Population Shocks, Firm Modernization, and Economic Growth: Evidence from Japan's Decolonization

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Abstract

I study Japan's post-WWII repatriation of six million people, one of the largest migration episodes in modern history, to examine how population shocks affect economic growth through firm modernization. I exploit Allied repatriation logistics and predetermined family registry locations to identify the effects of repatriate inflows. Cities receiving more high-skilled repatriates, who had accumulated managerial human capital in the colonies, experienced higher income per capita and a shift from traditional, family-run firms toward modern multi-unit firms with outside managers and more establishments per firm. These organizational changes allowed firms to absorb labor released from agriculture and accelerated structural transformation. I interpret these findings with a spatial model in which managerial human capital relaxes delegation constraints. The model matches the empirical patterns and predicts that high-skilled inflows expand the supply of managers, induce firms to hire more managers and operate more product lines, absorb workers from the agriculture sector, and raise income per capita. Using the estimated model, I find that high-skilled repatriation raised income per capita by 13.6 percent after 20 years.

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1 Introduction

How does population inflow affect economic growth? Standard growth and spatial models predict that larger populations raise productivity by generating more ideas or amplifying knowledge spillovers. However, the role of firm modernization in this relationship remains less understood. Firms in low-income countries typically operate as small, traditional, family-run units, while those in high-income economies rely on outside managers and modern, multi-unit production. While low-skilled labor inflows expand the workforce, they might fail to relax the managerial bottlenecks, such as supervision and coordination, that limit firm expansion. In contrast, high-skilled workers, especially managers, can relax these organizational constraints, enabling firms to professionalize management, transition into multi-unit organizations, and generate productivity gains. Thus, the impact of population shocks on economic growth depends on the skill composition of new arrivals and their ability to modernize local economies.

Although understanding how population inflows drive firm modernization is important for designing policies to modernize low-income economies and promote economic development, analyzing the relationship creates two major challenges. First, it requires a framework that can capture how heterogeneous workers affect firm modernization, structural transformation, and economic growth at both local and national levels. Second, identifying causal effects is difficult because population size is not randomly assigned. Workers sort into locations based on economic conditions, creating endogeneity. As a result, simple cross-sectional correlations between population inflows and modernization are uninformative.

In this paper, I study how population inflows affect economic growth and development in three steps. First, I exploit Japan's post-World War II repatriation, one of the largest migration episodes in modern history, to study how a sudden increase in population affects growth, focusing on its differential impact on the modernization of local economies between high- and low-skilled workers. I use predetermined family registry locations and Allied-controlled repatriation logistics as instruments to address the concern that repatriates settled in cities with better economic prospects. Second, I develop a spatial model with internal migration and two sectors, agriculture and non-agriculture, where in the non-agricultural sector, managers ease management constraints, allow firms to modernize and accommodate workers from agriculture, contributing to structural transformation. Third, drawing on the empirical findings, I estimate the model and conduct counterfactual analyses to quantify the aggregate impacts of population shocks and to evaluate the role of managers in economic growth and development.

First, I exploit the forced repatriation of over six million Japanese nationals after World

War II as a plausibly exogenous population shock. The massive inflow, equivalent to nearly 9% of the home population, was rapid and organized by Allied authorities. I digitize novel microdata on 460,000 repatriate households and more than 100,000 firms to track local economic responses. To identify causal effects, I construct an instrument variable using two predetermined features: family registry locations (*honseki*), which influenced post-World War II repatriate settlement but were not related to post-war economic outcomes, and Allied logistical assignments of landing ports. These two features help me isolate variation in repatriate settlement driven by historical ties and repatriation logistics rather than post-war economic opportunities.

Using the household repatriation microdata, I classify repatriates into high- and low-skilled groups based on pre-World War II occupations to study the differential impact of population inflow on firm modernization and economic growth. High-skilled repatriates were disproportionately white-collar workers employed in colonial governments and firms before the war. Because Japan maintained a sharp occupational hierarchy in its colonies, where Japanese workers almost exclusively occupied managerial and administrative positions while native workers were concentrated in agriculture and lower-tier roles, these high-skilled repatriates can be interpreted as bringing managerial human capital into local labor markets. This distinction is essential because managerial human capital is a key input for firm expansion and organizational modernization, allowing me to treat the inflow of high-skilled repatriates as an exogenous increase in local managerial capacity. I also use low-skilled repatriates who were agriculture workers or low-skilled service workers to study the potential differential impact of population inflow on firm modernization and economic growth.

I find that high- and low-skilled repatriates generate differential impact on local economic growth and modernization. High-skilled repatriates generated local economic growth through firm modernization, structural transformation, and internal migration.[1] Cities receiving more high-skilled returnees experienced a shift from traditional to modern firm organization. Firms became larger, transitioned from single-unit to multi-unit production, hired more wage workers, reduced the self-employed share, and raised the manager share.[2] These cities also saw faster growth in service and manufacturing sectors and higher output per worker in non-agricultural sectors. This economic transformation indicates that high-skilled workers modernized firms, accommodating workers out of agriculture, contributing to structural

[1] Kuznets (1973) identifies six features of modern economic growth, four of which are (i) growth of population, (ii) growth of productivity, (iii) structural change, reallocation from agriculture toward industry and the shift from family enterprises to modern impersonal firms, and (iv) urbanization driven by internal migration. My findings show that repatriation (the first characteristic) triggered the others: cities with more high-skilled repatriates saw higher productivity, greater internal migration, and faster structural change.

[2] In other words, in cities receiving more high-skilled returnees, firms transitioned from "small traditional enterprises" to "modern business enterprises," borrowing Chandler (1977)'s terminology.

transformation. In contrast, cities receiving low-skilled returnees showed little improvement in organizational structure or productivity, and in some cases faced slower modernization because the inflow expanded the pool of production workers without relaxing managerial constraints. Together, the results suggest that population inflow affects economic growth not uniformly, but through the contribution of high-skilled workers in enabling firms to transition from traditional, family-based production to multi-unit modern, professionally managed organizations.

Second, to interpret these empirical findings, I develop a spatial two sector model in which managerial human capital is heterogeneously distributed and firms can expand scope by delegating tasks to outside managers, following Akcigit et al. (2021). In non-agriculture, a firm operating more product lines dilutes the owner's managerial time, creating an endogenous delegation cutoff beyond which it hires outside managers. An inflow of high managerial human capital workers raises the local mean managerial human capital, increases the local supply of outside managers, and lowers the equilibrium manager wage. Lower manager wages reduce the delegation cutoff, increase manager intensity within firms, and make modern multi-line organization profitable for a larger set of firms, raising the average number of products per firm and reducing self-employment. The model therefore links high-skilled inflows to three empirical characteristics of modernization in the data: a decline in self-employed, a rise in managerial employment, and an increase in the number of establishments per firm, while low-skilled inflows that primarily raise production labor do not relax the managerial bottleneck and hence generate much weaker organizational change.

Next, I estimate the model's structural parameters combining microdata and simulation-based methods. I recover migration and location-choice parameters from repatriate origin-to-destination flows and estimate the Pareto shape of managerial skill from the upper tail of repatriate prewar incomes. I calibrate preference and technology parameters to expenditure shares and district-level production data. I estimate firm-organization parameters via the simulated method of moments, targeting the modern-firm share, manager employment share, and firm-size distribution. Finally, I recover the repatriate skill advantage and district-level mean managerial skill in 1970 using indirect inference that matches model-simulated manager-share responses to reduced-form estimates by exploiting the high-skill repatriate inflow.

