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低技能外国人労働者の流入が日本人労働者の賃金・職務・ウェルビーイングに及ぼす影響

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【要旨】

本研究では、日本における低技能外国人労働者の受け入れが、日本人労働者の賃金、職務内容、主観的ウェルビーイングに及ぼす影響を検証する。2019 年の特定技能制度の導入と新型コロナウイルス感染症の流行によって生じた時期的・地域的な変動を準自然実験として利用し、2019～2024 年の日本家計パネル調査（JHPS）を用いて、Bartik 型操作変数法による分析を行う。 分析の結果、外国人労働者の受け入れが日本人労働者の平均賃金に与える影響はほぼゼロである一方、賃金分布の中位層、特に第 40 パーセンタイル付近と第 60 パーセンタイル台半ばでは、小幅ながらプラスの効果が確認された。また、一部の労働者層では定型的な業務が減少しており、外国人労働者の受け入れに伴って職務の再配分が生じている可能性が示された。これらの結果は、外国人労働者との生産上の補完関係や、日本人労働者の職務の高度化によって、低技能労働者の賃金への下押し圧力が緩和されるという理論的枠組みと整合的である。 一方、仕事に関するウェルビーイングへの影響は全体として限定的であったものの、生活満足度には小幅なマイナスの影響がみられ、特に非正規雇用者や低賃金労働者で悪化が目立った。こうした結果は、雇用不安や職場環境の変化への適応負担、地域の生活環境への影響など、賃金以外の経路を通じた負担が生じている可能性を示唆する。 以上より、低技能外国人労働者の受け入れは、日本人労働者の賃金を全体として引き下げるものではなく、一部では賃金上昇や職務の変化をもたらす一方、ウェルビーイングへの影響は労働者の属性によって異なることが明らかになった。本研究は、低技能労働力の不足に直面する国々の外国人労働者政策に示唆を与えるものである。

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Impact of low-skilled foreign workers on wages, tasks, and well-being of native workers in Japan

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Abstract: This paper examines how low-skilled foreign workers affect native workers' wages, job tasks, and subjective well-being in Japan. We exploit temporal and regional variations generated by the 2019 Specified Skilled Worker program and the COVID-19 shock, which provide a quasi-natural experiment. Using individual-level panel data from the Japan Household Panel Survey (2019–2024) and a Bartik-type instrumental variable strategy, we find that average wage effects are close to zero. Modest positive impacts are observed around the middle of the wage distribution, most notably near the 40th percentile and the mid-60s percentiles, with small and imprecise effects at the tails. Subgroup analyses reveal similar patterns across employment, skill, and task profiles. Routine task content declines in the total sample and several subgroups, providing suggestive evidence of task reallocation. A nested CES framework with immigration-related improvements in native productivity interprets the wage and task patterns through production complementarity and task upgrading, which can offset wage pressure on native low-skilled workers. Work-related well-being shows minimal overall effects, while life satisfaction records a modest negative effect, with adverse outcomes concentrated among non-regular and low-wage workers and additional heterogeneity by task profiles and skills. Declining well-being among specific groups suggests non-pecuniary impacts, including perceived job insecurity, workplace adjustment costs, and local congestion/amenity pressures. Overall, we find no evidence of broad wage losses for native Japanese workers; the estimates instead suggest gains at some middle-wage quantiles and uneven non-pecuniary costs across worker groups. These findings are relevant to economies with persistent shortages of low-skilled labor.

Keywords: low-skilled foreign workers, wages, task upgrades, well-being, cognitive skills, non-cognitive skills.

Classification codes: JEL J31, J61, C26, J24, I31

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1. Introduction

Does the inflow of low-skilled foreign workers harm native workers by intensifying labor-market competition, or can it benefit them by alleviating labor shortages and enabling task reallocation? This question is particularly important in aging economies, where labor shortages are concentrated in manual, care, construction, and service occupations.[1] Japan provides a useful setting for answering this question because the introduction of the Specified Skilled Worker (SSW) program in April 2019 under the revised Immigration Control and Refugee Recognition Act generated a policy-driven expansion of low-skilled foreign labor in shortage sectors.

Japan has long been reluctant to admit foreign nationals as "workers" in low- and medium-skilled jobs, relying instead on highly skilled visas and quasi-labor schemes, such as the Technical Intern Training Program (TITP).[2] Against this background, the introduction of the SSW program marked a major shift in Japan's immigration regime. Despite the "specified skilled" terminology, the SSW scheme is intended for workers in low-skilled, predominantly manual jobs that do not require tertiary education.[3] It covers sectors with acute labor shortages, such as care work, agriculture, construction, food manufacturing, and accommodation, and sets sector-specific intake targets to alleviate shortages in blue-collar and service occupations (see Appendix A1).

Because the reform coincided with the COVID-19 pandemic, SSW inflows were initially limited. As shown in Figure A1, by the end of 2019, only 1,621 foreign nationals had SSW status, and strict border controls kept inflows low throughout 2020 and into early 2021. However, the number of SSW workers increased dramatically once border restrictions were lifted. By the end of 2021, 49,666 SSW Type 1 residents were recorded in Japan,[4] and by December 2022, the number had risen to nearly 130,000—an increase of roughly 80-fold in three years.[5] Combined with the pre-existing TITP, the SSW program has led to a significant, policy-driven expansion of low-skilled foreign labor in Japan since 2019. This pattern creates a quasi-natural experiment in which regions and sectors differ markedly in their exposure to a sudden increase in low-skilled foreign workers.

This paper exploits this setting to examine how the inflow of low-skilled foreign workers affects native workers in Japan. We study both pecuniary outcomes, measured by wages, and non-pecuniary outcomes, captured by subjective well-being (SWB) measures such as job satisfaction, work engagement, life satisfaction, and subjective health. We also examine whether these effects differ across the wage distribution and across workers with different employment

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[1] According to *Annual Report on Job Placement Service Statistics* (Ministry of Health, Labour and Welfare (MHLW), while the national average job-openings-to-applicants ratio was 1.55, it increased to 4.5 for construction workers and 4.8 for nursing and care service occupations, and more than 15 for low-wage care worker positions in the pre-COVID year 2019.

[2] In this paper, "immigration" and "foreign workers" refer to non-citizen residents employed in Japan under statuses of residence that permit work (including SSW and TITP), rather than to naturalized citizens.

[3] Therefore, we treat SSW entrants as part of a low-skilled immigration program.

[4] "SSW Type 1" refers to the first category of the SSW status, which allows foreign nationals with occupation-specific skills and basic Japanese-language proficiency to work in designated shortage sectors (such as care, construction, agriculture, and food services) for up to five years. In practice, it primarily targets low-skilled manual jobs.

[5] SSW stock and total foreign workers are based on Statistics on *Foreign Residents* (Immigration Services Agency) and *Summary of the Status of Foreign Workers in Japan* (MHLW).

status, skill profiles, and task profiles.

Empirically, we exploit this policy-induced variation across regions to estimate the average impact of low-skilled foreign-worker inflows on native workers' wages and well-being and to examine which groups gain or lose in Japan. We interpret these potentially heterogeneous effects using a nested constant elasticity of substitution (CES) framework that retains three skill groups and allows foreign-worker inflows to improve native low-skilled productivity through task reallocation. Foreign workers may undertake routine activities, allowing native workers to spend more time on customer interaction, explanation, and workplace coordination. An increase in effective low-skilled input raises the marginal products of complementary middle- and high-skilled labor. For native low-skilled workers, the productivity gain can offset the decline in the marginal product caused by the expansion of effective labor supply. Native labor endowments remain fixed, and scarcity is reflected in equilibrium marginal products. Wage effects arise from these production-side adjustments. In terms of well-being, a simple utility block allows income-related gains to coexist with non-pecuniary benefits and costs arising from working conditions and local amenities. These mechanisms provide a common framework for interpreting heterogeneous wage, task, and well-being outcomes.

The literature provides important but mixed insights into this question. Meta-analyses, such as Longhi et al. (2005) and Aubry et al. (2022), conclude that average wage effects are generally small and often statistically insignificant after accounting for publication bias and differences in identification strategies. At the same time, individual studies reveal substantial heterogeneity. Card (2001) found little evidence of wage losses in U.S. cities, whereas Borjas (2003) reported more negative effects for low-skilled natives using national education–experience cells. Task-based studies, including Peri and Sparber (2009) and Ottaviano and Peri (2012), further suggested that low-skilled immigrants may specialize in manual tasks, allowing natives to move into more complex or communication-intensive work. Distributional and dynamic studies, such as Dustmann et al. (2013), Foged and Peri (2016), and Price et al. (2020), also showed that immigration may slightly depress wages at the bottom and raise wages at the top, as well as induce occupational upgrading or geographic mobility for many native workers. Overall, the evidence suggests that average wage effects are small, with gains and losses unevenly distributed across skill groups, occupations, and positions in the wage distribution.

A parallel literature studies immigration and native workers' well-being. Akay et al. (2014) found small positive effects on life satisfaction in Germany, while Betz and Simpson (2013) and O'Connor (2020) reported only modest effects on natives' happiness and life satisfaction in Europe. Other studies documented heterogeneous outcomes, with some finding that ethnic or cultural diversity is positively associated with well-being once local conditions are accounted for, whereas others reported negative effects for subgroups who feel economically or culturally threatened. Immigration may ease care burdens or expand services, but it may also worsen outcomes in high-exposure or economically vulnerable regions. Overall, like the wage evidence, the well-being literature suggests small average effects but potentially sizable impacts for specific groups depending on local economic and institutional conditions.

Despite this rich literature, several gaps remain. First, relatively few studies exploit clearly defined, policy-induced inflows of low-skilled foreign workers, rather than broad immigration flows or gradual demographic changes. This makes it difficult to isolate causal

effects from underlying labor-market trends and regional selection. Second, although task-based research emphasizes specialization and upgrading, direct empirical evidence on whether inflows of low-skilled foreign workers induce task upgrading among native workers remains limited, particularly in labor-shortage economies. Third, the literature remains heavily focused on wages, and joint evidence on pecuniary and non-pecuniary outcomes remains limited. We still lack systematic evidence on whether wage impacts are offset or amplified by changes in well-being outcomes, such as job satisfaction, and on the relative magnitudes of economic versus psychological effects. Fourth, evidence from Japan is scarce: existing studies, such as Nakamura (2010) and Sasahara et al. (2023), mainly examine wages in earlier periods or aggregate immigration flows, and no study has jointly analyzed wages, task content, and subjective well-being in response to recent low-skilled migration channels such as SSW and TITP.

This paper makes four contributions corresponding to these gaps. First, it provides causal evidence on the recent, policy-induced expansion of low-skilled foreign labor in Japan by exploiting the introduction of the SSW program and the subsequent COVID-19 shock, showing that this expansion did not generate broad wage losses for native workers. Second, it contributes to the literature on task specialization and distributional wage effects by providing suggestive evidence of task upgrading among native workers, together with the modest wage gains around the middle of the wage distribution. These findings are qualitatively consistent with production complementarity and task reallocation: additional low-skilled foreign labor may allow some native workers to concentrate on customer interaction, explanation, and coordination, improving their productive contribution. Third, it shows that the welfare consequences of foreign-worker inflows cannot be inferred from wages alone: muted wage effects can coexist with non-pecuniary costs, with adverse well-being responses concentrated among vulnerable groups, especially non-regular and low-wage workers. Fourth, by focusing on Japan's SSW/TITP expansion, the paper highlights the importance of institutional context in an aging economy with persistent labor shortages. These findings also point to the importance of workplace policies that facilitate task reallocation and distribute communication and adjustment burdens fairly among native workers.

To support these findings, we use the Japan Household Panel Survey (JHPS), which provides information on native workers' wages, job tasks, skills, and subjective well-being. We combine these data with prefecture-level measures of SSW/TITP exposure and estimate individual fixed-effects models to control for time-invariant unobserved heterogeneity and use a Bartik-type instrument that combines nationality-specific settlement shares across prefectures in 2019 with the corresponding national stocks in each year, using foreign residents holding work-related residence statuses, including but not limited to SSW to address endogeneity. To capture distributional heterogeneity, we implement unconditional quantile regressions and examine how the estimated effects vary across the wage distribution, task and skill profiles, and other individual characteristics.

The rest of the paper is organized as follows. Section 2 reviews the related literature on immigration, wages, and well-being, with particular attention to studies of low- and medium-skilled migration and to the emerging evidence from Japan. Section 3 presents the theoretical framework linking low-skilled immigration to wages through production complementarity and task upgrading, together with non-pecuniary channels shaping well-being. Section 4 describes the institutional background, data, and empirical strategy, including the construction of our Bartik

instruments and the unconditional quantile IV estimators. Section 5 provides the main findings and robustness checks. Section 6 provides conclusions and implications for Japan's immigration and labor market policies.

2. Literature Review

A large and rapidly growing literature examines how immigration affects host-country labor markets and the well-being of native workers. In this section, we first review studies on wages, focusing on average effects, mechanisms, and distributional heterogeneity, as well as the limited evidence available for Japan. We then turn to immigration and well-being, summarizing average effects and heterogeneous responses in subjective well-being, mental health, and health.

2.1 Immigration and Wages: Average Effects

Meta-analyses provide the broadest picture of how immigration affects native wages. Longhi et al. (2005) pooled results from numerous studies and showed that, once publication bias and methodological heterogeneity are accounted for, the average wage effect of immigration is small and often statistically insignificant. Using a more recent and comprehensive sample, Aubry et al. (2022) confirmed that estimated wage elasticities are widely dispersed but centered near zero; large negative impacts are rare and tend to arise from specifications that use narrow national skill-experience cells and strong substitutability assumptions.

While individual-level empirical results are mixed, they generally show consistently small average effects. Using U.S. city-level data, Card (2001) found little evidence that metropolitan areas receiving large immigrant inflows experience systematically lower wages or employment rates among natives. In contrast, Borjas (2003), aggregating workers into national education–experience cells, reported more negative effects for low-skilled natives. These differences underscore that estimated average effects vary by how labor markets are defined and the underlying identification strategy, a theme echoed in the meta-analytic evidence.

