay is fixed but renewable as long as the requirements are met. Students can freely change employer or occupation, but their working hours and geographical locations are constrained. After completing post-secondary education in Japan, a substantial number of foreign students transition to highly skilled work visa as they find a job in a company in Japan.

[21] The rest of visa types are "student," "cultural activities," "trainee," "dependent," and "designated activities."

5.2 Summary Statistics by Visa Category

Summary statistics of foreign workers in each visa category are shown in the lower panels of Table A1. In the pooled 2020-2023 BSWS data, among the total of 59,100 foreign workers, 17,154 (29.0%) are residence-status workers, 12,121 (20.5%) are highly skilled workers, 23,339 (39.5%) are unskilled workers, and 6,486 (11.0%) are students.[22]

Human capital of foreign workers differs greatly and systematically across visa categories. The share of workers holding a university degree or above is 26.0% for the residence-status, 66.8% for the highly skilled, 4.4% for the unskilled, and 15.0% for students, compared to 29.8% for native workers. The average age is 43.4 years for the residence-status, 32.6 years for the highly skilled, 26.9 years for the unskilled, and 26.3 years for students, compared to 42.5 years for the natives. Residence-status workers and students are more likely to be female (both 55.4%), whereas highly skilled and unskilled workers are more likely to be male (62.7% and 54.0%, respectively).

In terms of workplace characteristics, tenure is short across all visa categories: 5.1 years for the residence-status, 2.7 years for the highly skilled, 1.5 years for the unskilled, and 0.98 year for students, compared to 11.2 for the natives. The share of part-time workers is 27.6% for residence-status workers, 8.5% for the highly skilled, 1.1% for the unskilled, and 99.5% for students, compared to 21.1% for native workers. The share of non-standard workers is 63.0% for the residence-status, 25.4% for the highly skilled, 54.2% for the unskilled, and 99.3% for students, compared to 31.3% for native workers. The share of workers under fixed-term contract is 48.7% for residence-status workers, 32.8% for the highly skilled, 100% for the unskilled, and 78.1% for students, compared to 21.6% for native workers. The characteristics of unskilled foreign workers (i.e., young employees working full-time under fixed-term contract with extremely short tenure) are highly consistent with the conditions imposed by their visa types. The human capital characteristics of residence-status workers are more comparable to those of native workers, yet it is striking that they have shorter tenure and a higher likelihood of working as nonstandard employees under fixed-term contract than native workers.

According to Table A1, the average total hourly wage is 2,099 JPY for residence-status workers, 2,363 JPY for the highly skilled, 1,117 JPY for the unskilled, and 1,287 JPY for students, compared to 2,265 JPY for native workers. Figure 4 compares wage distribution of native workers and that of foreign workers by visa category. While the wage distribution of highly skilled workers is similar

[22] Because a few visa types are not included in the four visa categories, the sample size of foreign workers falls slightly from 61,009 in the upper panels to 59,100 in the lower panels in Table A1.

to that of native workers (see Panel (b)), wages of unskilled workers and students are much more concentrated at the lower levels (see Panels (c) and (d)) than native workers.

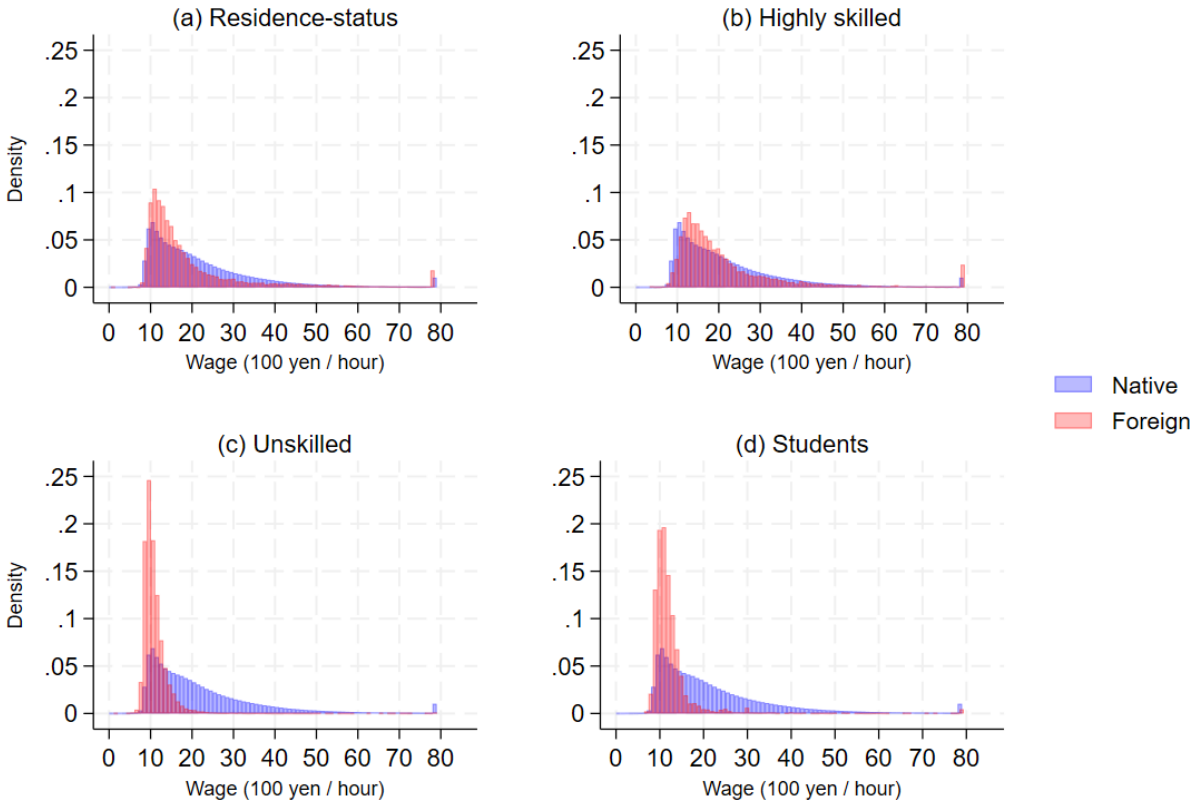


Figure 4: Wage Distribution of Foreign Workers by Visa Category

Source: The pooled BSWS 2020-2023 data.
Notes: Distribution of total hourly wages are shown. Top 1% are top-coded in each panel of this figure. The wage distribution of native workers is identical in all panels.