To quantify how managerial human capital translates population shocks into national income per capita growth, I use the estimated model to conduct counterfactuals. I use the model since the estimated reduced-form estimates face the missing-intercept problem and abstract from general equilibrium adjustments. I find that high-skilled repatriation raised income per capita by 13.6 percent after 20 years.

Overall, this paper shows that managerial human capital is a key driver of modernization and growth, and that population shocks can translate into economic transformation through the contribution of high-skilled workers. These findings offer insights for low-income economies where managerial constraints limit development, suggesting that policies expanding managerial capacity can trigger firm modernization and economic growth.

Related Literature. First, I contribute to the literature on the economic effects of migration. Existing work focuses largely on partial equilibrium effects of immigration on labor markets, innovation, and entrepreneurship (Card (1990), Borjas (2003), Ottaviano and Peri (2012), Hornung (2014), Bernstein et al. (2022), Beine et al. (2024)), and recent papers study general equilibrium impacts using spatial models (Monras (2020), Adda et al. (2022)). The closest paper is Piyapromdee (2021), who studies immigration in the modern United States and evaluates how heterogeneous workers are affected through wages, rents, and internal migration, taking each city's productivity as fixed. Her framework is designed to measure distributional welfare effects of immigration changes under exogenous productivity. My project asks a different question. I study a large, one-time population shock and allow productivity to be endogenous, responding to changes in managerial human capital, firm organization, and structural transformation. The goal is to estimate the aggregate impacts on output per worker, not the distributional welfare impact.

I also extend the forced-migration literature (Braun and Kvasnicka (2014), Becker and Ferrara (2019), Bahar et al. (2024)) by analyzing the Japanese repatriation, an understudied setting where migrants arrived with negligible physical capital, allowing me to isolate labor and human capital effects from wealth effects.

Second, this project is related to the growth literature (Romer (1990), Jones (1995), Klette and Kortum (2004), Jones (2022a), Jones (2022b)) by estimating the impacts of population size on output per worker, a parameter that Jones (2022a) highlights as rarely identified empirically. Two recent papers are closely related. Peters (2022) shows that German expellees increased local productivity and long-run income, and Terry et al. (2024) combine immigration shocks with an idea-based growth model to estimate a scale elasticity of innovation. My approach differs by targeting the impacts of population size on income per capita through firm modernization rather than idea creation, the mechanism emphasized in both papers.

Third, I contribute to the structural transformation literature (Matsuyama (1992), Herrendorf et al. (2014)). Recent work considers income effects, price effects, and sectoral productivity (Matsuyama (2019), Comin et al. (2021), Comin et al. (2025)), while other research embeds sectoral change in spatial settings and emphasizes how productivity diffusion, migration, and trade shape heterogeneous local outcomes (Takeda (2022), Eckert

and Peters (2022), Fan et al. (2023), Madhok et al. (2025)). My contribution is to show that population shocks can trigger structural transformation through firm modernization. High-skilled workers expand modern non-agricultural firms, enabling local economies to absorb workers from agriculture sector.

Fourth, I contribute to spatial economics and regional growth (Allen and Arkolakis (2014), Redding and Rossi-Hansberg (2017), Allen and Donaldson (2020), Allen and Arkolakis (2025), Desmet and Parro (2025)). Existing quantitative spatial frameworks emphasize how agglomeration forces, migration, and geography shape regional development, but they typically abstract from firm organization and managerial capacity. I introduce span-of-control constraints (Lucas (1978) and Akcigit et al. (2021)) with skill heterogeneity into a spatial general-equilibrium model, allowing population shocks to affect regional productivity not only through reallocation and migration responses but also through changes in firm organization.

I also contribute to a growing literature arguing that cross-country differences in firm size and organizational structure reflect differences in managerial human capital. Akcigit et al. (2021) show that when delegation efficiency is low, firms remain small and less productive. Evidence from the World Management Survey (Bloom and Van Reenen (2007), Bloom et al. (2014)) and field experiments (Bloom et al. (2013)) show that management quality varies widely, explains large portions of productivity differences, and predicts firm performance. Recent work shows that economic development raises the intensity of white-collar labor (Engbom et al. (2025)), that skill scarcity constrains firm expansion in poor countries (Gottlieb et al. (2025)), that managerial labor is relatively more expensive in low-income settings (Hjort et al. (2022)), and that plants add managerial layers as they grow (Tamkoc (2023)). The repatriation setting provides a rare opportunity to causally test this mechanism. High-skilled repatriates brought managerial and administrative human capital into local labor markets, increasing the manager share, establishments, and wage workers, and modernizing firm structures, whereas low-skilled inflows did not. This pattern aligns with delegation-based models and the management-practices literature, showing that managerial human capital drives firm modernization, structural transformation, and long-run economic development.

Lastly, I contribute to work on the economic and political aftermath of World War II in Japan. Existing studies document the country's resilience to wartime destruction. Bombed cities regained their prewar population and industrial structure (Davis and Weinstein, 2002, 2008), with Hiroshima following a similar recovery path (Takeda and Yamagishi, 2024). Other research highlights persistent political and social effects of devastation (Harada et al., 2024) and battlefield and civilian losses (Inoue et al., 2025). By contrast, the repatriation of

more than six million people has received almost no economic analysis. Work on returnees from Manchuria and other former colonies focuses primarily on social adjustment rather than economic transformation (Nishizaki, 2016, 2020, 2022). My project fills this gap by showing that high-skilled returnees reshaped local economies through firm modernization and structural change.

The remainder of the paper is organized as follows. Section 2 provides historical background on the repatriation and describes the data. Section 3 presents the empirical analysis, including the identification strategy and main results. Section 4 develops a spatial two-sector model that rationalizes the empirical findings. Section 5 estimates the model and conducts counterfactual analysis. Section 6 concludes.

2 Historical Context

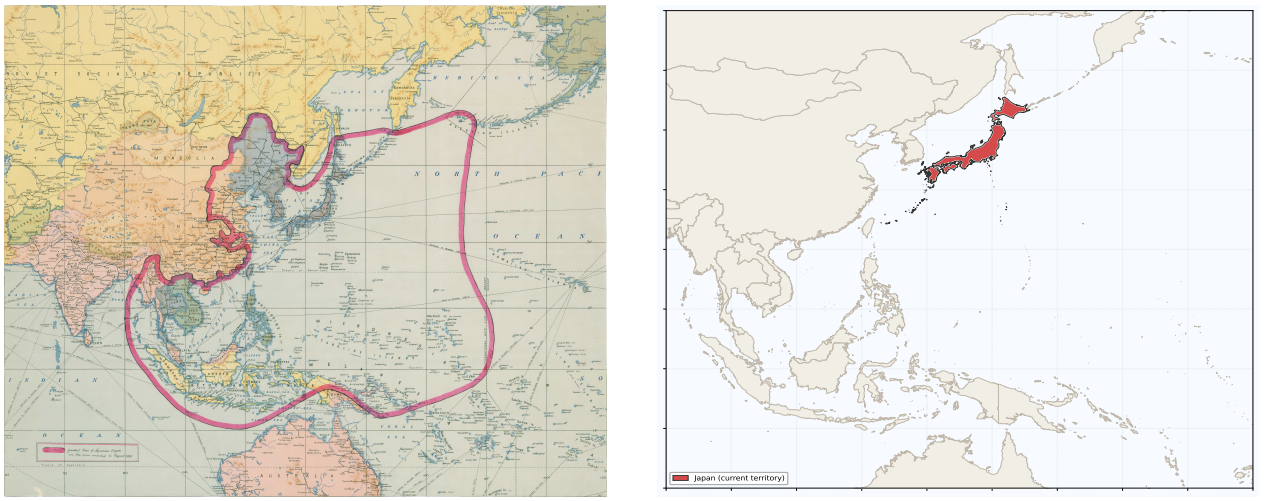
In this section, I provide a historical context for the repatriation. First, I establish the scale and coercive nature of the repatriation, which brought more than six million Japanese nationals back to Japan (Section 2.1). Second, I show that settlement patterns were driven by exogenous logistical and administrative factors, specifically, Allied-assigned landing ports and the pre-war family registry system (Section 2.2). Third, I show that high-skilled repatriates were overwhelmingly white-collar workers employed in managerial and administrative positions before the war (Section 2.3). Lastly, I briefly discuss the data (Section 2.4).