2.2 Immigration and Wages: Mechanisms and Heterogeneity

A second strand of work highlights mechanisms and distributional heterogeneity. Task-based and skill complementarity models show that immigrants and natives may specialize in different tasks rather than competing as homogeneous labor. Peri and Sparber (2009) documented that in the United States, low-skilled immigrants concentrate on manual and routine tasks, allowing natives to upgrade into more communication-intensive and complex activities; Ottaviano and Peri (2012) found that immigrants and native workers are imperfect substitutes even within education groups and that immigration can raise native wages in complementary occupations. For the United Kingdom, Dustmann et al. (2013) found that immigration slightly depresses wages at the bottom of the distribution while raising them at the top, with little effect near the median—indicating strongly heterogeneous impacts across the wage distribution.

Dynamic studies using longitudinal data further emphasize adjustment margins. Using Danish administrative records, Foged and Peri (2016) documented that low-skilled natives exposed to immigration upgrade to more complex, higher-wage jobs over time and experience

long-run wage gains. Drawing on historical U.S. data, Price et al. (2020) found that immigration triggers native out-migration; stayers in high-immigration areas tend to gain, while movers lose, with younger and low-skilled workers more likely to be displaced. Overall, the literature suggests that low-skilled immigration can raise the wages of middle-skilled natives whose tasks are complementary to manual labor. At the same time, any adverse effects are concentrated among specific low-wage subgroups and over short time horizons.

2.3 Immigration and Well-Being: Average Effects

A parallel literature examines the impact of immigration on natives' subjective well-being. Using the German Socio-Economic Panel, Akay et al. (2014) showed that increases in regional immigrant shares are associated with small but positive changes in natives' life satisfaction, and that labor market channels cannot fully account for these effects. Using the European Social Survey across 26 countries, Betz and Simpson (2013) found that immigration has at most modest effects on the happiness of native populations; only very large migrant inflows significantly affect average well-being. Using EU panel data, O'Connor (2020) similarly reported that immigration has little effect on average life satisfaction once individual fixed-effects and macroeconomic conditions are controlled for. Giovanis (2022) and the OECD (2023) reached comparable conclusions for Germany, Switzerland, the UK, and broader OECD samples: average well-being effects tend to be small and sometimes slightly positive, especially when immigrants help ease labor shortages or expand local services.

2.4 Immigration and Well-Being: Heterogeneity and Health Channels

At the same time, the literature on well-being reveals pronounced heterogeneity. Akay et al. (2017) found that in Germany, ethnic diversity is positively associated with life satisfaction once fixed-effects and local conditions are accounted for, suggesting that cultural and social interactions can enhance well-being for many natives. Conversely, Longhi (2014) for the UK and Kuroki (2018) for the U.S. show that local diversity is associated with lower subjective well-being for some majority-native groups, particularly in cases of intense perceived cultural threat or residential segregation. Ivlevs and Veliziotis (2018) documented that the effect of local immigration in England and Wales on life satisfaction, depending on socio-economic status and local labor market conditions. Howley et al. (2018) and related work showed that negative well-being responses to immigration in the UK are concentrated among natives who are unemployed, economically insecure, or who place a high value on national identity.

A related line of research studies health and mental health outcomes. Giuntella and Mazzonna (2015), using German panel data, found that immigration improves natives' health, particularly among low-educated workers in blue-collar occupations, partly through improvements in working conditions and workloads. Escarce and Rocco (2019) reported that higher immigrant shares are associated with lower depression scores among older natives in several European countries. In contrast, Akyol and Yılmaz (2022) showed that the sudden inflow of Syrian refugees into Turkey worsened some self-reported health outcomes among natives in high-exposure regions. At the same time, Akdede and Giovanis (2022) observed nuanced effects of migration on the well-being of elderly natives and migrants in Europe. Research on asylum seekers and large refugee inflows, such as Bharadwaj et al. (2026) and Bazzoli et al. (2023),

generally found limited average effects on host-country mental health while also highlighting significant heterogeneity across regions, exposure types, and population groups.

2.5 Evidence from Japan

Empirical evidence on immigration's effects on wages and well-being in Japan remains limited, compared with research in North America and Europe. Regarding wages, Nakamura (2010) found that foreign worker inflows have historically had small, sometimes positive, effects on native wages, especially in regions with severe labor shortages. Sasahara et al. (2023) reported modest average wage effects overall. Recent studies have begun to explore more specific dimensions of these effects. For instance, Kitao and Yamada (2021) examined the macroeconomic and fiscal impacts of foreign worker inflows, while Lu (2022) identified heterogeneous wage effects across different sex and age groups. Additionally, Roberts and Fujita (2024) provided qualitative insights into the institutional challenges and stakeholder perspectives within low-skilled migrant schemes like the Technical Intern Training Program (TITP) and Specified Skilled Worker (SSW). To our knowledge, however, these various dimensions have not yet been integrated into a unified empirical framework that jointly examines pecuniary and non-pecuniary outcomes, particularly in the context of recent policy-driven expansions of low-skilled labor.

3. Theoretical Framework

We develop a nested constant elasticity of substitution (CES) framework to examine how inflows of low-skilled foreign workers affect native workers' wages. The framework distinguishes high-, middle-, and low-skilled labor and draws on standard skill-complementarity models (Krusell et al., 2000; Borjas, 2003; Acemoglu and Autor, 2011). Following the task-specialization insights of Peri and Sparber (2009) and Foged and Peri (2016), we allow foreign inflows to improve the effective productivity of native low-skilled workers through task reallocation. Foreign workers may take over routine activities, enabling native workers to concentrate on customer interaction and workplace coordination, in which Japanese-language proficiency provides a comparative advantage.

The model distinguishes two effects on native low-skilled wages. An increase in effective low-skilled labor supply reduces its marginal product, whereas task upgrading increases the productive contribution of each native worker. Native low-skilled wages depend on the balance between these effects. Middle- and high-skilled workers can benefit from the expansion of complementary low-skilled input.

3.1 Production and Effective Labor Inputs

A competitive economy produces a single final good using high-skilled labor H, middle-skilled labor M, and effective low-skilled labor L. Production follows a nested CES structure, with final output given by equation (1) and the composite input defined in equation (2).

$$Y = B\left[\alpha X^{\frac{\sigma-1}{\sigma}} + (1-\alpha)H^{\frac{\sigma-1}{\sigma}}\right]^{\frac{\sigma}{\sigma-1}} \tag{1}$$

$$X = \left[\beta M^{\frac{\rho-1}{\rho}} + (1-\beta)L^{\frac{\rho-1}{\rho}}\right]^{\frac{\rho}{\rho-1}} \tag{2}$$

In equations (1) and (2), $B > 0$ denotes aggregate productivity, and $0 < \alpha, \beta < 1$ are distribution parameters. We assume $0 < \rho < 1 < \sigma$, so the lower nest is more complementary than the upper nest.

The lower-nest elasticity $\rho < 1$ captures strong complementarity between middle- and low-skilled labor. For example, an expansion of on-site routine work can increase the productive contribution of workers responsible for technical support, equipment operation, and other intermediate activities. The upper-nest elasticity $\sigma > 1$ allows greater substitution between high-skilled labor and the composite input X. These are production categories; they need not correspond directly to observed wage quantiles or education groups. Effective low-skilled labor combines native low-skilled labor N_L and foreign low-skilled labor F according to $L = A(F)N_L + \theta F,\ A(F) > 0,\ 0 < \theta \leq 1$.

The parameter θ represents the effective labor services supplied by a foreign worker relative to a reference native worker whose productivity is normalized to one. Japanese-language limitations may reduce the range of activities that recently arrived foreign workers can perform independently[6]. Even in predominantly manual jobs, workers may need to understand instructions, explain problems, communicate with customers, or coordinate with colleagues. Limited Japanese proficiency can therefore reduce effective labor services within a given skill category. The parameter θ provides a parsimonious representation of such limitations. This parameter is not a claim that foreign workers have lower underlying ability or cannot acquire Japanese proficiency. It summarizes language and adjustment constraints in the period considered by the model. We hold θ fixed to isolate the effects of foreign-worker inflows; language acquisition and learning on the job could change it over a longer horizon.

The function $A(F)$ represents the effective productivity of native low-skilled labor and we allow $A'(F) \geq 0$. Foreign workers may undertake repetitive activities that would otherwise occupy native workers' time. Native workers can then concentrate on Japanese-language-intensive customer service, reporting, explanation, or coordination. For example, additional workers performing food preparation or cleaning may allow native employees to spend more time handling customer requests and coordinating operations. Such changes can increase the productive contribution of native workers without changing their formal education or moving them into a different skill group. We represent this adjustment through $A(F)$, rather than explicitly modeling individual task choices. Task upgrading is therefore an assumed productivity channel whose wage implications are derived within the model. A reduction in routine work need not always improve productivity, and our empirical task measures do not directly identify $A'(F)$. The assumption describes the productive form of task reallocation that we examine.

[6] Japanese-language proficiency constitutes an important constraint on the range of tasks that foreign workers can perform independently in Japan. Reflecting the importance of this issue, the new Employment for Skill Development (Ikusei Shuro) system, scheduled to take effect in April 2027, explicitly incorporates Japanese-language proficiency and training requirements. These institutional developments highlight the importance of language barriers in the employment and workplace integration of foreign workers in Japan (Immigration Services Agency of Japan, 2026).

Native labor endowments are fixed as $N_L = \overline{N_L},\ M = \overline{M},\ H = \overline{H}$. Skill-group membership remains unchanged as tasks adjust. Native and foreign low-skilled workers are perfect substitutes in effective labor units, although their tasks and productivity per worker may differ. This aggregation assumption keeps the extension close to the skill-based framework.

3.2 Competitive Wages

We normalize the final-good price to one and assume competitive firms. Each firm takes wages and the economy-wide productivity function $A(F)$ as given: an individual firm's hiring does not affect aggregate foreign labor supply or native productivity. With positive employment of each input, wages equal the corresponding marginal products. Thus, $w_H = Y_H$ and $w_M = Y_M$ for high- and middle-skilled workers, while $w_{NL} = A(F)Y_L$ and $w_F = \theta Y_L$ for native and foreign low-skilled workers. Subscripts on the production function denote partial derivatives.

The marginal product Y_L is the return to one effective unit of low-skilled labor. A native low-skilled worker supplies $A(F)$ such units, whereas a foreign worker supplies θ units. Their wage ratio is therefore $w_{NL}/w_F = A(F)/\theta$, and native wages exceed foreign wages when $A(F) > \theta$. This difference reflects effective productivity, including the language-related limitations captured by θ and the productive task adjustment captured by $A(F)$.

Native labor endowments remain fixed. Foreign-worker inflows therefore change the relative abundance of effective low-skilled labor and the marginal products of the three skill groups. Scarcity is reflected in these equilibrium marginal products, without introducing a separate wage-premium term. With the final-good price normalized to one, wage effects arise from production-side adjustments rather than a separate consumption-demand multiplier.

3.3 Wage Effects on Native Workers

We compare equilibria following an increase in foreign labor supply, holding native labor endowments, aggregate productivity, and foreign-worker efficiency fixed. Effective low-skilled input increases through both additional foreign labor and any improvement in native productivity, so $d\,L/d\,F = A'(F)N_L + \theta > 0$. The expression includes the direct contribution of foreign workers and the increase in the effective contribution of native low-skilled workers.

The following propositions describe the wage responses of the three native skill groups. Second-order subscripts denote derivatives of marginal products with respect to the indicated inputs.

Proposition 1: Higher Middle-Skilled Wages

Differentiating the middle-skilled wage with respect to foreign labor supply gives the positive wage response in equation (3).

$$\frac{dw_M}{dF} = Y_{ML}(A'(F)N_L + \theta) > 0. \tag{3}$$

Foreign-worker inflows raise middle-skilled wages because effective low-skilled labor complements middle-skilled labor in the lower nest. Under the assumed CES structure, $Y_{ML} > 0$: additional effective low-skilled input raises the marginal product of middle-skilled labor. When

routine or on-site work becomes more readily available, workers performing complementary intermediate activities can contribute to a larger volume of production. Task upgrading can reinforce this effect. If native low-skilled workers use their time more productively, effective low-skilled input expands further, increasing the marginal product of middle-skilled labor. This result follows from production complementarity and does not require a separate consumption-demand effect.

Proposition 2: Conditional Changes in Native Low-Skilled Wages

Differentiating $w_{NL} = A(F)Y_L$ with respect to foreign labor supply separates the native low-skilled wage response into two components, as shown in equation (4).

$$\frac{d\, w_{NL}}{d\, F} = A'(F)Y_L + A(F)\frac{d\, Y_L}{d\, F}. \tag{4}$$

The first term captures the productivity gain from task upgrading. When foreign workers undertake routine activities, native workers may concentrate on customer interaction, explanation, and coordination, increasing their effective contribution to production. The second term in equation (4) captures the change in the return to each effective unit of low-skilled labor. With middle- and high-skilled labor fixed, an expansion of effective low-skilled input reduces its marginal product, as shown in equation (5).

$$\frac{d\, Y_L}{d\, F} = Y_{LL}(A'(F)N_L + \theta) < 0. \tag{5}$$

Here, $Y_{LL} < 0$ follows from diminishing marginal productivity. The increase in effective low-skilled input includes both the contribution of additional foreign workers and any improvement in native productivity. Native low-skilled wages remain unchanged or rise when $A'(F)Y_L \geq -A(F)\, d\, Y_L / d\, F$: the productivity gain must offset the decline in the marginal product. Without task upgrading, native low-skilled wages decline. With task upgrading, the wage response is conditional: productivity improvements can offset supply pressure, but they also expand effective low-skilled input and therefore do not automatically prevent a wage decline. The condition depends on the magnitude of productivity improvement and the curvature of the production function. The model does not establish that the required adjustment occurs empirically or that every native worker is protected.