5.3 Empirical Specifications

To decompose foreign-native wage differentials by visa category, we estimate the following equation in which we add each set of control variables sequentially:

$$log\, Wage_{irkojt} = \alpha + \sum_{V \in \{R,H,U,S\}} \beta^V Foreign_i^V + \tau_t + \zeta_r + \gamma X_i + \eta_k + \theta_o + \iota_j + \delta Z_{ij} + \epsilon_{irkojt} \quad (2)$$

where $Wage_{irkojt}$ is total hourly wage of employee i working in region r, industry k, occupation o,

establishment j, in year t. $Foreign_i^V$ is an indicator variable that takes 1 if employee i is a foreign worker in visa category $V \in \{R, H, U, S\}$, where R stands for residence-status workers, H for the highly skilled, U for the unskilled, and S for students. Coefficient β^V is our main parameter of interest. The rest of the variables are the same as in Equation (1).

5.4 Regression Results

In Figure 5, Panels (a)–(d), we plot estimated foreign-native wage differentials ($\hat{\beta}^V$) by visa category. Regression results are reported in Table A6. In each panel, Specification (1) shows the raw wage gap (no control except for year fixed effects) and Specification (7) shows the wage gap with full controls. Even though the raw wage gap differs widely across visa categories, the wage gap after full controls approaches to or exceeds zero in all visa categories. Moreover, as we discuss below, the pattern of wage convergence in each visa category is consistent with underlying visa policy.

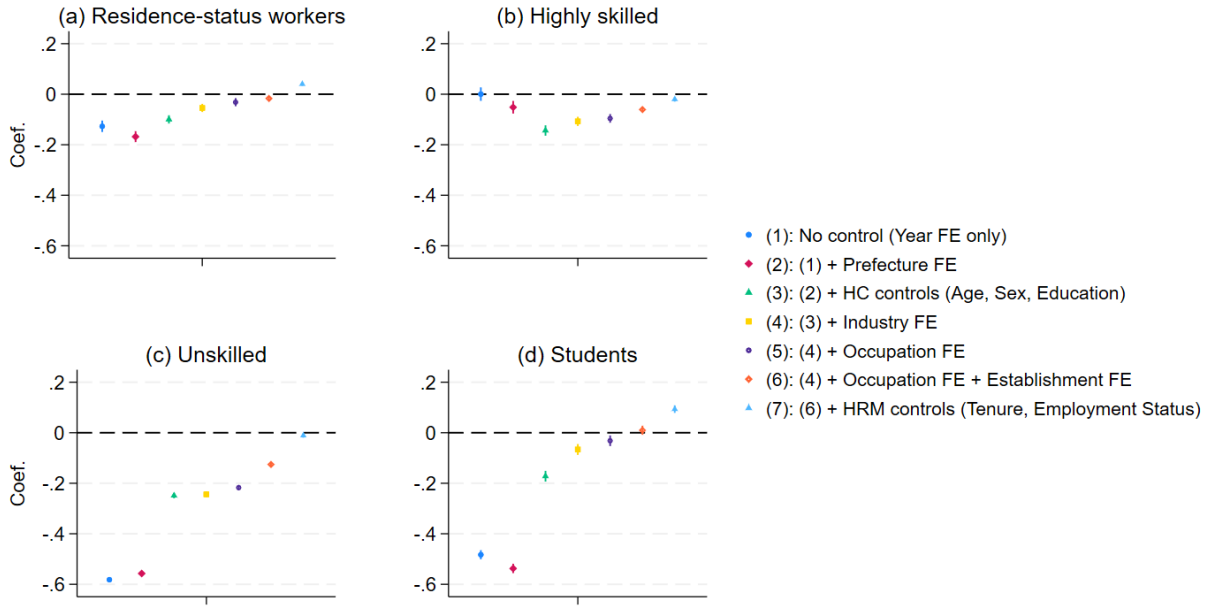


Figure 5: Foreign-Native Wage Gap by Visa Category in Japan

Source: The estimation results using the BSWS 2020-2023 pooled data reported in Table A6.

Notes: This figure shows the estimated foreign-native wage gap by visa category expressed in log points. Negative wage gap implies wage disadvantage for foreign workers. Wage is defined as total hourly wage including overtime pay and bonus. The 95% confidence intervals are based on the standard errors clustered at the establishment level.

Consistent with wage distributions shown in Figure 4, we observe large raw wage gaps of −0.582

log points (or −44.2%) for the unskilled category and −0.483 log points (or −38.3%) for the students category. By contrast, the raw wage gap for the residence-status workers category is much smaller (−0.127 log points or −11.9%), and for the highly skilled category there is *no* wage gap (0.000 log points).