2.1 Decolonization and Forced Repatriation

Japan's territorial expansion after the Meiji Restoration sent millions of settlers, administrators, and soldiers to Korea, Taiwan, Manchuria, and Southeast Asia. By the early 1940s, the empire extended across much of East and Southeast Asia. Figure 1(A) illustrates the geographic reach of the empire at its wartime peak. Japan's defeat in 1945 reversed fifty years of expansion. All overseas territories were lost, and the collapse of imperial administration set off one of the largest forced population movements of the twentieth century. Roughly six million Japanese, three million civilians and three million military personnel, were returned to Japan under Allied supervision.[3] Figure 1(B) shows modern Japan, highlighting the territorial contraction that generated this mass migration.

[3]Ministry of Health, Labour and Welfare, Hikiage to Engo Sanjūnen no Ayumi.

Figure 1: The Japanese Empire at Its Maximum Extent Compared to Modern Japan



(A) Japanese Empire (August 1942) (B) Modern Japan

Notes: Panel (A) depicts the territorial extent of the Japanese Empire in August 1942. The area enclosed by the pink boundary indicates regions under Japanese control at the time, including the Japanese home islands, Korea, Taiwan, Manchuria, southern Sakhalin, Pacific mandate islands, and territories occupied during the early phase of the Pacific War such as Indochina, the Philippines, the Dutch East Indies, Burma, and large parts of coastal China. Panel (B) shows modern-day Japan. Source: "Map of Japanese Empire, August 1942," Docsteach (NARA), taken from https://docsteach.org/document/map-of-japanese-empire-august-1942/.

Repatriation was compulsory, not voluntary. A December 1945 U.S. State Department directive stated that "all Japanese nationals whose place of origin was the main Japanese home islands ... should be repatriated to Japan."[4] Although the Japanese government initially attempted to preserve its overseas settlements, growing violence against Japanese civilians, particularly in Manchuria under Soviet occupation, forced a policy reversal by August 1945 (Nishizaki, 2016). The combination of Allied policy and deteriorating local security left Japanese civilians with essentially no choice but to return.[5]

Landing ports were also not chosen by returnees. The Supreme Commander for the Allied Powers (SCAP) designated fixed reception centers and directed that repatriation vessels land only at authorized ports. The Ministry of Welfare operated these centers at specified capacities based on schedules provided by the Shipping Control Authority for the Japanese Merchant Marine (SCAJAP)[6]. Allied health directives further rerouted ships when necessary. For example, during a cholera outbreak in April 1946, all ships arriving from

[4]U.S. Office of the Historian, Repatriation of Japanese and Other Persons From the Japanese Mandated Islands.

[5]Importantly, returnees brought virtually no physical capital. To prevent inflation, SCAP restricted civilians to carrying ¥1,000 and confiscated all financial assets and documents at entry. ¥1,000 covered roughly one month's food. Overseas assets were administered by successor authorities and later liquidated. Repatriation thus represented a pure labor supply shock, not a wealth transfer.

[6]SCAPIN-822 "Repatriation," taken from https://jahis.law.nagoya-u.ac.jp/scapindb/docs/scapin-822.

South China were ordered to Uraga, with Sasebo and Hakata as alternates.[7] Maizuru served as the receiving port for returnees from the Soviet sphere.[8] These procedures show that port-of-entry was determined entirely by colonial origin and Allied logistics, not by economic conditions or repatriates' preferences.

2.2 Family Registry Location as Ancestral Home

The Meiji government formalized Japan's traditional *ie* (household) system through the 1898 Civil Code, establishing the household, headed by a legally designated household head, as the basic unit of civil status and registration (Krogness, 2014). This legislation introduced the family registry system, which anchored each family's official registration (*koseki*) to a fixed location (*honseki*). Crucially, a family's *honseki* typically remained in its ancestral village for generations, regardless of where members actually lived (Office of Population Research, 1946).

In practice, *honseki* served as a marker of lineage rather than current residence. Individuals commonly moved for work, marriage, or schooling while keeping their ancestral *honseki* unchanged (Krogness, 2014). A Tokyo resident could live there for decades while officially registered in a rural hometown (Sawada, 1996). Historical evidence confirms this disconnect. In Tokyo, between 1891 and 1920, only 52% to 67% of residents held a Tokyo *honseki* (Sawada, 1996). This persistence extended to Japan's colonies. In Karafuto (southern Sakhalin), most Japanese settlers did not transfer their *honseki*, maintaining registration in their home prefectures despite long-term residence in the colony (Ivings, 2014). Hence, *honseki* locations reflect ancestral ties rather than economic opportunities or recent migration decisions.

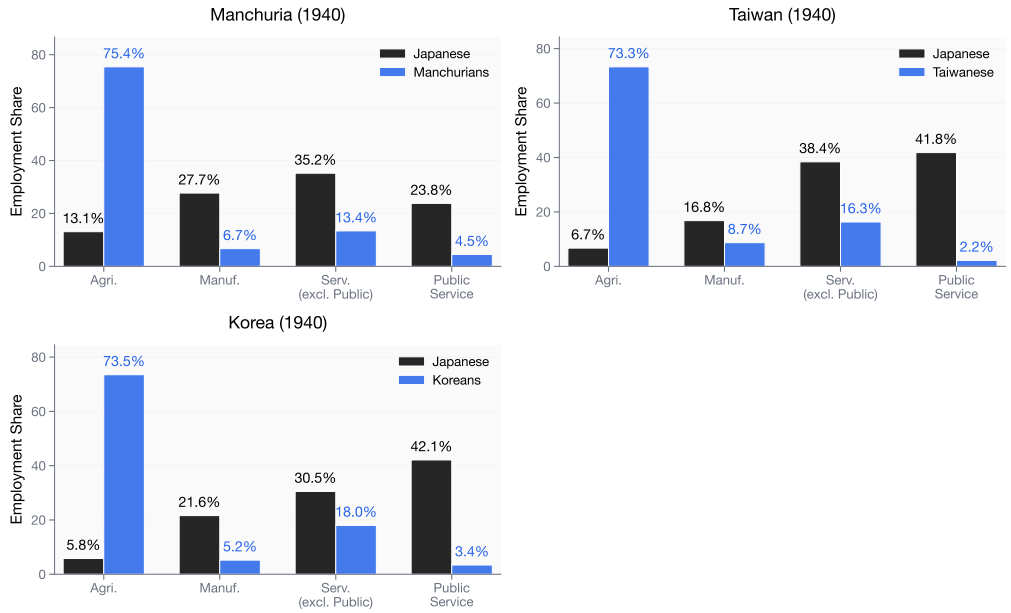
2.3 High-Skilled Returnees Brought Back Managerial Human Capital

A defining feature of Japan's colonial labor system was the sharp ethnic hierarchy that governed occupational assignment in Korea, Taiwan, and Manchuria. Japanese nationals monopolized managerial, supervisory, and administrative positions, while natives were concentrated in agriculture and low-tier work. Empirical evidence confirms this divide. Japanese residents were overwhelmingly employed in service and administrative sectors,

[7] SCAPIN-927/9: "Repatriation," taken from https://jahis.law.nagoya-u.ac.jp/scapindb/docs/scapin-927-9.
[8] Japan Center for Asian Historical Records (JACAR), taken from https://www.jacar.go.jp/english/newsletter/newsletter_022e/newsletter_022e.html.

whereas natives were overwhelmingly agricultural workers (Figure 2).[9]

FIGURE 2: SECTORAL EMPLOYMENT SHARES IN COLONIES, 1940



Notes: This figure shows the sectoral employment shares in three major colonies, Manchuria, Taiwan, and Korea, in 1940 by natives and Japanese. Black bars represent native employment shares, while blue bars represent Japanese employment shares. It shows that Japanese workers overwhelmingly occupied service sector jobs, while natives were concentrated in agriculture.