Proposition 3 Higher High-Skilled Wages

Differentiating the high-skilled wage with respect to foreign labor supply gives the positive wage response in equation (6).

$$\frac{d\, w_H}{d\, F} = Y_{HL}(A'(F)N_L + \theta) > 0. \tag{6}$$

The expansion of effective low-skilled labor increases the composite input X. With high-skilled labor supply fixed, this raises the marginal product of high-skilled workers, so $Y_{HL} > 0$. For example, a greater volume of operating activities can increase the productive contribution of specialized judgment, planning, and management. The relative proportional changes in high- and middle-skilled wages are given by equation (7).

$$\frac{d\ ln\ (w_H/w_M)}{d\ F} = \left(\frac{1}{\sigma} - \frac{1}{\rho}\right)\frac{X_L}{X}\frac{d\ L}{d\ F} < 0. \tag{7}$$

Under the assumed nesting and elasticities, middle-skilled wages increase proportionally more than high-skilled wages. This ranking reflects stronger complementarity in the lower nest. It concerns the model's production inputs and does not imply that empirical wage gains must be concentrated at particular observed wage quantiles.

Highly specialized tasks provide an additional perspective on the comparatively weak responses at the upper end of the observed wage distribution. Workers performing specialized professional or managerial activities may have little direct task overlap with the low-skilled foreign workers considered here, limiting direct competition. Their opportunities to benefit from the reassignment of routine work may also be smaller than those of workers whose activities are more closely connected to such work. Limited substitution alone does not imply an absence of wage gains, because complementary inputs can still raise marginal productivity. The smaller proportional response in Proposition 3 and potentially limited opportunities for task reallocation therefore offer complementary interpretations. Specialization is not modeled separately, and these interpretations concern possible mechanisms rather than an exact mapping between high wages and specialized occupations.

3.4 Well-Being and Empirical Interpretation

Wages are only one component of workers' welfare. Foreign-worker inflows may relieve workload and improve service provision, but they can also generate communication burdens, workplace adjustment costs, perceived job insecurity, or pressures on local amenities. We represent these additional channels through the utility function $U_i = u_i(c_i) + b_i B_i(F) - d_i Z_i(F)$.

In this expression, c_i is consumption, $B_i(F)$ denotes non-pecuniary benefits, and $Z_i(F)$ denotes non-pecuniary costs. Utility increases with consumption, and the benefit and cost weights are nonnegative. Maintained or higher wages can coexist with lower subjective well-being when additional costs outweigh the benefits. These channels supplement the production model; their magnitudes are not derived from it.

The framework helps interpret the empirical wage and task patterns jointly. Wage gains around the middle of the distribution are qualitatively consistent with production complementarity, while limited low-wage responses are compatible with productivity gains offsetting supply pressure. A decline in routine-task content provides suggestive support for the proposed task-reallocation channel. These patterns can support the mechanisms without directly identifying the productivity gain or the contribution of task reallocation to wages.

Observed wage quantiles, education groups, and other subgroups do not directly identify the model's three production inputs. The wage and task results are therefore interpreted as

qualitative evidence on the proposed mechanisms. A weak high-wage response can coexist with the model's smaller proportional gain for high-skilled than middle-skilled labor, although it does not establish a high-skilled wage increase. The framework clarifies these relationships while leaving the magnitude and location of empirical gains to the data.

4. Empirical Strategy and Data

Following the theoretical framework presented in Section 3, this section outlines the empirical strategy and dataset used to examine the effect of low-skilled foreign labor inflows on the wages, task content, and well-being of native workers.

4.1 Empirical Strategy

This study aims to identify the causal effect of an increase in the foreign labor (F) supply on the outcomes of native workers (Y) in Japan. However, the location choice of foreign workers may not be random; for example, they may sort into prefectures with better labor market conditions (Borjas, 2003; Glitz, 2012). In the presence of such endogeneity, simple ordinary least squares (OLS) estimation is likely to yield biased results. We address this issue by employing a fixed-effects instrumental variables (FEIV) approach, using a Bartik-type IV. This instrument exploits pre-existing migrant settlement networks across prefectures, interacting them with national-level changes in foreign labor supply to generate plausibly exogenous variation in local exposure. Indeed, in Japan, low-skilled foreign workers are highly concentrated in a small set of prefectures. Appendix A2 (Figure A2) provides descriptive evidence on this geographic concentration, which motivates our use of pre-reform settlement shares in a Bartik-type IV strategy.

(1) Estimation via FE Model

Equation (8) specifies the baseline relationship between native outcomes and prefecture-level foreign labor exposure.

$$Y_{i,j,t} = \beta F_{j,t} + \mathbf{X}'_{i,j,t}\boldsymbol{\gamma} + \varphi_i + \phi_j + \psi_t + \epsilon_{i,j,t}, \tag{8}$$

where $Y_{i,j,t}$ represents the outcome (log hourly wage or well-being index) of individual i residing in prefecture j in year t. $F_{j,t}$ denotes the ratio of low-skilled foreign workers in prefecture j (number per 1,000 employed persons), corresponding to the key independent variable in our theoretical model. $\mathbf{X}_{i,j,t}$ is a vector of time-varying individual attributes and regional characteristics. φ_i represents individual FEs, which control for time-invariant unobserved individual heterogeneity. ϕ_j denotes prefecture FEs, controlling for time-invariant regional characteristics. ψ_t represents year FEs, which absorb aggregate shocks common to all prefectures. $\epsilon_{i,j,t}$ is the error term.

(2) Bartik IV Method

We address the potential endogeneity of $F_{j,t}$ by constructing a Bartik-type instrument (Shift-Share IV), a method pioneered by Altonji and Card (1991) and Card (2001) and widely adopted in immigration research (e.g., Peri, 2012; Borjas, 2014). Specifically, the predicted ratio of foreign

workers in prefecture j, denoted as $F_{j,t}^{IV}$, is constructed as follows. We set the base year (t_0) to 2019, considering the impact of institutional reforms, such as the introduction of the SSW system. Equation (9) defines the instrument, whose components are explained below.

$$F_{j,t}^{IV} = \frac{1}{E_{j,t}} \sum_{g} \underbrace{\left(\frac{F_{j,g,2019}}{F_{g,2019}} \right)}_{\text{Initial Share}} \times \underbrace{F_{g,t}}_{\text{National Shift}} \tag{9}$$

First, the term $F_{j,g,2019}/F_{g,2019}$ inside the summation represents the "Initial Share," which is the proportion of foreign workers of nationality g residing in prefecture j relative to the national total for that nationality in the base year 2019. This captures the historical concentration of foreign networks in each prefecture. Second, the term $F_{g,t}$ represents the total number of foreign workers of nationality g in Japan in year t, referred to as the "National Shift." Both the initial shares and the national stocks are calculated using foreign residents holding work-related residence statuses with restrictions on permitted activities, including professional and technical categories as well as SSW and TITP. Thus, the instrument uses a broader population than the endogenous exposure measure, which covers only SSW and TITP residents. The national shift is measured as the stock in each year, rather than its annual change or growth rate. Finally, the sum of these products is divided by total employment in prefecture j in year t, $E_{j,t}$, yielding the exposure per 1,000 employed persons.

This instrument relies on empirical evidence suggesting that network effects—specifically, the presence of co-nationals—are a powerful determinant of immigrants' location choices (Munshi, 2003; McKenzie and Rapoport, 2010). Since the FE model estimates parameters using deviations from period averages, this instrument assumes that the national-level increase in foreign workers (Shift) is allocated to prefectures based on initial settlement shares (Share). By using this instrument, we seek to isolate variation in foreign labor supply that is uncorrelated with current region-specific labor demand shocks, subject to the instrument's exclusion restriction.

(3) Analysis of Heterogeneity: Unconditional Quantile Regression and Subsample Analysis

Our theoretical framework motivates examining heterogeneous wage responses through production complementarity and task-related productivity changes. We examine such distributional heterogeneity by employing unconditional quantile regressions (UQRs) and estimating effects at points from the 20th to the 80th percentile in 2-percentage-point increments, with selected estimates reported at the 20th, 40th, 60th, and 80th percentiles.

As proposed by Firpo et al. (2009), UQRs use the recentered influence function (RIF). Previous research has demonstrated that the impact of immigration varies across the wage distribution. For example, using UK data, Dustmann et al. (2013) demonstrated that immigration depresses wages at the bottom of the distribution while raising them at the top of the wage range. Similarly, using Swiss data, Favre (2011) found wage compression within high-skilled occupations. The UQR provides a method to examine such distributional heterogeneity more directly using individual-level data. Choe and Van Kerm (2014) applied RIF regressions with Luxembourgish data to examine the distributional impact of foreign workers on wages, but did

not address endogeneity concerns. Recently, Lombardo et al. (2021) combined RIF regressions with IV methods to analyze the effect of immigrant inflows on income distribution in Colombia. Similarly, Yasenov (2019) estimated the causal effect of immigration on the U.S. wage distribution using distributional regression methods and IVs. Our study builds on this literature by using an FEIV-based UQR approach (FEIV-UQR), which combines the UQR framework with fixed-effects and the Bartik-type IV.

We examine heterogeneity in the changes in wage, well-being and tasks across individual attributes using subgroup analysis. We stratify the sample by attributes such as gender (male/female), employment type (regular/non-regular), cognitive skills (education level, proficiency in IT or English), non-cognitive skills (low/middle/high GRIT score), and task content (level of routine). We then perform FEIV estimation for each subgroup.

We select these subgroup dimensions to examine differences in exposure to low-skilled foreign labor, opportunities for productive task adjustment, and adjustment costs. Employment status may affect access to internal task reassignment, training, and stable employment relationships: regular employees may have greater opportunities to reorganize their work, whereas non-regular employees may face greater insecurity or fewer opportunities to benefit. Education and IT skills provide indicators of capabilities that may support complementary activities and adaptation to new tasks. Routine task content captures both potential overlap with foreign workers' activities and the scope for reallocating repetitive work. These dimensions need not predict effects in the same direction: greater initial task overlap can increase competition, but can also create opportunities for native workers to shift toward complementary activities.

GRIT is used to explore whether responses vary with personal characteristics potentially related to persistence and adaptation, without assuming that higher GRIT must generate larger gains. English ability may be relevant to communication and coordination in workplaces employing foreign workers, potentially creating both opportunities and additional burdens; it is not a measure of Japanese-language proficiency. Wage position locates gains and losses within the distribution rather than identifying the model's skill groups. These analyses are exploratory comparisons motivated by the framework, which does not derive a distinct prediction for each subgroup. Differences in statistical significance across groups do not by themselves establish statistically significant differences in their effects.

(4) Control Variables and Avoidance of "Bad Controls"

To avoid over-controlling, we do not select control variables that may lie on the causal pathway. As emphasized by O'Connor (2020), building on Angrist and Pischke (2009) and Baron and Kenny (1986), prefectural economic conditions, such as GDP and unemployment rates, may respond to immigrant inflows. Thus, controlling for these variables would potentially introduce a "bad control" problem by blocking part of the total effect of immigration on economic and non-economic well-being. Our framework highlights production and task adjustments through which foreign inflows can change native wages. More broadly, regional economic outcomes may be part of the response to immigration rather than suitable controls for estimating its total effect. While we control for nationwide aggregate shocks using year fixed effects ψ_t, we allow prefecture-specific economic conditions to respond to foreign labor inflows. Accordingly, we exclude regional economic controls other than the Consumer Price Index (CPI).

4.2 Variables

(1) IVs and Subgroup Definition

Our key explanatory variable is the prefecture-level exposure to low-skilled foreign labor, $F_{j,t}$. We construct $F_{j,t}$ as the stock of foreign residents in prefecture j and year t holding SSW or TITP residence status, divided by the total number of employed persons in the same prefecture and year (i.e., the number of SSW/TITP residents per 1,000 employed persons). This measure is merged with JHPS respondents using their prefecture of residence.

In the subgroup analyses, we divide the native-worker sample into groups defined by cognitive and non-cognitive skill levels, as well as other individual characteristics. For cognitive skills, we use formal educational attainment and two indicators of practical skills—English ability and IT skills. Education is grouped into two categories: non-college graduates and college graduates. English ability is based on self-assessment and is recoded into three groups: "able" respondents report being able to use English fluently at a near-native level or to conduct everyday conversations despite occasional mistakes; "limited" respondents can convey their intentions only using simple English; and "none" are those respondents who can barely understand or speak English. Finally, IT skills are summarized using an original index constructed from survey questions on basic spreadsheet software skills, the use of macro functions in spreadsheet applications, and data processing and analysis with programming languages.

As non-cognitive skills, we construct a measure using the GRIT questionnaire presented in the 2019 JHPS wave and treat it as a time-invariant individual attribute. GRIT is a widely accepted personality-trait measure assessing perseverance and passion for long-term goals. The GRIT score ranges from 1 to 15, with higher scores indicating greater non-cognitive capabilities. Other individual factors include gender, employment status, job task content, and wage position. Employment status is classified as regular and non-regular employment. Job task content is measured using routine task content. Appendices B2 and B3 provide additional information on the creation and coding of the IT-skill index and the GRIT measure.

(2) Dependent Variables

The following dependent variables measure how inflows of low-skilled foreign workers affect native workers' welfare and assess the task upgrading mechanism emphasized in our theoretical framework: (i) economic welfare, (ii) job task content, and (iii) non-economic well-being.

Economic Welfare (Wages)

As our main economic outcome, we use the logarithm of the respondent's hourly wage, constructed from self-reported earnings, including bonuses and hours worked in the JHPS.

Job task content (routine task content)

We examine evidence relevant to the task-upgrading channel using a direct measure of routine task content available in the JHPS survey. The survey question about short, repetitive tasks in respondents' jobs provides a direct proxy for routine task intensity. Respondents are asked about

the proportion of the workday spent performing short, repetitive tasks. Responses are recorded on a four-point scale, ranging from 1 ("rarely") to 4 ("almost always").[7] In some analyses, we further dichotomize this variable by classifying responses of 1 and 2 as indicating low routine task content, and responses of 3 and 4 as indicating high routine task content. This measure captures routine, repetitive activities that foreign workers may undertake. A decline indicates task reallocation, but does not directly measure native productivity or identify the effect of task changes on wages.