When we control for geographical location in Specification (2), it narrows the wage disadvantage slightly for foreign workers in the unskilled category, whereas it *widens* the wage disadvantage for foreign workers in the other three categories. It indicates that, compared to native workers, unskilled foreign workers are sorting into locations with lower wages (i.e., more rural prefectures), while other foreign workers are sorting into locations with higher wages (i.e., more urban prefectures).

When we add human capital controls (age, sex, and education) in Specification (3), the wage gap *widens* by 0.092 log points for the highly skilled category. By contrast, the wage gap narrows by 0.308 log points for the unskilled category, by 0.365 log points for the students category, and by 0.068 log points for the residence-status workers category. It implies that foreign workers with high human capital (especially in education) are sorting into the highly skilled category, while those with low human capital are sorting into the unskilled and students categories. This is consistent with the systematic differences in human capital across visa categories observed in Table A1.

When we further control for workplace characteristics in succession (industry, occupation, establishment, and HRM) in Specifications (4)–(7), in all visa categories, the wage disadvantage for foreign workers becomes increasingly smaller (and in some categories, wage disadvantage turns into wage premium). The contribution of each factor varies across visa categories, however, as follows.

When industry is controlled in Specification (4), the wage disadvantage narrows by 0.046 log points for residence-status workers, by 0.037 log points for highly skilled workers, by 0.106 log points for students, and only by 0.005 log points for unskilled workers. This suggests that, sorting into lower-paying industries (relative to the natives) is an important factor in explaining the wage gap for students, but not for unskilled workers.

Adding occupation fixed effects in Specification (5) further reduces the foreign wage disadvantage, but the additional reduction is relatively small in magnitude, ranging between 0.011 and 0.034 log points across categories. This implies that occupational segregation is not a major factor in generating the foreign-native wage gap in any visa category.

In Specification (6), adding establishment fixed effects narrows the wage disadvantage by 0.015 log points for residence-status workers, by 0.035 log points for highly skilled workers, by 0.042 log points

for students, and by 0.091 log points for unskilled workers, indicating that sorting into lower-paying establishments is an important factor in accounting for the foreign wage disadvantage for unskilled workers, but not for residence-status workers.

Finally, when we control for HRM variables (tenure and detailed employment status) within the same occupation in the same establishment in Specification (7), not only that the wage disadvantage narrows to −0.020 log points (or −2.0%) for the highly skilled and to −0.011 log points (or −1.1%) for the unskilled, but it becomes *wage premium* of +0.040 log points (or +4.1%) for residence-status workers and +0.094 log points (or +9.9%) for students. Regression results also indicate that sorting into lower-paying career tracks or task assignments within the same job is an important factor in accounting for the wage disadvantage for unskilled workers and students.

To summarize, the decomposition of foreign-native wage differentials reveals starkly different patterns of wage convergence across visa categories. For the unskilled category, the most important factor in explaining the foreign-native wage gap is differences in human capital, which accounts for 57% of the raw wage gap, followed by differences in HRM variables (accounting for 19%) and differences in establishments (accounting for 16%). For the students category, the most important factor is also human capital differences (accounting for 64% of the raw gap), followed by differences in industry (accounting for 20%). By contrast, for the highly skilled and residence-status workers categories, the raw wage gap is much smaller to begin with, and all factors contribute relatively equally in accounting for the wage gap. Despite these differences, when we control for all observable employee and workplace characteristics, the wage disadvantage of foreign workers becomes negligible in all visa categories, and for students, we even observe sizable wage premium.

5.5 The Role of Visa Regime

From a policy perspective, Japan's visa regime can be seen as an explicit selection and allocation mechanism that matches specific workers to specific establishments (or even with specific career track in some cases). Highly skilled work visa is designed to admit individuals with high human capital by requiring post-secondary education (or equivalent professional skills). These workers earn wages comparable to those of native workers by performing high-paying tasks at high-paying establishments.

By contrast, although unskilled work visa is designed to accept workers in the designated occupations or industries, in the absence of educational requirements and with severe mobility restrictions, in reality TITP and SSW visa attracts young workers with low human capital and allocate them to

establishments with strong demand for unskilled low-wage labor.[23] Student visa does impose educational requirements but no occupational restrictions; they appear flexible at first glance, yet limits on working hours and the location of schools effectively channel students into low-paying part-time jobs in the service industries that are outside of the designated industrial fields of TITP and SSW.

6 Concluding Remarks

Our results show that both employee and workplace characteristics differ substantially not only between native and foreign workers but also among foreign workers across visa categories in Japan, implying highly segmented labor markets. Yet, at the same time, we observe near complete wage convergence between observably equivalent native and foreign workers in equivalent career track and task assignment. Given that Japan's visa regime has been formed largely in response to labor shortages, we conjecture that this demand-driven policy has led to a high degree of wage convergence in a very narrow sense, but at the cost of substantial labor market segmentation. In other words, Japan's visa system likely plays a central role in shaping the observed patterns of economic (dis)integration. To promote economic and social integration of foreign workers in Japan, it is necessary to design systematic and coherent immigration policies that address not only the demand-side issues but also the long-run welfare of foreign workers.

[23] The tendency for workers under a regime with mobility restrictions to receive lower wages is consistent with Naidu and Yuchtman (2013) and Naidu et al.(2016).