Private firms and the colonial government reinforced this structural divide. In the government bureaucracies of Taiwan and Korea, Japanese officials occupied virtually all high-ranking positions. Similarly, in large conglomerates like the South Manchuria Railway (Mantetsu), Japanese staff dominated technical and managerial roles (Nishizaki, 2022; Lim, 2024).

This colonial hierarchy reflected the domestic "Education-Status System" (*Gakureki Mibunsei*), which separated elite *Shain* (employees with higher education and managerial tracks) from blue-collar *Kōin* (Suzuki, 2008). *Shain* status served as a clear marker of managerial potential and authority.

I classify repatriates based on this institutional context (Table 1). The high-skilled category comprises occupations that Japanese nationals disproportionately held: *Shain*, government officials, educators, and police. These roles involved administrative and managerial responsibilities, making this group a shock to the supply of managerial human capital. By contrast, I classify primary and low-skilled tertiary occupations as low-skilled. This includes agricultural workers, and manual service jobs (e.g., waiters, hotel workers). I exclude secondary workers

[9]In 1940, Japan proper was mainly agricultural with almost 50% of workers in agriculture (Figure A5 and Figure A6). Hence, Japan, right after WWII, was economically similar to current low-income countries and lacked managerial human capital.

(factory and craft) from the main analysis due to the ambiguity between unskilled laborers and skilled craftsmen in the data.

Table 1: Occupation Distribution of Repatriates

Occupation Group	Share (%)
Primary & Low-Skilled Tertiary	22.3
Secondary	15.0
High-skilled	62.7
of which:	
Company Employee (*Shain*)	(42.1)
Government Official	(5.9)
Police Officer	(2.9)
Teacher	(2.6)
Railway Worker	(1.9)
Total	100.0

Note: This table shows the occupation distribution of repatriates using their pre-war occupation. Primary and low-skilled tertiary workers include agricultural workers and low-skilled service jobs such as waiters, hotel attendants, porters, and other manual service roles. Secondary workers include factory and craft workers. High-skilled workers include high-skilled service sector workers, company employees (*shain*), government officials, police officers, teachers, and railway staff in clerical or supervisory positions.

2.4 Data

The analysis draws on three main data sources; Section A provides comprehensive documentation.

Repatriate Data. I construct a novel micro-level dataset from the 1964 *Survey of Overseas Private Assets*, preserved at the Kanagawa Prefectural Archives. Originally commissioned for compensation purposes, this survey offers granular information on repatriate households, including pre-repatriation occupations, colonial residence locations, and initial settlement destinations in Japan.

Firm Data. To quantify firm modernization, I digitize the *Teikoku Bank and Company Directory* (*Teikoku Ginkou Kaisha Yoroku*) for the years 1957, 1964, and 1970. This directory comprises the near-universe of medium and large enterprises, containing firm-level records on employment, capital stock, and establishment counts.

Census, Manufacturing, and Other Data. I construct district-level economic and demographic panels using the Population Census (1920–1970), Manufacturing Census (1950, 1960), Census of Commerce (1952, 1960), *Prefectural Statistical Yearbooks* (1950), and 1934

Tax Statistics. Additionally, I integrate data on war destruction, transportation infrastructure, university locations, patent applications, and household expenditure from the National Survey of Family Income and Expenditure.

3 Structural Transformation, Economic Growth, and Modernization

In this section, I examine how population inflows reshaped local economies through structural transformation and the modernization of firms. I begin by examining city-level outcomes capturing sectoral employment shares and output (Section 3.1 and Section 3.2). I then analyze local production structure by tracking changes in family labor, self-employed, wage employment, and managers (Section 3.3). Finally, I use firm-level data to document how individual firms adjusted their organization in response to labor supply changes (Section 3.4). Together, these patterns establish a link between population shocks and firm modernization, motivating the theory of managerial human capital and economic growth that follows.

3.1 Structural Transformation

First, I examine the impact of repatriates on structural transformation by analyzing changes in sectoral employment shares. Moving labor from agriculture to manufacturing and services is central to economic development. A shift toward non-agricultural sectors signals the expansion of higher-productivity activities and modern economic structures. Thus, sectoral reallocation serves as a measure of how high- versus low-skilled repatriates reshaped local economies. Specifically, I estimate the following equation:

$$\Delta z_{r,1960-1940} = \beta_0 + \beta_1 \text{High-skilled Rep}_r + \beta_2 \text{Low-skilled Rep}_r + \boldsymbol{X}_r'\Gamma + \varepsilon_{r,t},$$

where $z_{r,t}$ represents either log labor force or sectoral employment shares (agriculture, manufacturing, or services) in district r at time t and $\boldsymbol{X}_r$ is a vector of control variables in district r. I analyze changes in these outcomes over the period 1940–1960. The denominator of the high- and low-skilled repatriate share is the size of the labor force in 1940. The specification includes controls for prefecture fixed effects, the extent of war damage, log density in 1940 and the level of the dependent variable in 1940, following Peters (2022). I estimate this using the instrumental variable described below, only reporting the coefficient of interest β_1 and β_2 for brevity.

Instrument. If repatriates had not chosen destinations at random, settlement reflected economic opportunities of cities, so OLS would conflate causal effects with selection. To address this, I construct an instrument based on the predicted settlement flows from a random-utility model whose shifters are determined by repatriation logistics and family registry system described in Section 2.1 and Section 2.2.

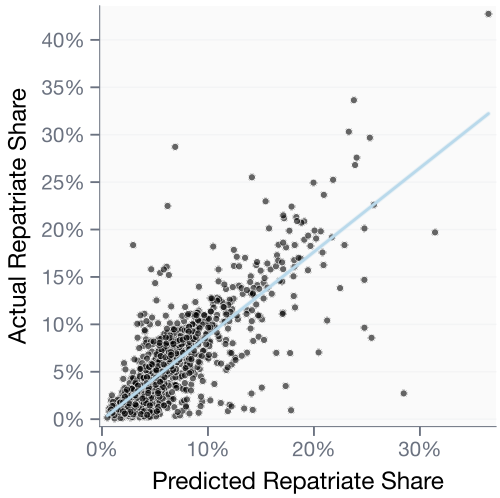
Specifically, each repatriate i, routed to landing port j by colonial origin and shipping logistics, chooses a final destination k to maximize

$$U_{ijk} = \underbrace{\beta_h \cdot \mathbf{1}\{k = \text{honseki}_i\}}_{\text{Institutional Ties}} + \underbrace{\beta_d \cdot \ln(\text{distance}_{jk})}_{\text{Geographic Constraints}} + \varepsilon_{ijk} \tag{1}$$

with $\varepsilon_{ijk} \sim$ i.i.d. Type-I extreme value. Conditional on the landing port, this delivers a conditional-logit probability for each destination. The key shifters are predetermined: (i) the *honseki* registry creates historically rooted ties to ancestral places; (ii) distances from assigned ports encode repatriation logistics rather than post-war local economic prospects. I estimate the conditional logit by maximum likelihood on the destination choice set. The coefficients are economically sensible. A large positive β_h (strong *honseki* pull), and a negative β_d (distance discourages settlement). Table A4 in the Appendix reports the estimates.