Non-economic well-being

We use four SWB measures available in the JHPS, which we interpret as proxies for non-pecuniary components of utility. Overall job satisfaction, reported on a 0–10 scale with higher values indicating greater satisfaction with one's current job, is the first SWB measure. The second outcome variable is work engagement, measured by the nine-item Utrecht Work Engagement Scale (UWES-9). Following the standard scoring procedure, we compute the UWES-9 as the average of the nine items, which assess vigor, dedication, and absorption on a 0–6 scale, with higher scores indicating greater work engagement. In our framework, these two measures reflect a key aspect of the work environment and job quality. Appendix B1 provides detailed descriptions of UWES-9. The third outcome variable, life satisfaction, is measured on a 0–10 scale and serves as a broad proxy for overall welfare, with higher values indicating greater satisfaction with life. Finally, we use a subjective health measure on a 1–5 scale based on the respondents' assessments of their general health status, with higher values indicating better perceived general health. In the main specifications, these outcomes are treated as continuous variables, consistent with standard practice in the SWB literature.

4.3 Data

This study uses individual-level panel data from the JHPS/Keio Household Panel Survey (KHPS), administered by the Panel Data Research Center (PDRC) at Keio University. The JHPS/KHPS is designed to represent Japanese nationals and is sampled from the basic resident register, which aligns with our focus on native workers. The panel originates from the KHPS, which began in 2004 with a nationally representative sample of 4,000 households (approximately 7,000 individuals) using a two-stage stratified random sampling design. Additional KHPS refresh samples were recruited in 2007 and 2012 to mitigate attrition and maintain representativeness. Building on this infrastructure, the PDRC launched the JHPS in 2009 with roughly 4,000 adults nationwide and later added refresh samples in 2019 and 2023. From 2014 onward, the KHPS and JHPS have been integrated and administered as a single, unified survey system. Throughout the study, we refer to the integrated survey as JHPS. The 2024 wave includes 5,143 respondents (households).

The survey is conducted annually (typically around late January to February) primarily via a door-to-door drop-off/pick-up method, with an option to respond online; in some years, mail procedures are also used. It collects rich longitudinal information on labor market outcomes,

[7] This survey item follows the task-based measurement approach developed in the Princeton Data Improvement Initiative and Autor and Handel (2013), which emphasizes direct measures of job task content based on workers' self-reported activities.

including wages, employment, and occupation; economic conditions; education; health and well-being; and a wide range of individual and household characteristics. The survey also features several distinctive modules that are less commonly available in other household panel studies, including measures of skills and work-related task content, which are useful for assessing heterogeneity in labor market responses. These modules help connect the empirical analysis to our theoretical framework by revealing heterogeneity across workers' skill profiles and changes in task content. The observed groups provide informative comparisons, although they do not directly identify the model's three production inputs.

Data on foreign workers are derived from the Immigration Services Agency of Japan's Statistics on Foreign Residents. We present the local exposure to low-skilled foreign workers by aggregating the stock of foreign residents by prefecture, holding SSW or TITP residence status. We divide this number by the total number of people employed in the same prefecture, as reported by the Statistics Bureau's labor force survey. The Consumer Price Regional Difference Index, compiled annually by the Statistics Bureau of Japan, is used to calculate CPI at the prefecture-level.

Our main sample consists of Japanese residents aged 18–60, excluding students and self-employed individuals. The objective is to assess how inflows of foreign workers affect labor market outcomes of employed Japanese nationals and their well-being. We use six waves of JHPS data from 2019 through 2024. This window is motivated by two considerations. First, the key policy reform introducing the SSW program took effect in April 2019, while the 2019 JHPS wave was fielded in late January–February, providing a natural pre-reform baseline. Second, the JHPS modules on skills and job task content—central to our analyses of heterogeneity and task upgrading—are available only from this point onward.

5. Results

5.1 Descriptive Statistics

Table 1 presents the regression sample descriptive statistics separately for the quintiles of the hourly wage distribution (Q1 lowest to Q5 highest). The means for continuous variables and within-quintile shares for categorical variables are reported. The column labeled N shows the usable sample size for each variable.

Several clear gradients can be observed across the wage distribution. Higher-wage quintiles are disproportionately male and more likely to be in regular employment. Education level rises strongly with wages, as does the share of workers with college degrees. English ability also improves with wages. Task content shows a similar pattern. Routine task content is lower in higher-wage groups. The IT-skill measure also varies systematically across quintiles. Overall, the descriptive patterns align with the logic that higher wages are associated with higher skills and less routine task profiles.

Sample sizes vary across variables from 9,175 to 15,279 for two reasons. First, information needed to construct GRIT is unavailable for the 2023 refresh sample, resulting in fewer observations. Second, English ability is not collected for the 2019 and 2023 refresh samples, markedly reducing the sample size for English-related descriptives. GRIT descriptives use 13,515

observations, whereas English-related descriptives use 9,175 observations.

Table 1. Descriptive statistics

	N	Q1	Q2	Q3	Q4	Q5	Total
Low-skilled foreign workers ratio [1)]	15,279	6.89	6.55	6.66	6.74	6.53	6.67
		(3.59)	(3.60)	(3.60)	(3.76)	(3.73)	(3.66)
Hourly wage (yen)	15,279	995.6	1240.4	1631.6	2282.4	5624.3	2354.0
		(51.7)	(93.1)	(134.5)	(264.6)	(3302.7)	(2249.6)
Level of routine task (1-4)	14,898	2.56	2.37	2.14	1.97	1.91	2.19
		(1.16)	(1.14)	(1.07)	(1.00)	(1.01)	(1.10)
Job satisfaction (0-10)	15,209	5.35	5.30	5.37	5.68	6.05	5.55
		(2.40)	(2.42)	(2.39)	(2.21)	(2.19)	(2.34)
Life satisfaction (0-10)	15,234	5.91	5.96	6.11	6.24	6.57	6.16
		(2.16)	(2.14)	(2.08)	(1.88)	(1.85)	(2.04)
Work engagement	15,214	2.88	2.82	2.79	2.91	2.99	2.88
		(1.37)	(1.37)	(1.33)	(1.28)	(1.28)	(1.33)
IT skill	15,237	2.48	2.68	2.94	3.17	3.26	2.90
		(0.89)	(0.95)	(0.95)	(0.89)	(0.97)	(0.98)
GRIT score	13,515	3.13	3.13	3.14	3.20	3.24	3.17
		(0.46)	(0.48)	(0.45)	(0.44)	(0.47)	(0.46)
Gender	15,279						
Male	8,372	26%	41%	56%	74%	78%	55%
Female	6,907	74%	59%	44%	26%	22%	45%
Employment status	15,024						
Regular	9,624	21%	47%	76%	89%	89%	64%
Non-regular	5,400	79%	53%	24%	11%	11%	36%
Education level	14,999						
Non-college graduate	9,060	78%	68%	61%	50%	44%	60%
College graduate	5,939	22%	32%	39%	50%	56%	40%
English Ability	9,175						
None	4,540	60%	54%	49%	45%	40%	49%
Limited	4,066	37%	41%	47%	49%	48%	44%
Able	569	3%	5%	4%	6%	12%	6%

Source: Authors' calculations using the JHPS, the Immigration Services Agency of Japan's Statistics on Foreign Residents, and the Labor Force Survey.

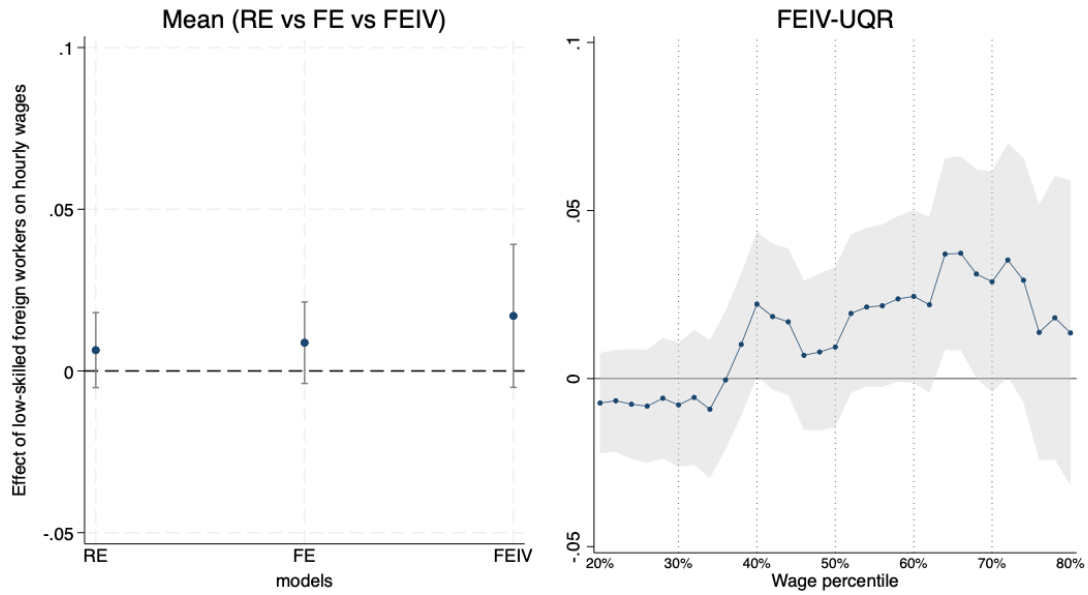
Note: 1) The low-skilled foreign worker ratio is measured per 1,000 employed persons.
2) Standard deviations are reported in parentheses.
3) Sample sizes differ across variables for three reasons. First, RTI is constructed from multiple survey items, so it is available only for respondents who answered all underlying questions, which naturally reduces the usable sample size. Second, information required to construct GRIT is not available for the 2023 refresh sample, resulting in fewer observations. Third, English ability is not collected for the 2019 refresh sample and the 2023 refresh sample, which substantially reduces the sample size for English-related descriptives.

5.2 Impact on Wages

Before presenting the instrumental variable (IV) estimates, we first verify that the instrument is

sufficiently strong. First-stage F-statistics are well above conventional thresholds in the main specifications, suggesting that weak-instrument concerns are unlikely to affect our estimates (see Section 5.5). Figure 1 illustrates the estimated effects of an increase in the ratio of low-skilled foreign workers on native workers' hourly wages in the total sample. Hourly wages are measured in logarithms. The navy dots indicate point estimates, and the vertical bars or shaded area denote 90% confidence intervals.

Figure 1. Mean and Unconditional Quantile Effects on Wage of Low-Skilled Foreign workers



Navy dots: point estimates. Shaded area/ Bars: 90% confidence intervals.

Source: Authors' calculations using the JHPS, the Immigration Services Agency of Japan's Statistics on Foreign Residents, and the Labor Force Survey.

Note: 1) The reported coefficients are conditional on controlling for years of tenure, years of tenure squared, and CPI in all specifications, which are estimated with individual, prefecture, and year fixed effects and standard errors clustered at the individual level.
2) Instrumental variables estimation is implemented using a Bartik-type (shift-share) instrument.
3) Hourly wages are measured in logarithms.

The left panel compares mean estimates from random-effects (RE), fixed-effects (FE), and fixed-effects instrumental variables (FEIV) specifications. The average effect on hourly wages is close to zero across these approaches, indicating that, at the aggregate level, low-skilled foreign labor has no statistically detectable effect on native workers' mean wage in these specifications. This near-zero mean effect is compatible with our framework of heterogeneous wage responses. Production complementarity can raise the wages of some native workers, while the response of native low-skilled wages depends on the balance between task-related productivity gains and the decline in the marginal product of effective low-skilled labor. Limited aggregate effects can therefore coexist with gains for particular groups.

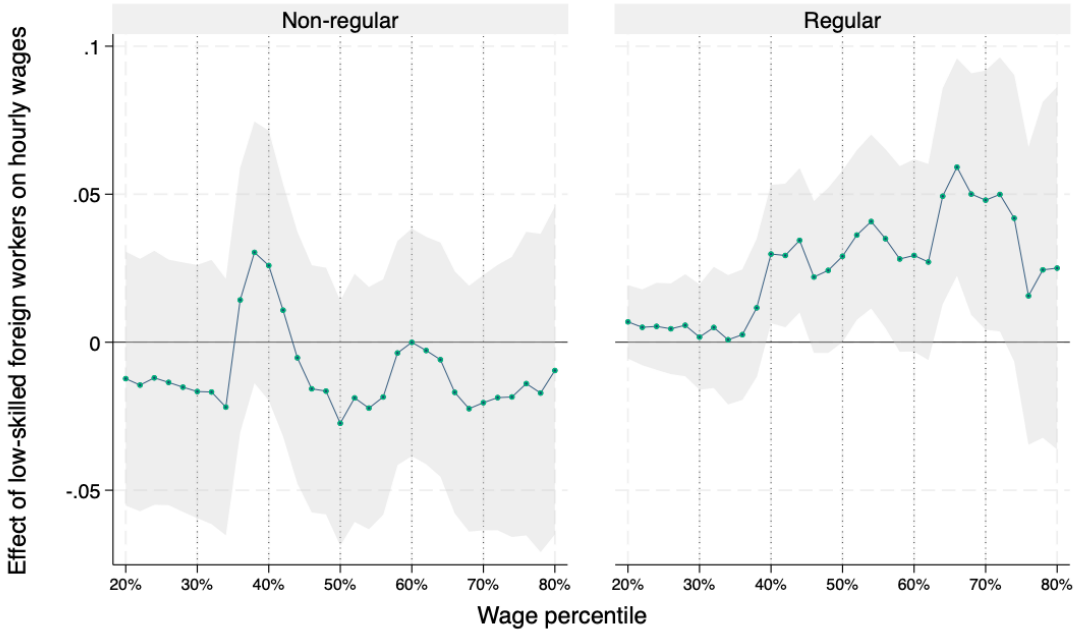
The right panel of Figure 1 shows FEIV-based unconditional quantile regression estimates (FEIV-UQR) across the wage distribution, ranging from the 20th to the 80th percentiles in 2-percentage-point increments, with estimates at the extreme tails being less precise. In contrast to the mean impacts, the quantile results indicate distributional heterogeneity. Although most estimates are near zero, there are positive and statistically significant effects around the 40th and mid-60th percentiles. The point estimates are approximately 0.022 at the 40th percentile and 0.037 at the mid-60th percentile. The standard deviation of the low-skilled foreign workers ratio is 3.66, as shown in Table 1, implying that a one-standard-deviation increase results in an 8 percent increase in hourly wages at the 40th percentile and 13–14 percent at the mid-60th percentile. This pattern is qualitatively consistent with Proposition 1 (native workers performing activities complementary to low-skilled labor can gain as effective low-skilled input expands). Limited wage responses at the bottom are compatible with Proposition 2 (under which task-related productivity gains may offset supply pressure). These are qualitative correspondences because observed wage quantiles do not directly identify the model's skill inputs.