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Appendix

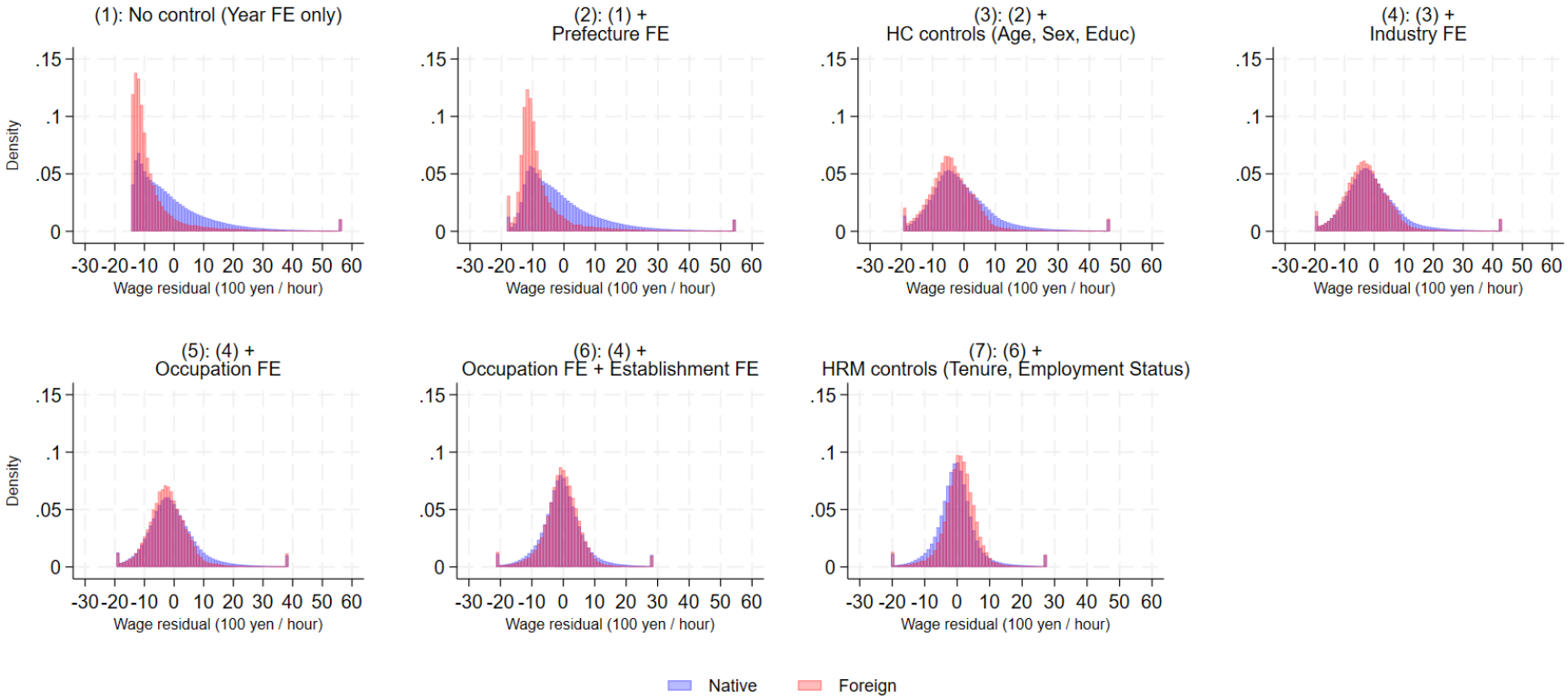


Figure A1: Distribution of Residuals for Foreign and Native Workers

Notes: In this figure, each panel displays the residuals induced by the regression analysis of Equation 1, where a set of controls is added sequentially, separately run for native and foreign workers. Top 1% and bottom 1% wage residuals are top- and bottom-coded, respectively.

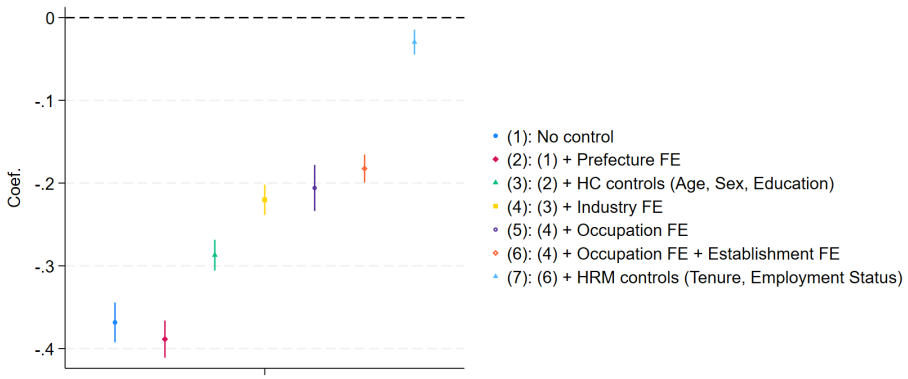


Figure A2: Foreign-Native Wage Gap using BSWS 2019

Source: The estimation results using the BSWS 2019 data reported in Table A4.

Notes: This figure shows the estimated foreign-native wage gap expressed in log points. The 95% confidence intervals are based on the standard errors clustered at the establishment level.

Table A1: Summary Statistics

Sample:	Native					Foreign (All)				
	N	Mean	Std.Dev	Min	Max	N	Mean	Std.Dev	Min	Max
Wage (unit = 100 yen / hour)	4,849,624	22.652	25.084	0.001	21,255.084	60,000	16.662	21.742	0.487	2,037.564
Female	4,910,779	0.432	0.495	0	1	61,009	0.470	0.499	0	1
Education (Junior high school grad.)	4,873,159	0.023	0.149	0	1	61,009	0.042	0.200	0	1
Education (High school grad.)	4,873,159	0.393	0.488	0	1	61,009	0.294	0.456	0	1
Education (Technical school grad.)	4,873,159	0.097	0.296	0	1	61,009	0.061	0.239	0	1
Education (2-yr college grad.)	4,873,159	0.085	0.279	0	1	61,009	0.025	0.155	0	1
Education (Univ. grad.)	4,873,159	0.266	0.442	0	1	61,009	0.181	0.385	0	1
Education (Master, Ph.D.)	4,873,159	0.032	0.177	0	1	61,009	0.063	0.242	0	1
Education (Unknown)	4,873,159	0.104	0.306	0	1	61,009	0.335	0.472	0	1
Age	4,910,779	42.515	12.845	15	65	61,009	32.727	10.675	15	65
Tenure	4,873,159	11.246	10.771	0	50	61,009	2.719	3.890	0	44
Part-time	4,873,159	0.211	0.408	0	1	61,009	0.212	0.408	0	1
Non-standard	4,873,159	0.313	0.464	0	1	61,009	0.558	0.497	0	1
Fixed-term	4,873,159	0.216	0.412	0	1	61,009	0.699	0.459	0	1