Using the estimated parameters, I compute individual settlement probabilities $\hat{P}_{ir} = \frac{\exp(X_{ir}'\hat{\beta})}{\sum_{k\in\mathcal{J}}\exp(X_{ik}'\hat{\beta})}$, where $\mathcal{J}$ is the destination set, r is individual i's destination choice, and X_{ir} contains *honseki* ties and distance from port in Equation (1). Then, I aggregate this individual term to the region-level to form a predicted settlement share in region r. This predicted share is the instrument for the *actual* repatriate share in region r, $\widehat{\text{Share}}_r \equiv \frac{1}{\text{Labor Force}_{r,1940}} \sum_{i=1}^{N} \hat{P}_{ir}$. Figure 3 shows the strong positive relationship between the predicted repatriate share and the actual shares at the district level, supporting instrument relevance. I construct the predicted share for high- and low-skilled repatriates separately.

FIGURE 3: PREDICTED VS. ACTUAL SETTLEMENT



Notes: District-level comparison of predicted repatriate shares (X-axis) and actual repatriate shares (Y-axis).

The identifying assumption is that $\widehat{\text{Share}}_r$ is uncorrelated with unobserved post-war shocks to outcomes, conditional on pre-war controls and prefecture fixed effects. This assumption is credible because the instrument is built from predetermined registries, colonial geography, and repatriation logistics.

Results. High-skilled repatriates generated shifts in local economic structure (Table 2).[10] They reduced agricultural employment shares, expanded manufacturing and service employment shares, and increased the labor force by more than one-for-one. This coefficient implies a crowding-in effect. Rather than displacing locals, high-skilled repatriates created jobs that attracted additional native workers from other districts. These patterns show that high-skilled repatriates acted as catalysts for structural transformation. In contrast, low-skilled repatriates had no significant effects on any sectoral margin.

[10] I present IV estimates in the main text, with OLS results reported in the Section B.12.

TABLE 2: REPATRIATES AND LOCAL STRUCTURAL TRANSFORMATION (IV)

Panel A: Log Labor Force Change					
	1960-1940			1940-1930	1930-1920
	(1)	(2)	(3)	(4)	(5)
Low-Skilled Rep. Share$_{1950}$	2.774***	2.537***	0.732	0.503	-0.344
	(0.855)	(0.820)	(0.861)	(0.567)	(0.347)
High-Skilled Rep. Share$_{1950}$	4.242***	4.050***	2.617***	-1.943**	0.263
	(0.669)	(0.643)	(0.822)	(0.820)	(0.168)
N	1,107	1,107	1,107	1,107	1,107
Panel B: Agriculture Emp. Share Change					
	1960-1940			1940-1930	1930-1920
	(1)	(2)	(3)	(4)	(5)
Low-Skilled Rep. Share$_{1950}$	-0.146	-0.150	-0.141	-0.131	0.171**
	(0.342)	(0.343)	(0.337)	(0.113)	(0.070)
High-Skilled Rep. Share$_{1950}$	-0.974***	-0.973***	-0.980***	0.048	-0.034
	(0.255)	(0.254)	(0.245)	(0.096)	(0.057)
N	1,107	1,107	1,107	1,107	1,107
Panel C: Manufacturing Emp. Share Change					
	1960-1940			1940-1930	1930-1920
	(1)	(2)	(3)	(4)	(5)
Low-Skilled Rep. Share$_{1950}$	0.381	0.384	0.379	0.028	-0.066
	(0.234)	(0.234)	(0.234)	(0.052)	(0.055)
High-Skilled Rep. Share$_{1950}$	0.265*	0.264*	0.258**	-0.014	0.005
	(0.139)	(0.139)	(0.129)	(0.040)	(0.032)
N	1,107	1,107	1,107	1,107	1,107
Panel D: Service Emp. Share Change					
	1960-1940			1940-1930	1930-1920
	(1)	(2)	(3)	(4)	(5)
Low-Skilled Rep. Share$_{1950}$	-0.236	-0.234	-0.238	0.105	-0.107***
	(0.157)	(0.157)	(0.154)	(0.087)	(0.035)
High-Skilled Rep. Share$_{1950}$	0.709***	0.709***	0.717***	-0.030	0.029
	(0.141)	(0.141)	(0.140)	(0.062)	(0.030)
N	1,107	1,107	1,107	1,107	1,107
Pref FE	✓	✓	✓	✓	✓
Log Density$_{1940}$	✓	✓	✓	✓	✓
War Destruction		✓	✓	✓	✓
Level Dep.			✓	✓	✓

Notes: The table presents the estimation results of the relationship between the share of high- and low-skilled repatriates and local economic outcomes. The dependent variables are changes in log labor force (Panel A) and sectoral employment shares (agriculture (Panel B), manufacturing (Panel C), or services (Panel D)) between 1940 and 1960. The independent variable is the share of high- and low-skilled repatriates in district r at time 1950. The control variables include prefecture fixed effects (Pref FE), log density (Log Density$_{1940}$), war damage (War Destruction). To check pre-trends, I include the change in log labor force and sectoral employment shares between 1930 and 1940, between 1930 and 1920, and between 1940 and 1930 as additional dependent variables. Standard errors are clustered at the district level and reported in parentheses. $^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.1$.

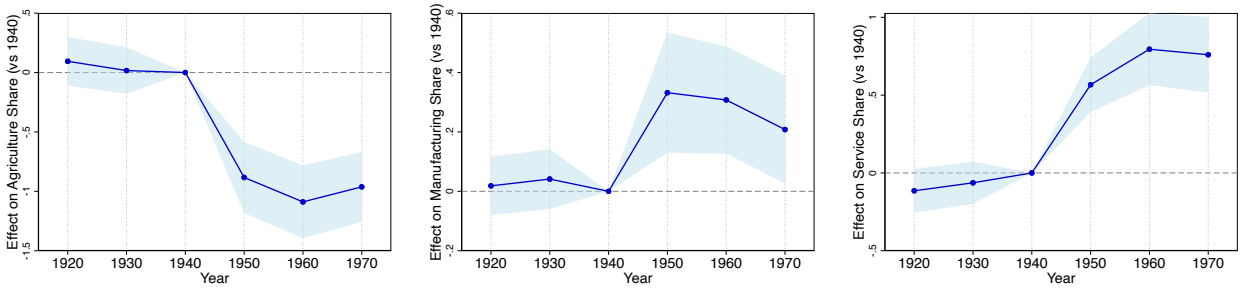
These findings parallel Peters (2022), who shows that the arrival of post-World War II German refugees increased local population, lowered agricultural employment, and expanded manufacturing employment. However, unlike the German setting, the Japanese case shows that these transformative effects were driven entirely by high-skilled repatriates.[11]

A main concern for my empirical analyses is that high-skilled repatriates simply settled in places that were already going through structural transformation and modernization before World War II. Measuring pre-trends for local production structure, firm modernization, or output per worker is impossible due to data limitations, but sectoral employment shares provide a consistent long-run proxy for local modernization and economic development. If high-skilled inflows were merely chasing pre-existing growth, we should see differential structural transformation before 1945. To test this, I estimate an event-study specification for the impact of the high-skilled repatriate share on agricultural, manufacturing, and service employment shares using census years from 1920 to 1970. Figure 4 plots the event-study coefficients of the following specification:

$$Y_{r,t} = \sum_{\tau \neq 1940} \beta_{\tau}^{LS} \cdot \left(LS_r \times \mathbf{1}\{t = \tau\}\right) + \sum_{\tau \neq 1940} \beta_{\tau}^{HS} \cdot \left(HS_r \times \mathbf{1}\{t = \tau\}\right) + \alpha_r + \lambda_t + \lambda_p + \epsilon_{rt}$$

where $Y_{r,t}$ is the sectoral employment share in district r at time $t \in 1920, 1930, 1940, ..., 1970$, LS_r is the low-skilled repatriate share in district r in 1950, HS_r is the high-skilled repatriate share in district r in 1950, α_r is the district fixed effect, λ_t is the time fixed effect, and λ_p is the prefecture fixed effect.