Figure 2 extends the FEIV-UQR analysis to key subgroups, where wage percentiles are defined within each subgroup, so that estimates trace distributional effects among workers who share the same subgroup characteristics. Figure 2(1) indicates positive and statistically significant effects for regular workers primarily between the 40th and 70th percentiles. Figure 2(2) shows that non-college graduates have positive effects mostly above the 50th percentile, which likely corresponds to the middle of the overall wage distribution, given their relatively low wages. Figure 2(3) illustrates that positive impacts for workers with low IT skills emerge from the 40th percentile onward, indicating that the gains are concentrated among mid- to higher-wage workers within the low IT group. Figure 2(4) shows positive effects for the middle-GRIT group mainly between the 40th and 76th percentiles. Figure 2(5) illustrates positive effects for workers who report limited English ability in the mid-50th to the mid-60th percentiles, and for those with higher English ability between the mid-50th and upper-70th percentiles. Finally, Figure 2(6) shows that positive effects are more evident among workers engaged in highly routine tasks, particularly in the mid-40th to mid-70th percentiles. In contrast, effects for workers in less routine jobs remain close to zero.

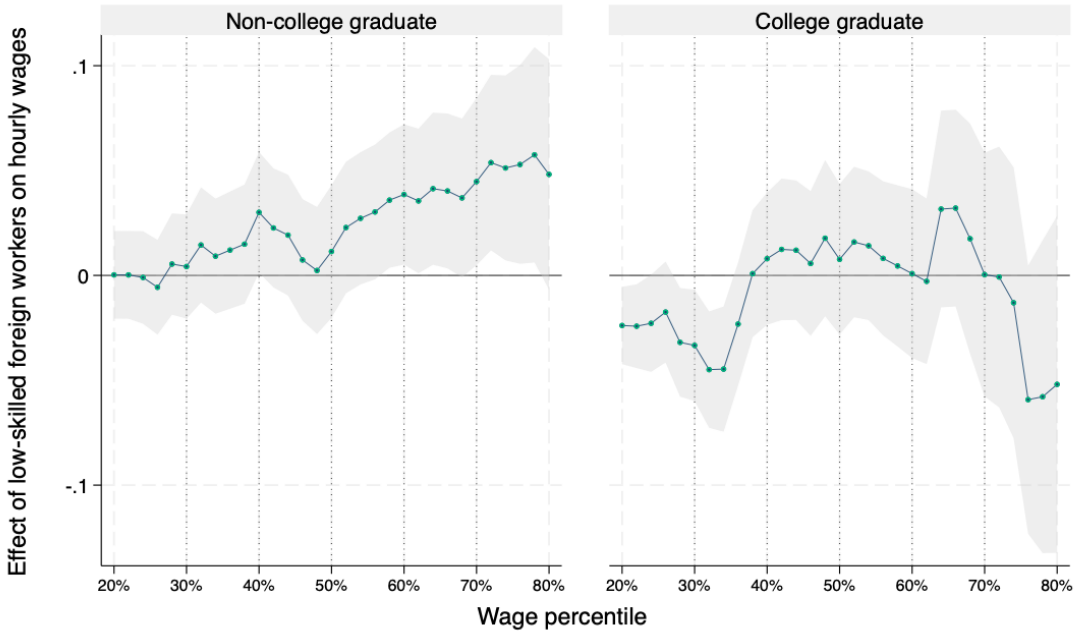
Overall, these patterns indicate that wage gains tend to be concentrated among middle-positioned workers, with separate subgroup analyses suggesting gains among regular employees, non-college graduates, workers engaged in routine tasks, those with low IT skills, and those with moderate levels of GRIT. These patterns are broadly consistent with the production-complementarity mechanism in Proposition 1. The absence of clear wage declines at the lower end is also compatible with the offsetting productivity and supply effects in Proposition 2. Although statistically insignificant estimates do not establish that wages are unchanged, the wage patterns provide coherent qualitative support for the proposed mechanisms.

Figure 2. Heterogeneous Effects on Wage: FEIV-UQR Estimates by Subgroups

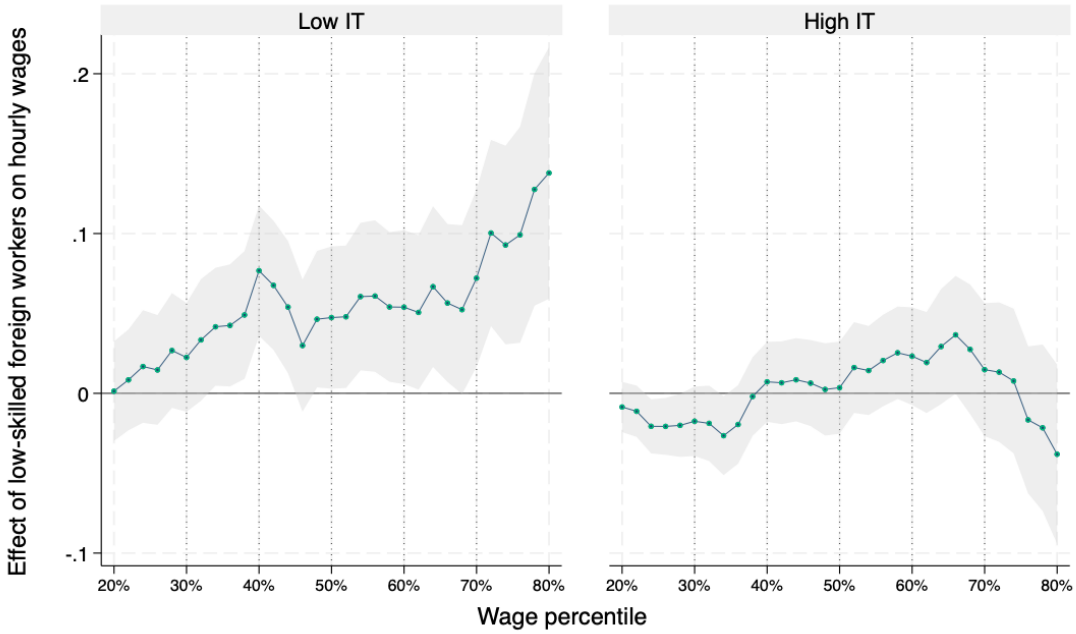
(1) By employment status



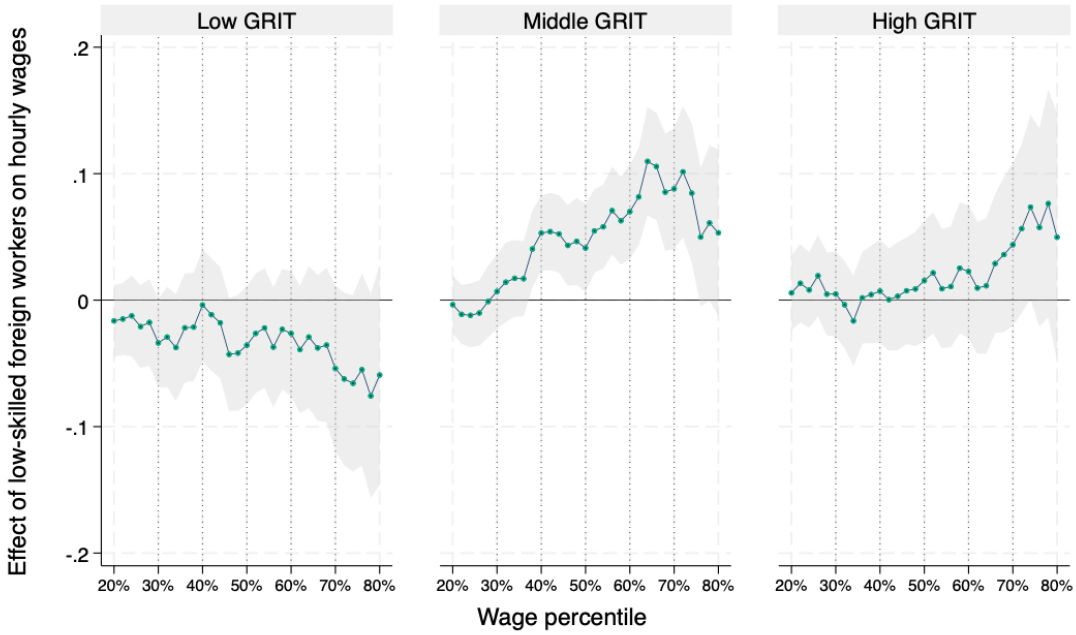
(2) By Educational level



(3) By IT skill level



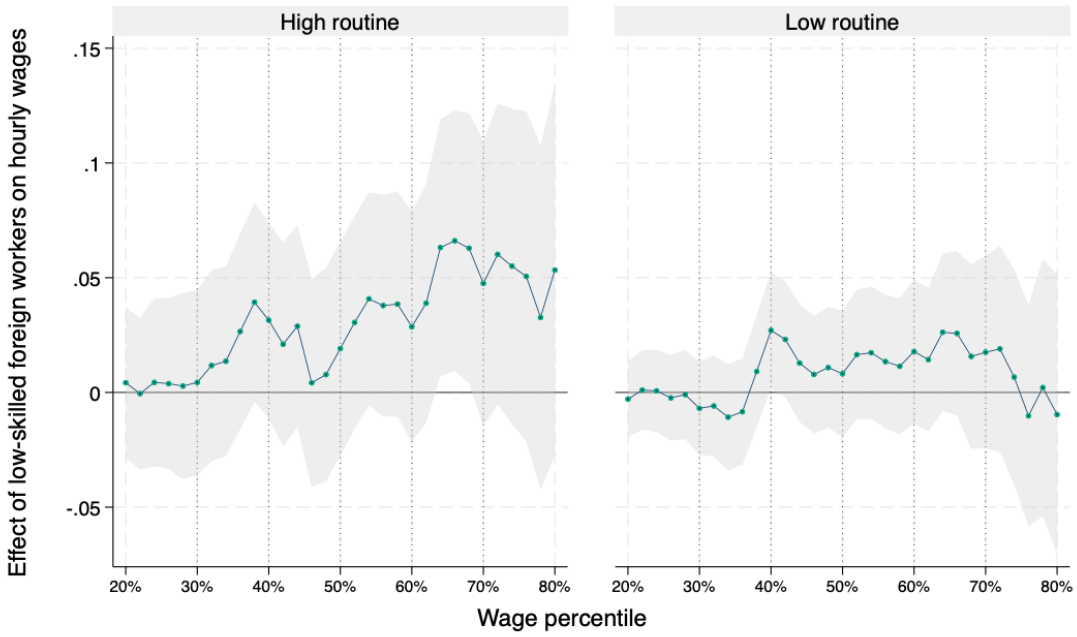
(4) By GRIT score



(5) By English ability



(6) By Routine task



Source: Authors' calculations using the JHPS, the Immigration Services Agency of Japan's Statistics on Foreign Residents, and the Labor Force Survey.

Source: Authors' calculations using the JHPS, the Immigration Services Agency of Japan's Statistics on Foreign Residents, and the Labor Force Survey.

Note: 1) The reported coefficients are conditional on controlling for years of tenure, years of tenure squared, and CPI in all specifications, which are estimated with individual, prefecture, and year fixed effects and standard errors clustered at the individual level.
2) Instrumental variables estimation is implemented using a Bartik-type (shift-share) instrument.
3) Hourly wages are measured in logarithms.

Table 2. Heterogeneous Effects on Wage: Mean FEIV Estimates by Subgroup

Subgroup	Coefficient of foreign workers	*N*	*N of ID*	F-statistic for excluded instruments
Employment status				
Regular	0.027	8,930	2211	886
Non-regular	-0.012	4,766	1320	380.7
Sex				
Male	0.023	7,870	1859	784.7
Female	0.007	6,385	1652	509.2
Education				
Non-college graduate	0.035*	8,571	2089	847.9
College graduate	-0.019	5,642	1407	441.9
GRIT score				
Low GRIT	-0.038	5,049	1141	324.2
Middle GRIT	0.059***	4,694	1055	607.8
High GRIT	0.028	3,233	716	309.9
English skill				
None	0.034	4,399	958	468
Limited	0.015	3,952	841	316
Able	0.097	559	116	72.80
Routine task				
High routine task	0.029	4,377	1401	414.8
Low routine task	0.015	8,064	2259	853.9
Wage				
Q1(Lowest)	-0.00538	2,276	761	206.3
Q2	-0.00724	2,115	728	136.7
Q3	-0.00143	2,254	769	200.2
Q4	0.00463	2,457	778	274.9
Q5(Highest)	0.0270	2,289	663	282
IT skill				
Q1(Lowest)	0.0580**	3,548	1060	328.6
Q2	-0.0154	1,507	553	188
Q3	-0.00249	3,418	1149	436.9
Q4	0.0300	894	352	74.85
Q5(Highest)	-0.0209	2,095	606	193.3

Source: Authors' calculations using the JHPS, the Immigration Services Agency of Japan's Statistics on Foreign Residents, and the Labor Force Survey.

Note: 1) The reported coefficients are conditional on controlling for years of tenure, years of tenure squared, and CPI in all specifications, which are estimated with individual, prefecture, and year fixed effects and standard errors clustered at the individual level.
2) Instrumental variables estimation is implemented using a Bartik-type (shift-share) instrument.
3) Hourly wages are measured in logarithms.
4) ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

Table 2 reports mean estimates from FEIV regressions estimated separately by subgroup, complementing the FEIV-UQR results. Consistent with the figures, subgroup mean estimates remain generally small. However, we observe moderate, statistically significant effects for the middle-GRIT group and the non-college graduate group, pointing to wage improvements concentrated in the middle segment. We also observe a significantly positive mean effect among workers with the lowest IT skills, which may include many workers in jobs with little IT use, even if the employees' overall skills are not necessarily low. Collectively, the results suggest that increased low-skilled foreign labor has a negligible impact on average wages in the overall sample but may generate small gains for specific segments of the workforce, which become visible only when examining heterogeneity across the wage distribution and worker characteristics.