Sample:	Foreign (Residence-status)					Foreign (Highly skilled)					Foreign (Unskilled)					Foreign (Students)				
	N	Mean	Std.Dev	Min	Max	N	Mean	Std.Dev	Min	Max	N	Mean	Std.Dev	Min	Max	N	Mean	Std.Dev	Min	Max
Wage (unit = 100 yen / hour)	16,806	20.987	30.734	0.487	2,037.564	11,941	23.631	27.239	3.333	659.375	23,232	11.174	5.299	1.102	288.750	6,175	12.866	11.016	6.420	339.800
Female	17,154	0.554	0.497	0	1	12,121	0.373	0.484	0	1	23,339	0.440	0.496	0	1	6,486	0.554	0.497	0	1
Education (Junior high school grad.)	17,154	0.058	0.234	0	1	12,121	0.006	0.075	0	1	23,339	0.057	0.232	0	1	6,486	0.005	0.070	0	1
Education (High school grad.)	17,154	0.279	0.448	0	1	12,121	0.046	0.210	0	1	23,339	0.457	0.498	0	1	6,486	0.189	0.391	0	1
Education (Technical school grad.)	17,154	0.029	0.168	0	1	12,121	0.133	0.339	0	1	23,339	0.041	0.198	0	1	6,486	0.082	0.274	0	1
Education (2-yr college grad.)	17,154	0.015	0.122	0	1	12,121	0.038	0.191	0	1	23,339	0.027	0.163	0	1	6,486	0.015	0.123	0	1
Education (Univ. grad.)	17,154	0.183	0.387	0	1	12,121	0.498	0.500	0	1	23,339	0.043	0.202	0	1	6,486	0.108	0.311	0	1
Education (Master, Ph.D.)	17,154	0.077	0.267	0	1	12,121	0.180	0.384	0	1	23,339	0.001	0.036	0	1	6,486	0.042	0.201	0	1
Education (Unknown)	17,154	0.359	0.480	0	1	12,121	0.100	0.299	0	1	23,339	0.374	0.484	0	1	6,486	0.559	0.497	0	1
Age	17,154	43.401	11.120	15	65	12,121	32.633	7.706	18	65	23,339	26.973	5.704	18	61	6,486	26.290	6.320	16	65
Tenure	17,154	5.147	5.688	0	44	12,121	2.682	3.494	0	36	23,339	1.493	1.328	0	9	6,486	0.975	1.449	0	18
Part-time	17,154	0.276	0.447	0	1	12,121	0.085	0.279	0	1	23,339	0.011	0.106	0	1	6,486	0.995	0.073	0	1
Non-standard	17,154	0.630	0.483	0	1	12,121	0.254	0.435	0	1	23,339	0.542	0.498	0	1	6,486	0.993	0.082	0	1
Fixed-term	17,154	0.487	0.500	0	1	12,121	0.328	0.469	0	1	23,339	1.000	0.000	1	1	6,486	0.781	0.414	0	1

Source: The Pooled BSWS 2020-2023 data.

Table A2: Foreign-Native Wage Gap in Japan, 2020-2023

Dependent variable:	Total hourly wage (log)						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Foreign	-0.324***	-0.342***	-0.177***	-0.143***	-0.118***	-0.069***	0.012***
	(0.007)	(0.006)	(0.005)	(0.005)	(0.004)	(0.003)	(0.003)
Female			-0.341***	-0.312***	-0.270***	-0.224***	-0.147***
			(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Age			0.061***	0.056***	0.051***	0.051***	0.027***
			(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Age-sq/100			-0.064***	-0.057***	-0.054***	-0.053***	-0.028***
			(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Education (High school grad.)			0.110***	0.046***	0.025***	-0.005***	-0.011***
			(0.002)	(0.002)	(0.002)	(0.001)	(0.001)
Education (Technical school grad.)			0.174***	0.086***	0.032***	0.001	-0.001
			(0.003)	(0.002)	(0.002)	(0.001)	(0.001)
Education (2-yr college grad.)			0.242***	0.129***	0.065***	0.003**	-0.004***
			(0.003)	(0.002)	(0.002)	(0.002)	(0.001)
Education (Univ. grad.)			0.378***	0.233***	0.130***	0.057***	0.050***
			(0.003)	(0.002)	(0.002)	(0.001)	(0.001)
Education (Master, Ph.D.)			0.647***	0.413***	0.214***	0.073***	0.094***
			(0.005)	(0.004)	(0.004)	(0.002)	(0.002)
Education (Unknown)			-0.048***	-0.050***	-0.065***	-0.220***	-0.064***
			(0.003)	(0.003)	(0.003)	(0.003)	(0.002)
Tenure							0.021***
							(0.000)
Tenure-sq/100							-0.027***
							(0.000)
Part-time							-0.021***
							(0.001)
Non-standard							-0.262***
							(0.001)
Fixed-term							-0.046***
							(0.001)
Year FE	Y	Y	Y	Y	Y	Y	Y
Prefecture FE	N	Y	Y	Y	Y	-	-
Industry FE	N	N	N	Y	Y	-	-
Occupation FE	N	N	N	N	Y	Y	Y
Establishment FE	N	N	N	N	N	Y	Y
# of observations	4,909,624	4,909,624	4,873,045	4,873,045	4,812,626	4,812,245	4,812,245
# of establishments	170,603	170,603	170,601	170,601	169,678	169,297	169,297
Adj R-sq	0.005	0.050	0.365	0.465	0.540	0.697	0.775