Figure 4: Event Study: Sectoral Employment Shares and High-Skilled Repatriates



(A) Agriculture (B) Manufacturing (C) Services

Notes: This figure shows the event-study coefficients for the impact of the high-skilled repatriate share on agricultural, manufacturing, and service employment shares in Japan from 1920 to 1970.

[11] Section B.6 shows the regression results using total repatriate share as the independent variable. The results show that repatriates increased labor force size, reduced agricultural employment, and expanded manufacturing and service employment shares.

Across all three sectors, the coefficients are flat and statistically indistinguishable from zero in all pre-repatriation years. Districts that would later receive high-skilled repatriates were not on different structural-change trajectories before repatriation. Agricultural shares decline only after repatriation begins. Manufacturing and service shares increase only in the post-war period.

This event pattern strengthens identification in two ways. First, no differential structural change before treatment. Because sectoral shares summarize broad economic structure, the absence of pre-trends suggests that high-skilled exposure is not proxying for unobserved economic development dynamics. Second, it is reassuring for other outcomes for which I cannot measure pre-trends. Although output per worker, local production structure, and firm-level pre-trends are unavailable, sectoral employment shares act as a summary signal of local modernization and economic development. If high-skilled repatriate exposure had captured faster-growing or more modern places ex ante, this would already appear in pre-war sectoral trends. The absence of such patterns increases confidence that the post-war effects reflect true causal impacts rather than continuation of earlier growth.

3.2 Economic Growth

I next examine how high- and low-skilled repatriates affected productivity and output per worker. I estimate regressions of the form

$$\Delta \ln Y_{r,1960-1950/1940} = a_0 + a_1 \text{High-skilled Rep}_r + a_2 \text{Low-skilled Rep}_r + X_r'\delta + \varepsilon_r,$$

where the dependent variable Y_r is either (i) the number of establishments between 1950 and 1960, (ii) employees per establishment between 1950 and 1960, or (iii) revenue per employee between 1940 and 1960.[12] The controls match those used in Table 2. Table 3 reports the corresponding IV estimates. I begin with the number of establishments, which in standard variety-expansion models of growth serves as a proxy for local productivity. In addition, because firms that modernize typically extend into multi-establishment organizations, growth in the number of establishments also captures organizational upgrading. Employees per establishment capture the scale of production within an establishment. Larger establishments indicate a shift away from small, family-based operations toward multi-worker organizations. Revenue per employee provides a direct measure of non-agricultural output per worker.

Across all three outcomes, the coefficient on the high-skilled repatriate share is positive and statistically significant. High-skilled inflows increased the number of establishments,

[12] The number of establishments before WWII is not available and the earliest year for the number of establishments is 1950.

raised establishment size and output per worker. In contrast, the coefficients on the low-skilled share are small and statistically indistinguishable from zero, indicating that low-skilled inflows did not contribute to these margins of economic growth.

Table 3: Productivity (1960–1950) and Output per Worker (1960–1940), IV

	# of Establishment$_{1960-1950}$	Establishment Size$_{1960-1950}$	Output per Worker$_{1960-1940}$
	(1)	(2)	(3)
Low-Skilled Rep$_{1950}$	1.103	-1.230	-0.891
	(1.039)	(0.921)	(0.709)
High-Skilled Rep$_{1950}$	3.028***	2.107***	1.888***
	(0.672)	(0.680)	(0.512)
N	1,100	1,090	1,102
Pref FE	✓	✓	✓
Log Density$_{1940}$	✓	✓	✓
War Destruction	✓	✓	✓
Level Dep.	✓	✓	✓

Notes: This table presents the estimation results of the relationship between the share of high- and low-skilled repatriates and non-agricultural productivity. The dependent variable is the change in the number of establishments, the average employees per establishment, and the average revenue per employee in log between 1960 and 1950 or 1940. The independent variable is the share of high- and low-skilled repatriates in district r at time 1950. The control variables include prefecture fixed effects (Pref FE), log density (Log Density$_{1940}$), war damage (War Destruction), and level of the corresponding dependent variable in 1950 or 1940 (Level Dep). Standard errors are clustered at the district level and reported in parentheses. $^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.1$.

3.3 Modernization of Local Economy

How did repatriates affect the organization of local production? I examine changes in four core margins: the share of self-employed workers, the share of family workers, the share of wage workers, and the share of managers. These measures capture the extent to which cities transitioned from traditional household-based production toward modern wage-labor firms.

In lower-income economies, production is typically organized around small, owner-operated firms that rely on unpaid family labor and fewer outside managers (Akcigit et al. (2021), Engbom et al. (2025), Gottlieb et al. (2025)). These firms have limited ability to scale, delegate tasks, or adopt complex production processes, because the owner must personally manage most activities. As a result, self-employed and family labor shares tend to be high, while wage employment is relatively low.

In higher-income economies, production is dominated by larger, multi-establishment firms that rely primarily on hired wage workers and outside managers (Akcigit et al. (2021), Engbom et al. (2025), Gottlieb et al. (2025)). These firms employ managers who specialize in supervision and coordination, allowing them to operate at scale and adopt more sophisticated

technologies. Consequently, the wage-worker share and manager share are much higher, and reliance on self-employed and family workers is much lower.

Shifts in these labor-force shares therefore provide a measure of organizational modernization. A fall in self-employed or family-worker shares reflects movement away from traditional, household-based production toward firms that separate ownership, management, and labor. An increase in the wage-worker or manager share reflects the emergence of scalable, managerial organizations. I estimate the following specification:

$$\Delta w_{r,1970-1950} = \theta_0 + \theta_1 \text{High-skilled Rep}_r + \theta_2 \text{Low-skilled Rep}_r + X_r'\Gamma + \varepsilon_r,$$

where $w_{r,t}$ is one of the organizational outcomes in district r, and the control set X_r matches that used in the structural-transformation regressions (prefecture fixed effects, log density in 1940, war destruction, and the 1950 level of the dependent variable).[13] The specification is estimated by IV.

High-skilled repatriates pushed cities away from traditional organizational forms (Table 4). A one percentage point increase in the high-skilled repatriate share reduces the self-employed share by roughly 0.27 percentage points and the family-worker share by about 0.13 percentage points, while raising the wage-worker share by about 0.34 percentage points and the manager share by about 0.03 percentage points. All effects are statistically significant.[14]

This pattern shows that high-skilled repatriates contributed to firm modernization by reducing reliance on family labor and expanding the use of hired wage workers and outside managers. These changes are consistent with high-skilled repatriates bringing managerial capabilities that relax organizational constraints and allow firms to scale.