Japanese-language limitations provide one reason why native and foreign workers may differ in their effective contribution within low-skilled jobs. In the model, foreign-worker efficiency is represented by θ, while task reallocation can improve native productivity through A(F). Foreign workers performing routine activities may allow native workers to focus on Japanese-language-intensive customer service and coordination. This mechanism can mitigate wage pressure on native low-skilled workers, although a lower θ alone does not eliminate the decline in the marginal product as effective labor supply expands. The limited low-wage response is compatible with such productive adjustment; it does not directly establish that the offset condition in Proposition 2 holds. Proposition 3 predicts higher high-skilled wages, with a smaller proportional increase than for middle-skilled labor. The small and imprecise responses toward the upper end of the wage distribution can be reconciled with this relatively smaller effect, although support for a high-skilled wage increase itself remains limited. Highly specialized tasks may further limit both direct competition and opportunities for task reallocation among some high-wage workers, whose work is less closely connected to the routine activities affected by these inflows. This provides an additional possible interpretation of the weak upper-end response, rather than a separately tested mechanism.

5.3 Task Upgrading

Table 3 explores the task upgrading mechanism. Using FEIV regressions estimated separately for the total sample and each subgroup, it examines how the inflow of low-skilled foreign workers affects native workers' tasks in year $t + 1$. A negative coefficient suggests a shift away from routine task content. We focus on the level of routine tasks in $t + 1$ because such within-job reorganization and task reassignment may occur with a lag rather than contemporaneously.

The estimate of the total sample is negative and statistically significant, indicating an overall shift away from routine task content following a rise in the number of low-skilled foreign workers. The subgroup analysis suggests that this effect is concentrated in specific segments of the workforce, with the estimated effect significantly negative for regular workers, male workers, workers with high IT skills, those in the middle of the wage distribution—especially the third wage quintile—and those with a moderate level of GRIT. These groups broadly represent workers who are more likely to be eligible for task reallocation within firms. Workers in mid-level positions or with intermediate skill sets may be better able to shift away from routine tasks toward

more complex or non-routine activities when low-skilled labor becomes more available. Although these significant effects are not widespread, the pattern appears in several subgroups. These findings provide suggestive support for the task-reallocation channel represented by A(F) in Section 3. Native workers may spend less time on repetitive activities and more on customer interaction, explanation, or coordination, improving their productive contribution. The model's low-skilled input need not coincide with the lowest wage quintile, so task changes among middle-wage workers can also be relevant to this channel. The task and wage findings together support the proposed interpretation, although routine-task reductions do not directly measure productivity gains or identify a causal mediation effect on wages, and the subgroups with significant task and wage responses do not fully coincide.

Table 3. Heterogeneous Effects on the level of routine task in t+1 : Mean FEIV Estimates by Subgroup

Subgroup	Coefficient of foreign workers	*S.D.*	*N*	*N of ID*	F-statistic for excluded instruments
Total	-0.108**	(0.0547)	8,520	2247	314.3
Employment status					
Regular	-0.117*	(0.060)	5,558	1,463	235.6
Non-regular	-0.0885	(0.136)	2,648	782	81.76
Gender					
Male	-0.138**	(0.068)	4,870	1,256	208.8
Female	-0.0609	(0.091)	3,650	991	107.5
Education					
Non-college graduate	-0.113	(0.070)	5,130	1,358	203.4
College graduate	-0.0939	(0.089)	3,374	883	111.1
IT skill					
Low IT skill	-0.0958	(0.112)	2,497	792	80.21
High IT skill	-0.119*	(0.065)	5,492	1,540	213.4
Routine task					
High Routine task	-0.186	(0.127)	2,493	852	67.72
Low Routine task	-0.0929	(0.067)	4,988	1,498	214.8
Wage					
Q1(Lowest)	-0.118	(0.191)	1,282	444	41.05
Q2	0.146	(0.156)	1,238	445	40.39
Q3	-0.421***	(0.148)	1,386	495	52.25
Q4	-0.00921	(0.127)	1,514	505	60.85
Q5(Highest)	0.0117	(0.096)	1,426	448	81.74
GRIT score					
Low GRIT	-0.149	(0.103)	3,249	875	87.73
Middle GRIT	-0.161**	(0.081)	3,041	791	158.6
High GRIT	0.0187	(0.111)	2,137	556	77.73
English skill					
None	-0.0485	(0.094)	2,931	755	117.7
Limited	-0.144	(0.112)	2,675	692	78.16
Able	-0.224	(0.432)	398	100	29.31

Source: Authors' calculations using the JHPS, the Immigration Services Agency of Japan's Statistics on Foreign Residents, and the Labor Force Survey.

Note: 1) The reported coefficients are conditional on controlling for years of tenure and years of tenure squared in all specifications, which are estimated with individual, prefecture, and year fixed effects and standard errors clustered at the individual level.
2) Instrumental variables estimation is implemented using a Bartik-type (shift-share) instrument.
3) Standard deviations are reported in parentheses.
4) ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

5.4 Impact on Well-being

We examine subjective well-being as complementary evidence on welfare outcomes beyond wages and tasks. Table 4 presents the estimated effects of low-skilled foreign worker inflows on four SWB outcomes—job satisfaction, work engagement, life satisfaction, and subjective health—along with heterogeneity across key worker characteristics. In the total sample, the estimated effects on job satisfaction, work engagement, and subjective health are small and statistically indistinguishable from zero, indicating limited average responses in job-related well-being and self-rated health. In contrast, life satisfaction shows a modest negative average effect that is statistically significant at the 10% level, indicating that overall life evaluation may be more responsive to low-skilled foreign-worker exposure than job-specific measures are.

This pattern is broadly consistent with the non-pecuniary channels discussed in Section 3.4. Well-being depends on income-related effects as well as benefits and costs associated with working conditions and local amenities. Limited average responses in job-related well-being coexist with a negative life satisfaction response, suggesting that changes beyond wages and the immediate workplace may be relevant.

The subgroup analyses reveal differences in estimated responses underlying this average pattern. By employment status, the negative life satisfaction response is concentrated among non-regular workers, while the corresponding estimate for regular workers is smaller and statistically insignificant. A similar pattern appears along the wage distribution. Workers in the bottom wage quintile experience a large and statistically significant decline in life satisfaction, accompanied by a deterioration in subjective health. In contrast, estimates for higher-wage quintiles are generally closer to zero and statistically insignificant. Routine task content also points to a similar non-pecuniary channel: life satisfaction declines significantly among workers in highly routine jobs, while the estimate for less routine jobs is close to zero. Non-cognitive and IT skills show significant effects only in specific subgroups, with little evidence of systematic gradients across groups. These results are compatible with the distinction between wage and non-pecuniary outcomes in Section 3.4: perceived competition, reduced job security, or workplace adjustment burdens may outweigh benefits from labor-shortage relief even when wage responses are limited.

Additional heterogeneity factors demonstrate that well-being responses are not monotonic across worker characteristics. The English proficiency split indicates negative effects on job satisfaction among workers with limited English proficiency (significant at the 5% level) and those able to use English (significant at the 10% level). Work engagement also declines in the latter group at the 10% level. One possible interpretation is that language barriers in Japanese workplaces increase communication-related adjustment costs for workers with higher English proficiency. These workers may be more likely to take on informal coordination between foreign and native workers, which could reduce job satisfaction even in the absence of wage losses. The

results for workers with limited English proficiency should be interpreted cautiously because some estimates are imprecise.

Collectively, these results highlight that the SWB consequences of low-skilled immigration are heterogeneous and cannot be summarized by average effects alone. The wage results show little evidence of broad wage losses and generally muted average wage effects. Read alongside these findings, the concentration of negative well-being responses among non-regular workers, bottom wage workers, and workers in highly routine jobs suggests that adverse impacts are more likely to operate through non-pecuniary channels rather than through wage declines. These channels may include perceived job insecurity, workplace adjustment costs, communication frictions, informal coordination burdens, and changes in local conditions such as congestion and amenities. Overall, the evidence is broadly consistent with the framework in Section 3.4, suggesting uneven welfare effects that reflect heterogeneous combinations of income-related and non-pecuniary channels.

Table 4. Heterogeneous Effects on Well-being: Mean FEIV Estimates by Subgroup

(1) Work-related subjective well-being

	Job satisfaction					Work Engagement				
	Coeff. of foreign workers	*S.D.*	*N*	*N of ID*	F-stat. for excluded instruments	Coeff. of foreign workers	*S.D.*	*N*	*N of ID*	F-stat.for excluded instruments
Total	-0.003	(0.047)	14,188	3499	1286	-0.015	(0.024)	14,190	3503	1287
Subgroup										
Employment status										
Regular	0.028	(0.055)	8,880	2199	871.5	0.020	(0.026)	8,893	2209	878.3
Non-regular	-0.020	(0.105)	4,747	1316	377.7	-0.086	(0.053)	4,745	1317	377.4
Sex										
Male	0.005	(0.058)	7,828	1853	774.8	0.004	(0.031)	7,833	1855	777.5
Female	-0.013	(0.080)	6,360	1646	501.7	-0.044	(0.037)	6,357	1648	499.7
Education										
Non-college graduate	0.044	(0.062)	8524	2081	835.5	-0.004	(0.031)	8522	2081	836.4
College graduate	-0.095	(0.072)	5622	1403	438.9	-0.041	(0.038)	5627	1407	438.5
GRIT score										
Low GRIT	0.043	(0.089)	5,026	1140	317.4	-0.017	(0.046)	5,029	1138	319.6
Middle GRIT	-0.034	(0.062)	4,674	1052	599.4	-0.001	-0.034	4,669	1055	603.1
High GRIT	-0.066	(0.110)	3,222	714	303.2	-0.047	(0.051)	3,221	715	298
English skill										
None	0.092	(0.075)	4,385	958	460	0.007	(0.037)	4,384	957	460
Limited	-0.190**	(0.095)	3,937	841	310.5	-0.073	(0.045)	3,934	840	313.5
Able	-0.557*	(0.306)	558	116	70.78	-0.252*	(0.131)	559	116	70.81
Routine task										
High routine task	0.037	(0.081)	4,357	1397	406.2	-0.024	(0.047)	4,361	1398	410.4
Low routine task	-0.020	(0.061)	8,035	2254	844.1	0.003	(0.029)	8,039	2253	830.9
Wage										
Q1(Lowest)	-0.168	(0.154)	2,265	757	205.2	0.0238	(0.0711)	2,265	758	203
Q2	-0.000468	(0.134)	2,103	725	132	-0.0310	(0.0725)	2,103	726	137.6
Q3	0.0220	(0.133)	2,236	762	194.7	-0.0581	(0.0544)	2,251	769	196.4
Q4	-0.107	(0.0905)	2,451	777	271.2	-0.0333	(0.0500)	2,446	777	271.8
Q5(Highest)	0.0381	(0.101)	2,276	662	278.8	-0.0000673	(0.0499)	2,279	662	280.6
IT skill										
Q1(Lowest)	0.115	(0.0904)	3,528	1054	324	0.0106	(0.0558)	3,531	1056	324.8
Q2	0.116	(0.164)	1,495	548	178.8	-0.0627	(0.0622)	1,504	553	179.3
Q3	-0.0841	(0.0954)	3,405	1145	430.4	-0.0416	(0.0430)	3,396	1142	430.8
Q4	-0.175	(0.161)	892	351	73.46	0.0495	(0.0853)	891	351	72.95
Q5(Highest)	-0.0157	(0.130)	2,082	603	191.3	0.0176	(0.0593)	2,083	603	186.7

(2) Overall subjective well-being

	Life satisfaction					Subjective health				
	Coeff. of foreign workers	*S.D.*	*N*	*N of ID*	F-stat. for excluded instruments	Coeff. of foreign workers	*S.D.*	*N*	*N of ID*	F-stat.for excluded instruments
Total	-0.062*	(0.037)	14,212	3505	1284	-0.023	(0.020)	14,179	3500	1283
Subgroup										
Employment status										
Regular	-0.032	(0.043)	8,895	2204	870.6	-0.023	(0.024)	8,883	2207	868.3
Non-regular	-0.138*	(0.077)	4,757	1318	378.1	-0.030	(0.037)	4,743	1315	377.6
Sex										
Male	-0.059	(0.046)	7,840	1855	772.7	-0.015	(0.026)	7,823	1852	770.3
Female	-0.068	(0.063)	6,372	1650	502.6	-0.037	(0.031)	6,356	1648	503.6
Education										
Non-college graduate	-0.050	(0.050)	8,544	2086	834.4	-0.016	(0.025)	8,530	2084	832.3
College graduate	-0.080	(0.055)	5,626	1404	438.2	-0.031	(0.033)	5,607	1401	438.2
GRIT score										
Low GRIT	-0.059	(0.072)	5,031	1140	316.3	-0.021	(0.040)	5,021	1137	317.4
Middle GRIT	-0.067	(0.050)	4,681	1053	598.4	-0.055*	(0.029)	4,676	1055	598.4
High GRIT	-0.074	(0.086)	3,226	715	302.8	0.015	(0.036)	3,219	716	301.8
English skill										
None	-0.042	(0.060)	4,387	958	457.5	0.007	(0.034)	4,379	957	458.2
Limited	-0.115*	(0.066)	3,944	841	310.5	0.029	(0.039)	3,927	839	309.1
Able	-0.310	(0.249)	558	116	71.11	-0.168	(0.155)	556	116	68.90
Routine task										
High routine task	-0.154**	(0.071)	4,371	1401	408.4	-0.061	(0.038)	4,347	1392	404.7
Low routine task	-0.006	(0.047)	8,042	2256	841.5	-0.009	(0.025)	8,027	2254	837
Wage										
Q1(Lowest)	-0.340***	(0.122)	2,272	760	204.7	-0.108**	(0.0550)	2,265	758	204.6
Q2	0.0154	(0.108)	2,109	727	135.6	0.0492	(0.0717)	2,101	724	133.6
Q3	0.0308	(0.115)	2,246	766	193.4	0.0108	(0.0508)	2,243	767	195.5
Q4	-0.0309	(0.0696)	2,451	777	270.9	0.0386	(0.0475)	2,444	774	270.4
Q5(Highest)	-0.0122	(0.0708)	2,274	659	276.3	-0.0682	(0.0414)	2,273	659	279.9
IT skill										
Q1(Lowest)	-0.000828	(0.0795)	3,544	1059	325.6	-0.0135	(0.0437)	3,527	1055	320.3
Q2	0.00120	(0.0992)	1,501	551	179.4	-0.0141	(0.0589)	1,497	551	181.3
Q3	-0.146**	(0.0741)	3,403	1144	426.9	-0.00115	(0.0363)	3,398	1143	427.8
Q4	0.145	(0.131)	894	352	74.36	0.0736	(0.0834)	887	349	73.89
Q5(Highest)	0.0627	(0.107)	2,084	603	191.7	-0.0824	(0.0593)	2,084	603	192.5

Source: Authors' calculations using the JHPS, the Immigration Services Agency of Japan's Statistics on Foreign Residents, and the Labor Force Survey.