Source: The Pooled BSWS 2020-2023 data.
Notes: This table displays the estimation results of Equation (1). Standard errors are clustered at the establishment level and reported in parentheses. For Education, the base group is junior high school graduates.
*** p<0.01, ** p<0.05, * p<0.1

Table A3: Foreign-Native Wage Gap in Japan using Hermansen et al. (2025)'s Specifications

Dependent variable:	Total hourly wage (log)							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Foreign	-0.324***	-0.177***	-0.143***	-0.148***	-0.067***	-0.064***	-0.057***	-0.081***
	(0.007)	(0.005)	(0.005)	(0.004)	(0.003)	(0.003)	(0.003)	(0.003)
Female		-0.341***	-0.312***	-0.291***	-0.271***	-0.203***	-0.169***	-0.172***
		(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Age		0.061***	0.056***	0.052***	0.056***	0.050***	0.040***	0.048***
		(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Age-sq/100		-0.064***	-0.057***	-0.055***	-0.056***	-0.051***	-0.047***	-0.048***
		(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Education (High school grad.)		0.110***	0.046***	0.042***	0.002*	-0.007***	0.004***	-0.012***
		(0.002)	(0.002)	(0.002)	(0.001)	(0.001)	(0.001)	(0.001)
Education (Technical school grad.)		0.174***	0.086***	0.042***	0.032***	-0.004***	0.023***	-0.014***
		(0.003)	(0.002)	(0.002)	(0.002)	(0.001)	(0.001)	(0.001)
Education (2-yr college grad.)		0.242***	0.129***	0.090***	0.033***	-0.004**	0.020***	-0.011***
		(0.003)	(0.002)	(0.002)	(0.002)	(0.002)	(0.001)	(0.001)
Education (Univ. grad.)		0.378***	0.233***	0.157***	0.119***	0.041***	0.083***	0.025***
		(0.003)	(0.002)	(0.002)	(0.002)	(0.001)	(0.001)	(0.001)
Education (Master, Ph.D.)		0.647***	0.413***	0.266***	0.224***	0.049***	0.128***	0.035***
		(0.005)	(0.004)	(0.004)	(0.004)	(0.002)	(0.002)	(0.002)
Education (Unknown)		-0.048***	-0.050***	-0.051***	-0.234***	-0.226***	-0.145***	-0.171***
		(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.002)	(0.003)
Tenure							0.015***	
							(0.000)	
Part-time								-0.243***
								(0.001)
Year FE	Y	Y	Y	Y	Y	Y	Y	Y
Prefecture FE	N	Y	Y	Y	-	-	-	-
Industry FE	N	N	Y	N	-	-	-	-
Occupation FE	N	N	N	Y	N	-	-	-
Establishment FE	N	N	N	N	Y	-	-	-
Occupation × Establishment FE	N	N	N	N	N	Y	Y	Y
# of observations	4,909,624	4,873,045	4,873,045	4,812,626	4,872,759	4,630,897	4,630,897	4,630,897
# of establishments	170,603	170,601	170,601	169,678	170,315	168,815	168,815	168,815
Adj R-sq	0.005	0.365	0.465	0.502	0.639	0.735	0.773	0.749

Source: The Pooled BSWS 2020-2023 data.
Notes: This table displays the estimation results based on Hermansen et al. (2025)'s specifications. Standard errors are clustered at the establishment level and reported in parentheses. For Education, the base group is junior high school graduates.
*** p<0.01, ** p<0.05, * p<0.1

Table A4: Foreign-Native Wage Gap in Japan, 2019

Dependent variable:	Total hourly wage (log)						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Foreign	-0.368***	-0.389***	-0.287***	-0.220***	-0.206***	-0.182***	-0.030***
	(0.012)	(0.011)	(0.010)	(0.009)	(0.014)	(0.009)	(0.008)
Female			-0.272***	-0.274***	-0.168***	-0.138***	-0.116***
			(0.002)	(0.002)	(0.002)	(0.001)	(0.001)
Age			0.075***	0.074***	0.048***	0.047***	0.028***
			(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Age-sq/100			-0.077***	-0.076***	-0.048***	-0.046***	-0.027***
			(0.000)	(0.000)	(0.001)	(0.000)	(0.000)
Education (High school grad.)			0.154***	0.091***	0.037***	0.014***	0.011***
			(0.005)	(0.004)	(0.004)	(0.003)	(0.003)
Education (Technical school or 2-yr college grad.)			0.279***	0.170***	0.068***	0.030***	0.024***
			(0.005)	(0.004)	(0.004)	(0.003)	(0.003)
Education (Univ. grad. +)			0.470***	0.300***	0.141***	0.065***	0.072***
			(0.005)	(0.004)	(0.004)	(0.003)	(0.003)
Tenure							0.019***
							(0.000)
Tenure-sq/100							-0.029***
							(0.001)
Non-standard							-0.227***
							(0.004)
Fixed-term							-0.077***
							(0.004)
Prefecture FE	N	Y	Y	Y	Y	-	-
Industry FE	N	N	N	Y	Y	-	-
Occupation FE	N	N	N	N	Y	Y	Y
Establishment FE	N	N	N	N	N	Y	Y
# of observations	1,187,363	1,187,363	926,990	926,990	414,391	410,569	410,569
# of establishments	53,823	53,823	52,793	52,793	40,370	36,548	36,548
Adj R-sq	0.005	0.057	0.354	0.489	0.703	0.834	0.868