Low-skilled repatriates, by contrast, have no significant effects on any of the organizational margins. Their arrival increases labor supply but does not change production structure. The modernization of local economies was therefore driven by managerial human capital rather than by population size alone or channels through increased demand for goods and services due to population inflow. Overall, these findings show that high-skilled repatriates shifted cities toward more complex, scalable firm structures.

[13] The Population Census first measured the number of self-employed, family workers, wage workers, and managers in 1950. Hence, I use the change between 1950 and 1970.

[14] As shown in Table A3, Japan underwent a significant shift in organizational structure: the share of family workers fell from 38% in 1950 to 22% in 1970, while the share of managers rose from 1.5% in 1950 to 2.8% in 1970.

TABLE 4: MODERNIZATION OF THE LOCAL ECONOMY (1970–1950, IV)

	Self-employed Share$_{1970-1950}$	Family Worker Share$_{1970-1950}$	Wage Worker Share$_{1970-1950}$	Manager Share$_{1970-1950}$
	(1)	(2)	(3)	(4)
Low-Skilled Rep$_{1950}$	0.080	0.143	-0.234	-0.009
	(0.075)	(0.093)	(0.144)	(0.014)
High-Skilled Rep$_{1950}$	-0.269***	-0.132***	0.342***	0.027***
	(0.045)	(0.045)	(0.077)	(0.010)
N	1,107	1,107	1,107	1,107
Pref FE	✓	✓	✓	✓
Log Density$_{1940}$	✓	✓	✓	✓
War Destruction	✓	✓	✓	✓
Level Dep.	✓	✓	✓	✓

Notes: This table presents the estimation results of the relationship between the share of high- and low-skilled repatriates and the modernization of the local economy. The dependent variable is the change in the share of self-employed workers, the share of family workers, the share of wage workers and the change in the share of managers (including managers in public sector) in between 1970 and 1950. The independent variable is the share of high- and low-skilled repatriates in district r at time 1950. The control variables include prefecture fixed effects (Pref FE), log density (Log Density$_{1940}$), war damage (War Destruction), and level of the corresponding dependent variable in 1950 (Level Dep). Standard errors are clustered at the district level and reported in parentheses. $^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.1$.

3.4 Modernization of Firms

Next, I examine how repatriates influenced the modernization of individual firms. At the firm level, modernization has several distinct dimensions. First, employment captures the span of control and the capacity of a management team to coordinate a larger workforce. In environments with scarce managerial talent, firms tend to remain small, with few non-family workers. An increase in firm employment therefore provides a direct measure of whether managerial constraints have been relaxed and whether firms are able to scale up.

Second, capital reflects both access to finance and the ability to organize and operate more complex production technologies. Modern business enterprises are typically more capital-intensive than traditional family businesses. If high-skilled repatriates truly brought managerial and administrative human capital, firms should exhibit not only more workers per firm but also higher capital stocks, consistent with managers being able to plan, borrow, and invest at larger scale.

Third, the number of shareholders speaks to the organizational and ownership structure of firms. Traditional enterprises are often closely held, family-owned units. In contrast, modern firms mobilize outside investors, separate ownership from control, and rely on formal governance. An increase in the number of shareholders therefore indicates a shift toward more formal, investor-backed organizations.

Finally, the number of establishments within a firm captures whether firms expand beyond a single production unit. Operating multiple establishments requires delegation,

monitoring, and coordination across establishments, and is therefore linked to managerial capacity. In environments with limited managerial human capital, firms tend to remain single-establishment even when demand grows. An increase in the number of establishments within a firm thus provides a direct measure of organizational upgrading toward modern, multi-unit enterprise structures. This measure is an important characteristic of "modern enterprises" according to Chandler (1977) since firms transition to multi-unit structures when managers coordinate production across multiple establishments.

Unlike the city-level analyses, which study changes over time, the firm-level analysis uses a pooled panel of all firms observed in 1957, 1964, and 1970 due to data limitations. For each firm, I estimate

$$\ln Y_{frt} = \theta_1 \text{High-skilled Rep}_r + \theta_2 \text{Low-skilled Rep}_r + X_r'\Gamma + \lambda_t + \varepsilon_{frt},$$

where Y_{frt} is firm employment, capital, number of shareholders, or number of establishments for firm f in region r and year t, X_r includes pre-war density and war destruction, and λ_t denotes year fixed effects. The specification exploits cross-sectional variation across cities in 1950 repatriate exposure while controlling for aggregate time trends in firm outcomes. Table 5 reports the IV results.

High-skilled repatriates are strongly associated with larger and more modern firms. Firms in cities that received more high-skilled repatriates employ more workers, hold more capital, report more shareholders, and operate a greater number of establishments. The establishment margin is particularly informative. High-skilled inflows increased not only firm size within a single unit, but also the likelihood that firms expanded into multi-establishment organizations. This pattern aligns with the interpretation that managerial human capital relaxes coordination and delegation constraints, allowing firms to scale across units rather than merely expanding within a single location.

Low-skilled inflows, in contrast, are associated with substantially smaller and less capitalized firms. Cities receiving more low-skilled repatriates have firms with fewer employees, lower capital stocks, fewer shareholders, and fewer establishments per firm. This finding is consistent with an influx of production labor into environments without corresponding managerial capacity, leading firms to remain single-unit, labor-intensive, and organizationally simple.

Taken together, the firm-level results reinforce the broader mechanism linking population composition to economic development. High-skilled repatriates upgraded the managerial frontier of local economies, allowing firms to grow along multiple margins: employment, capital deepening, ownership formalization, and expansion into multi-establishment organi-

zations. Low-skilled inflows did not generate comparable changes. This firm-level upgrading complements the structural transformation patterns documented earlier and provides direct evidence that who arrives, rather than how many arrive, shapes long-run economic development.

TABLE 5: MODERNIZATION OF FIRMS (1957, 1964, 1970, IV)

	Log Employee	Log Capital	Log Shareholder	Log Establishment
	(1)	(2)	(3)	(4)
Low-Skilled Rep_{1950}	-6.318**	-6.487**	-5.925**	-4.581***
	(3.007)	(2.677)	(2.620)	(1.303)
High-Skilled Rep_{1950}	1.316*	1.436*	1.191*	0.648*
	(0.699)	(0.838)	(0.717)	(0.352)
N	91,175	95,748	68,611	96,083
Pref FE	✓	✓	✓	✓
Log $Density_{1940}$	✓	✓	✓	✓
War Destruction	✓	✓	✓	✓

Notes: This table presents the estimation results of the relationship between the share of high- and low-skilled repatriates and the modernization of firms. The dependent variable is firm employment, capital, number of shareholders or number of establishments in a firm in log in 1957, 1964, and 1970. The independent variable is the share of high- and low-skilled repatriates in district r at time 1950. The control variables include prefecture fixed effects (Pref FE), log density (Log $Density_{1940}$), and war damage (War Destruction). Standard errors are clustered at the district level and reported in parentheses. $^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.1$.

3.5 Other Channels

I examine three other potential channels through which high-skilled repatriates influence local growth: universities, innovation, and transportation infrastructure.[15]

Universities. The structural transformation literature highlights universities as engines of local economic development. Two mechanisms emphasized in recent work are particularly relevant. First, universities shape local human-capital supply. Dziadyk (2025) shows that the opening of new universities can increase the stock of skilled workers in a region by attracting students, retaining graduates, and raising local productivity. Universities thus function as persistent sources of skilled labor and can catalyze long-run growth.