Note: 1) The reported coefficients are conditional on controlling for years of tenure and years of tenure squared in all specifications, which are estimated with individual, prefecture, and year fixed effects and standard errors clustered at the individual level.

2) Instrumental variables estimation is implemented using a Bartik-type (shift-share) instrument.

3) ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

5.5 Robustness Checks

(1) Robustness of Statistical Inference

In the baseline specification, standard errors are clustered at the individual level. However, if unobserved factors are correlated within prefectures, inference based on individual-level clustering may overstate statistical significance. We account for this possibility by re-estimating p-values using a wild cluster bootstrap at the prefecture-level, which is appropriate in settings with a limited number of clusters, as in our case with 47 prefectures (Cameron et al., 2008). Results are presented in Table C1 in Appendix C, which reports inference based on alternative clustering schemes.

The point estimates remain positive in the upper-middle part of the wage distribution, but their statistical significance depends on the inference procedure. Conventional prefecture-clustered tests do not reject the null of no effect at the 10% level at the reported quantiles. The wild cluster bootstrap yields p-values of 0.059 and 0.080 at the 64th and 66th percentiles, respectively, retaining evidence at the 10% level at these two quantiles. These findings provide qualified support for positive wage responses in the upper-middle part of the distribution.

Table C1 also reports first-stage diagnostics in its notes. The first-stage F-statistic is approximately 1,303 under individual-level clustering and 21.51 under prefecture-level clustering. These diagnostics reduce concerns about a weak first stage in the total-sample specification, while the second-stage inference remains sensitive to the method used to account for within-prefecture dependence.

(2) Instrument Validity Beyond Weak-Instrument Concerns

In addition to weak-instrument concerns, we examine the composition of the identifying variation and potential mechanical correlations using a Rotemberg decomposition and a leave-one-out IV specification. Table C2 reports the decomposition for a 2023 cross-sectional diagnostic, following Goldsmith-Pinkham et al. (2020). Vietnam, Indonesia and China receive weights of 43.3%, 19.5% and 13.6%, respectively. The five largest positive weights sum to 89.1%. Their country-specific IV estimates are positive, ranging from approximately 0.013 to 0.035. Negative weights sum to −0.0551, accounting for approximately 5.0% of the sum of absolute weights. This diagnostic indicates concentration in a small number of origin countries; it does not directly decompose the panel FEIV-UQR estimates or establish the exclusion restriction.

Second, following Jaeger et al. (2018), we implement a leave-one-out IV estimator to address potential mechanical bias arising from the inclusion of local immigration flows in the instrument's construction. The results, reported in Table C3 in Appendix C, remain stable relative to the baseline specification, maintaining the positive wage effects for middle-income workers (e.g., from 0.0184 to 0.0240 at the 60th percentile). The first-stage F-statistic remains sufficiently large, indicating that instrument strength is not compromised; this conclusion also holds under more conservative prefecture-level clustering (see Table C1). These findings indicate that mechanical correlations between local immigrant inflows and the aggregate components do not drive the baseline estimates. Collectively, these findings suggest that, although the identifying variation is concentrated in a limited number of origin-country components, the estimated effects

are not driven by mechanical bias or any single dominant component. This supports the validity of our identification strategy.

(3) Alternative Explanations

A key concern in our setting is that the postreform period overlaps with the COVID-19 pandemic, which may confound the relationship between immigration and local labor market outcomes. We address this concern using two complementary approaches, with the results presented in Table C4 in Appendix C. First, we exploit the variation in Japan's border control policies. When we restrict the sample to the border closure period (survey years up to 2022), the first-stage F-statistic drops to near zero ($F = 0.027$), indicating that the instrument loses explanatory power when cross-border mobility is effectively shut down. Consequently, the second-stage IV estimates become highly unstable and imprecise, with large coefficients and standard errors, as expected when the instrument loses relevance. This evidence confirms that our instrument captures policy-driven international migration flows rather than reflecting spurious native trends.

Second, we directly control for the local severity of the pandemic by including prefecture-level COVID-19 infection and death rates (per 1,000 population). Including these controls leaves our main results largely unchanged, with positive wage effects remaining at the 40th and 60th percentiles. The first-stage relationship also remains strong (F-statistics above conventional thresholds; see Table C4). These results reduce concerns that the measured prefecture-level pandemic variables explain the baseline estimates, although unmeasured pandemic-related shocks may still matter. Additional robustness checks restricting the sample to non-movers yield qualitatively similar results, further supporting the robustness of our findings.

(4) Placebo Tests

Finally, to assess whether the baseline pattern also appears with a randomized instrument, we conduct a placebo test by randomly reassigning the Bartik components (national growth rates) across prefecture-year cells and re-estimating the model. Table C5 in Appendix C presents the results. This procedure preserves the instrument's overall distribution while breaking its link to local labor market conditions. Under this randomized Bartik IV, the systematic distributional pattern revealed in the baseline results disappears. In particular, the positive wage effects concentrated in the upper-middle part of the distribution disappear, and the estimates fluctuate around zero without a consistent pattern. These findings provide an evidence that spurious spatial correlations do not drive our baseline results but instead reflect the causal effect of local exposure to immigrant inflows.

6. Conclusion

This study examines how inflows of low-skilled foreign workers affect native workers' wages, job tasks, and subjective well-being in Japan. We exploit sharp temporal and regional variations generated by the 2019 introduction of the SSW program and the subsequent COVID-19 shock. To interpret heterogeneous effects, we also develop a nested CES framework that preserves three skill groups and represents task upgrading as an improvement in native low-skilled productivity.

Foreign inflows expand effective low-skilled input and raise the marginal products of complementary middle- and high-skilled labor, while native low-skilled wages depend on the balance between productivity gains and supply pressure. A separate utility block describes non-pecuniary channels shaping SWB.

Empirically, we estimate individual fixed-effects specifications and address the endogenous location choices of foreign workers using a Bartik-type FEIV that combines nationality-specific settlement shares in 2019 with the corresponding national stocks in each year among foreign residents holding work-related residence statuses. For wages, we further combine this approach with FEIV-UQR to trace effects across the wage distribution. Overall, average wage effects are close to zero, and mean FEIV estimates remain small in both the total sample and most subgroup splits. However, FEIV-UQR estimates reveal modest positive effects around the middle of the distribution—most notably near the 40th percentile and the mid-60s percentiles—while estimates at the lower and upper tails are generally small and imprecise. Extending FEIV-UQR to key subgroups—by employment status (regular vs. non-regular), education (non-college graduates vs. college graduates), IT skills (low vs. high), non-cognitive skills (GRIT), English ability, and routine task content (high vs. low)—yields broadly similar patterns. These findings are broadly consistent with the production-complementarity mechanism in Proposition 1. The absence of clear wage losses at the bottom is compatible with Proposition 2, under which task-related productivity gains can offset the decline in the marginal product of effective low-skilled labor. The weak response at the upper end can be reconciled with the smaller proportional gain for high-skilled than middle-skilled labor in Proposition 3, although a high-skilled wage increase itself is not clearly established. Observed wage quantiles and skill subgroups do not directly identify the model's production inputs.

We also find suggestive evidence consistent with task upgrading. The estimated effects on routine task content in t+1 are negative for the total sample and for several subgroups, including regular workers, male workers, workers with high IT skills, workers in the middle of the wage distribution, and those with moderate GRIT. Although these effects are not widespread, they provide suggestive support for the task-reallocation channel in our framework: some native workers appear to shift away from routine tasks when low-skilled foreign labor becomes more available. Taken together, the wage and task patterns are broadly qualitatively consistent with production complementarity and productive task adjustment. They do not directly identify productivity gains or the contribution of task reallocation to wages.

Regarding SWB, the results are more heterogeneous. The FEIV estimates indicate limited average effects on job-related subjective well-being—namely, job satisfaction and work engagement—and on subjective health in the total sample. By contrast, life satisfaction shows a modest but statistically significant negative average effect. Subgroup analyses reveal that these adverse responses are not uniform across workers. Declines in life satisfaction are concentrated among non-regular workers, those at the bottom of the wage distribution, and those engaged in highly routine tasks, and are accompanied by a deterioration in subjective health for the lowest wage group. These patterns are broadly consistent with Section 3.4, which allows wage gains or limited wage responses to coexist with lower well-being when non-pecuniary costs outweigh the benefits. Additional heterogeneity, including lower job satisfaction among workers with higher English proficiency, suggests that communication-related adjustment costs and informal

coordination burdens may also matter in Japanese workplaces, although these subgroup results should be interpreted cautiously.

A series of robustness checks supports the credibility of our findings. The point-estimate pattern is unchanged by the clustering choice, but statistical significance is sensitive to inference: conventional prefecture-clustered tests are insignificant at the reported quantiles, whereas wild cluster bootstrap tests retain significance at the 10% level at the 64th and 66th percentiles. A Rotemberg decomposition and a leave-one-out specification provide further diagnostics of concentrated identifying variation and potential mechanical bias. We also address potential confounding from the COVID-19 pandemic: the instrument loses explanatory power during the border closure period, while controlling for prefecture-level COVID-19 infection and death rates leaves the main results largely unchanged. Furthermore, analyses restricted to non-movers yield qualitatively similar results. Overall, these checks support the stability of our findings, while leaving the identifying assumptions open to further scrutiny.

Taken together, the results suggest that recent expansions of low-skilled foreign labor in Japan are not associated with statistically detectable broad wage losses for native workers in our estimates. Wage impacts are generally small and uneven, with modest gains appearing mainly around the middle of the wage distribution rather than at the bottom or the top. In terms of non-pecuniary effects, the evidence points to uneven impacts on SWB. While work-related SWB shows little average change, life satisfaction declines modestly, with adverse responses concentrated among non-regular workers, those at the bottom of the wage distribution and those engaged in highly routine tasks. Viewed through our theoretical framework, the coexistence of moderate wage gains concentrated in the middle of the distribution and concentrated losses in SWB among specific groups highlights the joint operation of income-related adjustments and non-pecuniary, environment-related channels—such as perceived job insecurity, workplace adjustment costs, and local congestion or amenity pressures—in shaping the welfare consequences of low-skilled immigration.

From a policy perspective, the evidence suggests that in contexts with persistent labor shortages, expanding low-skilled foreign labor is unlikely to depress native wages significantly in the short- to medium-run. However, it may still entail non-pecuniary costs for certain groups. This highlights the value of complementary policies that facilitate workplace adjustment—such as training, task redesign, communication support, and clearer allocation of coordination responsibilities—and that address local pressures on housing, commuting, and public services in high-exposure areas.

The policy implication is therefore not only whether to admit additional foreign workers, but also how to organize work so that their arrival generates benefits for native employees. The joint wage and task patterns point to the potential value of training and job redesign that allow native workers to undertake complementary customer-facing, technical, or coordination activities. Access to these opportunities may be particularly important for workers with limited scope for internal reassignment, including non-regular employees. Because the task results do not identify a causal mediation effect on wages, these measures should be understood as policy directions suggested by the evidence rather than interventions whose effectiveness is established by this study.

The heterogeneous well-being results also motivate attention to the allocation of

adjustment burdens. Japanese-language support, clear communication procedures, and explicit recognition of coordination responsibilities may help prevent informal support duties from falling disproportionately on particular native workers. These workplace measures are more closely connected to the observed task and well-being patterns than policies addressing local congestion, housing, or public services, which remain possible considerations but are not directly evaluated here. Facilitating productive adjustment while monitoring burdens on vulnerable groups can complement the objective of alleviating labor shortages.

Several limitations of this study should be kept in mind when interpreting its results. First, our analysis focuses on short- to medium-run adjustments after the 2019 SSW reform and the COVID-19 shock; thus, longer-run effects on career trajectories, occupational mobility, and firm-level reorganization may differ. Second, our empirical design relies on prefecture-level exposure and a postreform period that overlaps with the COVID-19 pandemic. While these features may raise concerns about spatial measurement and pandemic-related confounding, our robustness checks, including analyses restricted to non-movers, controls for local pandemic severity, and tests exploiting border control variation, suggest that these factors are unlikely to be the primary drivers of our results. Finally, sample size and module availability limit precision in some subgroup and distributional estimates, implying that it may be difficult to detect smaller effects—especially at the tails of the wage distribution.