Source: The BSWS 2019 data.
Notes: This table displays the estimation results based on the specification Equation (1) except for year fixed effects. Standard errors are clustered at the establishment level and reported in parentheses. For Education, the base group is junior high school graduates.
*** p<0.01, ** p<0.05, * p<0.1

Table A5: Summary Statistics of Wages & Residuals

Statistics:	N	Mean	Variance	Skewness	Kurtosis
	(1)	(2)	(3)	(4)	(5)
Control:	**Panel A** **(1): No control (Year FE only)**				
Native	4,849,624	0.073	629.017	258.605	196,165.529
Foreign	60,000	-5.915	472.928	27.687	1,797.838
p-value of native-foreign difference		0.000	0.664	0.920	0.526
Control:	**Panel B** **(2): (1) + Prefecture FE**				
Native	4,849,624	0.079	619.315	264.296	202,011.292
Foreign	60,000	-6.352	453.134	29.098	1,950.645
p-value of native-foreign difference		0.000	0.732	0.904	0.686
Control:	**Panel C** **(3): (2) + HC controls (Age, Sex, Educ-)**				
Native	4,813,045	0.030	552.985	314.511	255,024.931
Foreign	60,000	-2.376	412.870	31.495	2,224.970
p-value of native-foreign difference		0.000	0.526	0.984	0.230
Control:	**Panel D** **(4): (3) + Industry FE**				
Native	4,813,045	0.016	533.955	330.163	272,198.155
Foreign	60,000	-1.304	398.253	32.763	2,384.006
p-value of native-foreign difference		0.000	0.514	0.932	0.160
Control:	**Panel E** **(5): (4) + Occupation FE**				
Native	4,752,796	0.011	510.512	353.368	296,866.909
Foreign	59,830	-0.898	377.934	34.694	2,586.627
p-value of native-foreign difference		0.000	0.506	0.848	0.060
Control:	**Panel F** **(6): (4) + Occupation FE + Establishment FE**				
Native	4,752,419	-0.000	439.886	425.544	389,949.786
Foreign	59,826	0.019	282.738	42.646	3,889.436
p-value of native-foreign difference		0.652	0.572	0.892	0.846
Control:	**Panel G** **(7): (6) + Task controls (Tenure, Emp- Status)**				
Native	4,752,419	-0.015	430.633	439.197	406,722.366
Foreign	59,826	1.208	278.526	43.656	4,011.761
p-value of native-foreign difference		0.000	0.552	0.926	0.638

Notes: This table displays the summary statistics corresponding to Figure A1. Mean, variance, skewness, and kurtosis are based on non-coded wage and residual distributions. The p-values to test the difference of moment statistics between native and foreign subsamples are calculated in the following steps: (1) Randomly permute the combinations of the wage-nationality pairs (residual-nationality pairs, respectively) in Panel A (in Panels B–G, respectively), keeping native and foreign populations identical with those in the observed data. (2) Calculate the statistics based on the randomly permuted data. (3) Repeat (1) and (2) 1,000 times. (4) Obtain the p-value for the two-sided test, $p_{\text{two-sided}} = 2 * \min(p_{\text{lower}}, p_{\text{upper}})$, where $p_{\text{lower}} =$ #{Native-foreign difference of the statistic calculated based on the randomly permuted data $\leq$ Native-foreign difference of the statistic calculated based on the observed data}/1,000, and $p_{\text{upper}} =$ #{Native-foreign difference of the statistic calculated based on the randomly permuted data $\geq$ Native-foreign difference of the statistic calculated based on the observed data}/1,000.

Table A6: Foreign-Native Wage Gap in Japan by Visa Category

Dependent variable:	Tot. wage incl. bonus (log)						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Foreign (Residence-status)	-0.127***	-0.168***	-0.100***	-0.054***	-0.032***	-0.017***	0.040***
	(0.012)	(0.011)	(0.008)	(0.008)	(0.008)	(0.004)	(0.004)
Foreign (Highly skilled)	0.000	-0.052***	-0.144***	-0.107***	-0.096***	-0.061***	-0.020***
	(0.014)	(0.013)	(0.011)	(0.009)	(0.009)	(0.005)	(0.005)
Foreign (Unskilled)	-0.582***	-0.557***	-0.249***	-0.244***	-0.217***	-0.126***	-0.011**
	(0.004)	(0.004)	(0.005)	(0.006)	(0.005)	(0.005)	(0.004)
Foreign (Students)	-0.483***	-0.537***	-0.172***	-0.066***	-0.032***	0.010	0.094***
	(0.009)	(0.009)	(0.011)	(0.011)	(0.011)	(0.009)	(0.008)
Female			-0.341***	-0.312***	-0.270***	-0.224***	-0.147***
			(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Age			0.061***	0.055***	0.051***	0.051***	0.027***
			(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Age-sq/100			-0.064***	-0.057***	-0.054***	-0.053***	-0.028***
			(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Education (High school grad.)			0.110***	0.046***	0.025***	-0.005***	-0.011***
			(0.002)	(0.002)	(0.002)	(0.001)	(0.001)
Education (Technical school grad.)			0.174***	0.086***	0.032***	0.001	-0.001
			(0.003)	(0.002)	(0.002)	(0.001)	(0.001)
Education (2-yr college grad.)			0.242***	0.129***	0.065***	0.003**	-0.004***
			(0.003)	(0.002)	(0.002)	(0.002)	(0.001)
Education (Univ. grad.)			0.378***	0.233***	0.129***	0.057***	0.050***
			(0.003)	(0.002)	(0.002)	(0.001)	(0.001)
Education (Master, Ph.D.)			0.646***	0.412***	0.214***	0.073***	0.094***
			(0.005)	(0.004)	(0.004)	(0.002)	(0.002)
Education (Unknown)			-0.048***	-0.049***	-0.064***	-0.219***	-0.064***
			(0.003)	(0.003)	(0.003)	(0.003)	(0.002)
Tenure							0.021***
							(0.000)
Tenure-sq/100							-0.027***
							(0.000)
Part-time							-0.021***
							(0.001)
Non-standard							-0.262***
							(0.001)
Fixed-term							-0.045***
							(0.001)
Year FE	Y	Y	Y	Y	Y	Y	Y
Prefecture FE	N	Y	Y	Y	Y	-	-
Industry FE	N	N	N	Y	Y	-	-
Occupation FE	N	N	N	N	Y	Y	Y
Establishment FE	N	N	N	N	N	Y	Y
# of observations	4907778	4907778	4871199	4871199	4810780	4810399	4810399
# of establishments	170,603	170,603	170,601	170,601	169,678	169,297	169,297
Adj R-sq	0.007	0.052	0.365	0.465	0.540	0.697	0.775

Notes: This table displays the estimation results based on the specification Eq. (2). Standard errors clustered at the establishment level are in parentheses. Education base group is junior high school graduates.
*** p<0.01, ** p<0.05, * p<0.1

Table A7: Foreign-Native Wage Gap by Visa Category using Hermansen et al. (2025)'s Specifications

Dependent variable:	Tot. wage incl. bonus (log)							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Foreign (Residence-status)	-0.127***	-0.100***	-0.054***	-0.077***	-0.014***	-0.022***	0.007*	-0.025***
	(0.012)	(0.008)	(0.008)	(0.008)	(0.005)	(0.004)	(0.004)	(0.004)
Foreign (Highly skilled)	0.000	-0.144***	-0.107***	-0.117***	-0.065***	-0.059***	-0.042***	-0.079***
	(0.014)	(0.011)	(0.009)	(0.010)	(0.005)	(0.005)	(0.005)	(0.005)
Foreign (Unskilled)	-0.582***	-0.249***	-0.244***	-0.238***	-0.117***	-0.116***	-0.119***	-0.164***
	(0.004)	(0.005)	(0.006)	(0.005)	(0.005)	(0.005)	(0.004)	(0.005)
Foreign (Students)	-0.483***	-0.172***	-0.066***	-0.071***	-0.002	0.022***	-0.003	0.102***
	(0.009)	(0.011)	(0.011)	(0.010)	(0.010)	(0.008)	(0.007)	(0.008)
Female		-0.341***	-0.312***	-0.291***	-0.271***	-0.203***	-0.169***	-0.172***
		(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Age		0.061***	0.055***	0.052***	0.055***	0.050***	0.040***	0.048***
		(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Age-sq/100		-0.064***	-0.057***	-0.055***	-0.056***	-0.051***	-0.047***	-0.048***
		(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Education (High school grad.)		0.110***	0.046***	0.042***	0.002*	-0.007***	0.004***	-0.012***
		(0.002)	(0.002)	(0.002)	(0.001)	(0.001)	(0.001)	(0.001)
Education (Technical school grad.)		0.174***	0.086***	0.042***	0.032***	-0.004***	0.023***	-0.015***
		(0.003)	(0.002)	(0.002)	(0.002)	(0.001)	(0.001)	(0.001)
Education (2-yr college grad.)		0.242***	0.129***	0.090***	0.033***	-0.003**	0.020***	-0.011***
		(0.003)	(0.002)	(0.002)	(0.002)	(0.002)	(0.001)	(0.001)
Education (Univ. grad.)		0.378***	0.233***	0.156***	0.119***	0.041***	0.083***	0.025***
		(0.003)	(0.002)	(0.002)	(0.002)	(0.001)	(0.001)	(0.001)
Education (Master, Ph.D.)		0.646***	0.412***	0.265***	0.224***	0.048***	0.128***	0.035***
		(0.005)	(0.004)	(0.004)	(0.004)	(0.002)	(0.002)	(0.002)
Education (Unknown)		-0.048***	-0.049***	-0.051***	-0.234***	-0.226***	-0.143***	-0.170***
		(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
Tenure							0.015***	
							(0.000)	
Part-time								-0.245***
								(0.001)
Year FE	Y	Y	Y	Y	Y	Y	Y	Y
Prefecture FE	N	Y	Y	Y	-	-	-	-
Industry FE	N	N	Y	N	-	-	-	-
Occupation FE	N	N	N	Y	N	-	-	-
Establishment FE	N	N	N	N	Y	-	-	-
Occupation × Establishment FE	N	N	N	N	N	Y	Y	Y
# of observations	4,907,778	4,871,199	4,871,199	4,810,780	4,870,913	4,629,049	4,629,049	4,629,049
# of establishments	170,603	170,601	170,601	169,678	170,315	168,813	168,813	168,813
Adj R-sq	0.007	0.365	0.465	0.502	0.639	0.735	0.773	0.749

Notes: This table displays the estimation results based on the specification Eq. (2) but modified to Hermansen et al.'s (2025) specification. Standard errors clustered at the establishment level are in parentheses. Education base group is junior high school graduates.
*** p<0.01, ** p<0.05, * p<0.1