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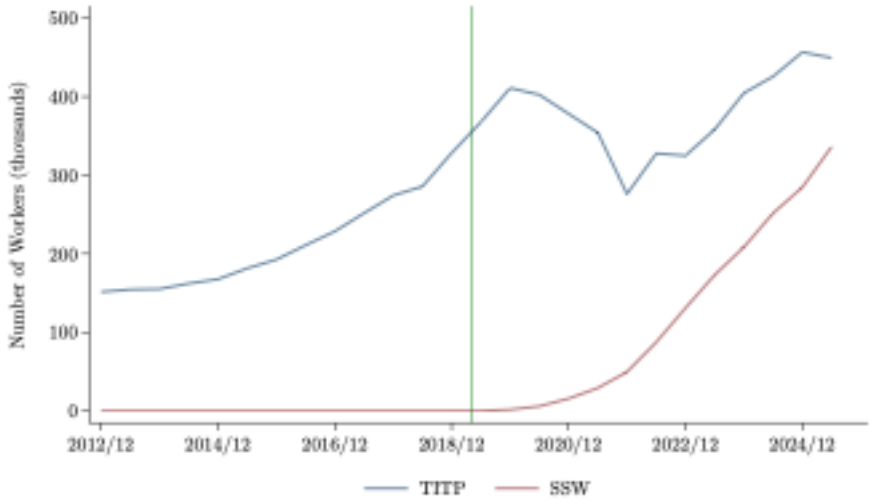
Appendix A. Institutional Background

This appendix outlines the institutional context of the "Technical Intern Training Program (TITP)" and the "Specified Skilled Worker (SSW)" scheme, focusing on their roles as labor supply channels and the source of variation exploited in our identification strategy.

A1 Evolution of Foreign Labor Policy

Historically, Japan restricted the acceptance of low-skilled foreign workers. However, to address chronic labor shortages, the government has gradually expanded supply channels. The most significant reform was the introduction of the "Specified Skilled Worker" (SSW) status in April 2019.

Figure A1. Trends in the Stock of Foreign Workers (TITP and SSW)



Source: Immigration Services Agency of Japan.
Note: The vertical line indicates the introduction of SSW (April 2019).

Prior to 2019, the "Technical Intern Training Program" (TITP), established in 1993, served as the de facto channel for low-skilled labor while being formally framed as a program for international contribution and skill transfer. While TITP trainees were legally restricted from changing employers, the new SSW status officially recognizes foreign nationals as workers, granting them greater mobility and rights. The 2019 reform marked a structural break, explicitly targeting labor-shortage sectors such as agriculture, construction, and care work. As shown in Figure A1, inflows were initially constrained by border controls during 2020 to early 2021, but the stock of SSW workers rose sharply after restrictions were eased, generating substantial policy-driven variation in low-skilled foreign labor supply.

Table A1 compares the work covered by TITP and SSW Type 1, using the 12 official SSW industrial fields as the reference. The schemes overlap substantially in manufacturing, construction, agriculture, care and services, although the permitted activities are not identical. TITP formally aims to transfer skills through international cooperation, whereas SSW addresses labor shortages. We combine residents holding either status in the exposure measure; these institutional categories do not directly measure individual skills.

Table A1. Work Covered by TITP and SSW Type 1, as of August 30, 2022

SSW industrial field	TITP	SSW Type 1
Nursing care	✓	✓
Building cleaning	✓	✓
Machine parts and tooling, industrial machinery, and electric, electronics and information industries	✓	✓
Construction	✓	✓
Shipbuilding and ship machinery	✓	✓
Automobile repair and maintenance	✓	✓
Aviation	△ (airport ground handling)	✓
Accommodation	✓	✓
Agriculture	✓	✓
Fishery and aquaculture	✓	✓
Food and beverage manufacturing	✓	✓
Food service	△ (medical/welfare facility meal production)	✓

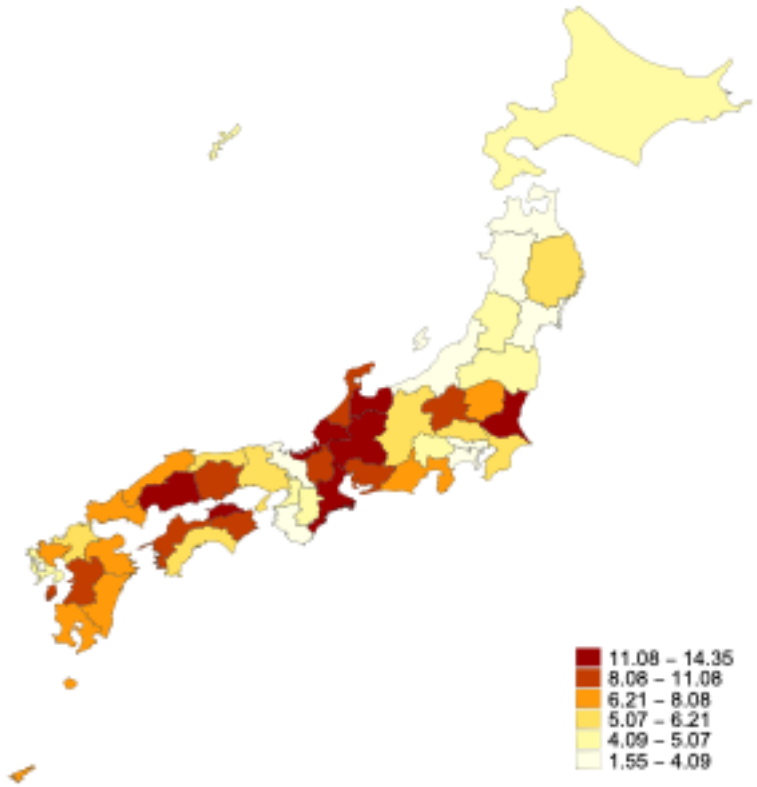
Source: Authors' compilation based on Immigration Services Agency of Japan (2023, pp. 111–113), Ministry of Justice and Ministry of Health, Labour and Welfare (2016, Appended Table 2; 2017, paragraph 2). Coverage is shown as of August 30, 2022.

Note: ✓ indicates that related work is covered; △ identifies the corresponding work in parentheses. Permitted activities differ between the schemes. TITP entries refer to designated occupations for second-year training onward. TITP also covers textile/clothing and other occupations outside the 12 SSW fields.

A2 Geographic Distribution and Identification

The settlement of these workers is highly uneven across Japan. Figure A2 illustrates the geographic concentration of low-skilled foreign labor (TITP and SSW) relative to total employment in 2019. Immigrants tend to cluster in specific regions based on historical networks of their co-nationals. Our identification strategy (Bartik instrument) exploits this variation: we predict the local inflow of foreign workers by interacting the historical settlement patterns of each nationality (Initial Share; prefecture-level shares of foreign workers of each nationality in the pre-reform period) with the national-level increase in low-skilled foreign labor supply over time (National Shift; the post-2019 change in the total national stock of foreign workers by nationality). This approach relies on the well-established observation that new immigrants tend to settle in areas with existing networks of their countrymen (Card, 2001). While placements under TITP and SSW are mediated by firms and supervising organizations and concentrated in designated labor-shortage sectors, the geographic distribution of these workers is highly persistent and uneven across prefectures. This persistence motivates using pre-reform local exposure as the initial share in the shift–share design and supports the relevance and plausibility of the shift–share design.

Figure A2. Share of Foreign Workers (TITP and SSW) by Prefecture



Source: Immigration Services Agency of Japan.

Appendix B. Measurement and Construction of Key Indices

B1. Utrecht Work Engagement Scale (UWES-9)

The UWES-9 is a measure developed by Shimazu et al. (2008) to capture a positive mental state toward work. It consists of 9 questions grouped into 3 categories (vigor, dedication, and absorption). The final score is calculated by averaging the response, using 6-point scale. A higher score indicates greater work engagement.

B2. IT skill index

I The IT skill index is our original measure constructed from three survey questions on (i) basic tasks using spreadsheet software, (ii) the use of macro functions (recording and iteration) in spreadsheet applications, and (iii) data processing and analysis with programming languages. Responses are recorded on a five-point scale. We compute the index as the average score across the three items, and we reverse-code the responses so that higher values indicate higher IT skills.

Table B1. Question items for IT skill

Q2. How much computer skills do you have to perform your job?

	I can do without trouble	I can do to some extent	I can hardly do	I cannot	I don't know
(1) Basic processing using a spreadsheet software	**1**	**2**	**3**	**4**	**5**
(2) Processing using a macro function (recording and iteration) if spreadsheet software	**1**	**2**	**3**	**4**	**5**
(3) Data processing and analyzing using a programming language	**1**	**2**	**3**	**4**	**5**

B3. GRIT

GRIT is an indicator that reflects one's perseverance and passion for long-term goals. In this survey, we use the 12-item questionnaire developed by Duckworth et al. (2007), with the Japanese translation provided by Takehashi, Higuchi, Ozaki, et al. (2019). From the 12 items, two factors are extracted: Consistency of Interest and Perseverance of Effort. These can be used separately as two indicators, or combined into a single GRIT score. In both cases, higher values indicate stronger grit.

Appendix C. Robustness checks

Table C1. Inference Robustness: Alternative Clustering and Wild Bootstrap

Quantile	Coefficient	*p-value*		
		ID cluster	Prefecture cluster	Prefecture cluster (wild bootstrap)
20	-0.0073	0.422	0.558	0.523
40	0.0222	0.091	0.222	0.177
60	0.0245	0.117	0.265	0.204
64	0.0370	0.033	0.110	0.059
66	0.0373	0.034	0.134	0.080
68	0.0311	0.099	0.195	0.134
80	0.0136	0.622	0.753	0.730

Source: Authors' calculations using the JHPS, the Immigration Services Agency of Japan's Statistics on Foreign Residents, and the Labor Force Survey.

Note: 1) This table reports IV estimates from unconditional quantile regressions. Standard errors are clustered at the individual level (ID cluster) or prefecture level (Prefecture cluster).

2) The final column reports null-imposed wild cluster bootstrap-t p-values with prefecture-level clustering, Rademacher weights, 9,999 replications and seed 12345. All specifications include individual, prefecture and year fixed effects. For bootstrap computation, individual effects are absorbed and prefecture and year indicators are included explicitly; the estimation sample and point estimates are the same as in the baseline FEIV specification.

3) The first-stage F-statistics are 1,303.45 with individual-level clustering and 21.51 with prefecture-level clustering. The sample comprises 14,255 observations, 3,511 individuals and 47 prefectures. Conventional p-values use the corresponding cluster-based degrees of freedom.

Table C2. Rotemberg Decomposition: Identifying Variation of the Bartik Instrument

Rank	Origin Country	Rotemberg Weight (Share)	Country-specific estimate (β_k)
1	Vietnam	0.433	0.014
2	Indonesia	0.195	0.013
3	China	0.136	0.035
4	Philippines	0.088	0.017
5	Thailand	0.040	0.015

Source: Authors' calculations using the JHPS, the Immigration Services Agency of Japan's Statistics on Foreign Residents, and the Labor Force Survey.

Note: 1) This table reports the five largest positive Rotemberg weights from a 2023 cross-sectional diagnostic (Goldsmith-Pinkham et al., 2020), controlling for tenure, tenure squared and CPI. The component instruments incorporate the prefectural employment denominator used in the Bartik instrument. It is not a decomposition of the panel fixed-effects quantile estimates.

2) The column β_k reports the IV estimate obtained using each country-specific shock separately.

3) The five reported weights sum to 89.1% of the total signed weight. All country weights sum to one; negative weights sum to −0.0551 and represent 5.0% of the sum of absolute weights.

Table C3. Leave-one-out IV Robustness

Quantile	Baseline coefficient (SE)	Leave-one-out IV coefficient (SE)
20	-0.007 (0.009)	-0.008 (0.009)
40	0.022* (0.013)	0.018 (0.012)
60	0.025 (0.016)	0.024 (0.015)
80	0.014 (0.028)	0.013 (0.026)

Source: Authors' calculations using the JHPS, the Immigration Services Agency of Japan's Statistics on Foreign Residents, and the Labor Force Survey.

Note: 1) This table reports IV estimates from unconditional quantile regressions. The second column shows the baseline specification, while the third column reports estimates using a leave-one-out Bartik instrument that excludes each prefecture's own immigrant inflow from the national aggregate shock.
2) Standard errors are clustered at the individual level and reported in parentheses. All specifications include individual, prefecture, and year fixed effects.
3) First-stage F-statistics are identical across quantiles and equal to 1538, indicating that instrument strength is preserved under the leave-one-out construction and well above conventional thresholds (e.g., $F > 10$).
4) ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

Table C4. Robustness to COVID-19 and Sample Period

Quantile	(1) Year ≤ 2022	(2) Year ≥ 2023	(3) COVID Controls
20th	3.838 (23.43)	-0.0345** (0.0155)	-0.0073 (0.0091)
40th	1.672 (11.16)	0.0112 (0.0240)	0.0222* (0.0131)
60th	-0.907 (8.735)	0.0023 (0.0307)	0.0245 (0.0156)
80th	-2.835 (20.48)	-0.0032 (0.0508)	0.0136 (0.0276)
First-stage F-statistic	0.0273	1581	1303

Source: Authors' calculations using the JHPS, the Immigration Services Agency of Japan's Statistics on Foreign Residents, and the Labor Force Survey.

Note: 1) This table reports IV estimates from unconditional quantile regressions under alternative specifications related to the COVID-19 pandemic. Column (1) restricts the sample to the border-closure period (survey years up to 2022). Column (2) uses the post-reopening period (2023 onward). Column (3) includes prefecture-level COVID-19 infection and death rates (per 1,000 population) as controls.
2) Standard errors are clustered at the individual level and reported in parentheses. All specifications include individual, prefecture, and year fixed effects.
3) ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

Table C5. Placebo Test: Randomized Bartik Instrument

Quantile	Coefficient (SE)
20th	0.004 (0.030)
40th	0.055 (0.046)
60th	0.010 (0.059)
80th	-0.021 (0.092)
First-stage F-statistic	125.29

Source: Authors' calculations using the JHPS, the Immigration Services Agency of Japan's Statistics on Foreign Residents, and the Labor Force Survey.

Note: 1) This table reports IV estimates from unconditional quantile regressions using a randomized Bartik instrument. National shocks are randomly reassigned across prefecture-year cells, preserving the distribution of the instrument while removing its economic content.

2) Standard errors are clustered at the individual level and reported in parentheses. All specifications include individual, prefecture, and year fixed effects.

3) The absence of systematic patterns across quantiles confirms that the baseline results are not driven by spurious spatial correlations.

4) ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.