Second, universities act as intellectual and organizational hubs. Liu and Takeda (2025) demonstrate that universities accelerate local innovation by facilitating knowledge diffusion and generating interaction between researchers and firms. In their framework, universities serve as anchor institutions. They upgrade local capabilities, raise the quality of management, and stimulate firm formation and expansion.

[15] All the results in this subsection are available in Section B.11.

Taken together, these papers suggest that if repatriates had expanded the university sector, this could have created a complementary mechanism through which high-skilled inflows increased growth. Universities could have amplified managerial talent, raised the supply of skilled workers, and stimulated local knowledge creation, any of which might explain part of the structural transformation and economic growth documented earlier.

Motivated by this mechanism, I examine whether cities receiving more high-skilled repatriates experienced differential growth in their university sector. Specifically, I estimate difference-in-differences regressions of the number of universities per capita on the high- and low-skilled repatriate shares, controlling for prefecture fixed effects. The effects are small and statistically insignificant. Cities that received more high-skilled repatriates did not open more universities. This null result implies that the university channel, which is central in other settings, played no meaningful role in post-war Japan through high-skilled repatriates.

Innovation. I also examine whether high-skilled repatriates increased idea creation, using city-level patenting as an innovation proxy. Regressions analogous to the main specification, with the number of patents per capita as outcomes, yield coefficients on the high-skilled share that are small and statistically indistinguishable from zero, and the low-skilled coefficients are similarly null. This null effect is informative when viewed in light of the existing growth literature. In models of scale effects based on idea creation, such as those emphasized by Peters (2022) and Terry et al. (2024), population inflows raise growth by increasing the innovation rate and accelerating technological discovery. My results point to a distinct mechanism. High-skilled repatriates did not increase measured innovative output, but they significantly expanded firm size, capital, and the adoption of modern organizational forms. Their comparative advantage lay not in generating new ideas but in executing and scaling existing ones, coordinating larger workforces, mobilizing external finance, and implementing known technologies more efficiently. Thus, while Peters (2022) and Terry et al. (2024) link population shocks to growth through innovation, my estimates show that the impacts on income per worker in this setting operate through managerial execution and firm modernization rather than idea creation.

This mechanism speaks directly to central questions in growth and development economics. Most developing economies do not grow by inventing frontier technologies. My results suggest that they can grow by closing the gap in organizational efficiency, making factories run productively, formalizing ownership structures, and deploying known technologies at scale. The results show that managerial human capital is the key input that enables this catch-up process. Whereas idea-creation models emphasize the role of scientists and inventors, the evidence here demonstrates that the growth in income per worker in post-war Japan operated through managerial execution and firm modernization rather than

innovation.

Transportation. Finally, I examine whether high-skilled repatriates improved transportation access, which could stimulate growth by reducing trade costs and improving labor mobility. I therefore estimate difference-in-differences regressions using the number of train stations and the number of highway exits in each city as outcomes. The results show no positive effect. The coefficients are small and, in the case of transportation infrastructure, statistically significant and negative. Cities receiving larger high-skilled inflows did not expand transportation networks and in some cases experienced slightly fewer station or highway additions. There is no evidence that repatriate-heavy cities built more transportation infrastructure as a result of the inflows.

The absence of any transportation response rules out physical connectivity as a source of the growth effects. Combined with the null results for universities and patenting, the evidence indicates that high-skilled repatriates stimulated local development through changes inside firms rather than through external channels such as new educational institutions, knowledge hubs, or infrastructure upgrades.

3.6 Taking Stock

There are three main takeaways from the empirical evidence. First, high-skilled repatriates triggered structural transformation. Districts that received more high-skilled repatriates lost agricultural employment, expanded manufacturing and services, and experienced net in-migration, while districts that received mainly low-skilled repatriates did not. Second, where high-skilled inflows were larger, local production shifted away from self-employed and family workers toward wage workers and outside managers, indicating a move from household production to scalable modern firms. Third, at the firm level, high-skilled exposure raised employment, capital, and the number of shareholders and establishments per firm, while low-skilled exposure produced smaller and less capitalized firms.

Despite these changes in firm scale and organization, neither high- nor low-skilled repatriates affected patenting. The population shock acted not through idea creation, but by relaxing managerial constraints and improving the execution of existing technologies, an interpretation the model in the next section builds in explicitly.

Taken together, these results suggest that population inflows matter for development primarily through the arrival of workers who relax managerial and organizational constraints. High-skilled repatriates did not simply add labor. They changed how production was organized, allowing cities to absorb workers from agriculture, expand the non-agricultural sector, and raise output per worker. Low-skilled repatriates, in contrast, increased the supply

of production labor without easing managerial bottlenecks and therefore did not generate comparable gains in productivity or modernization.

4 Theory

This section develops a spatial two-sector model that links managerial human capital to firm modernization and regional growth. I adopt a span-of-control framework rather than a standard scale-effects model because the empirical evidence rules out innovation channels: high-skilled repatriates raised productivity through organizational upgrading, not through patenting or idea creation.

Regions are indexed by r. Each region is small and takes agricultural and non-agricultural goods prices as given. Agriculture uses production labor and a fixed supply of local land. The non-agriculture sector consists of monopolistically competitive firms producing differentiated varieties. Following Akcigit et al. (2021), firms can expand scope by delegating tasks to outside managers, but doing so requires adopting a modern multi-line organizational form. Managerial human capital is heterogeneously distributed across workers, and workers are mobile across regions subject to moving frictions.

4.1 Production

Agriculture. The agricultural good is produced using production labor and land:

$$Y_r^A = Q_r \, \mathcal{T}_r^{1-\gamma} \, (L_r^{PA})^{\gamma}, \qquad \gamma \in (0,1),$$

where $\mathcal{T}_r$ is land in fixed supply, L_r^{PA} is production labor employed in agriculture, and Q_r is agricultural productivity in region r.

Non-agriculture. In region r, a competitive non-agricultural good producer aggregates a set of non-agricultural varieties Ω_r. The non-agricultural composite is CES:

$$Y_r^M = \left(\int_{\Omega_r} y_{jr}^{\frac{\varepsilon-1}{\varepsilon}} \, dj \right)^{\frac{\varepsilon}{\varepsilon-1}}, \qquad \varepsilon > 1.$$

Each variety is produced by a monopolistically competitive firm with productivity φ, which is distributed according to a Pareto distribution. Within a variety, effective productivity depends on managerial services per line e with diminishing returns according to $y = \varphi e^{\zeta} l$ where $\zeta < 1$ and l is a production worker. Hence, aggregate non-agricultural production and

production wages are

$$Y_r^M = N_r^{\frac{1}{\varepsilon-1}} \tilde{a}_r L_r^{PM}, \qquad w_{P,r} = P_r^M N_r^{\frac{1}{\varepsilon-1}} \tilde{a}_r,$$

where L_r^{PM} is production labor employed in non-agriculture, P_r^M is the price of the non-agricultural composite, $\tilde{a}_r = \left(\mathbb{E}\left[a^{\varepsilon-1}\right]\right)^{\frac{1}{\varepsilon-1}}$ and $a = \varphi\, e^{\zeta}$. Hence, output per worker is increasing in the number of varieties N_r and the average productivity $\tilde{a}_r$. Since P_r^M is fixed, $w_{P,r}$ is increasing in N_r and $\tilde{a}_r$. Under CES demand, optimal pricing implies that per-line profits excluding manager payment take the form

$$\pi(\varphi, e) = A_r\, \varphi^{\varepsilon-1} e^{\sigma}, \qquad \sigma \in (0, 1),$$

where A_r collects region-level demand and price index terms.[16] Note that the difference from Akcigit et al. (2021) is that my profit includes heterogeneous productivity φ and is increasing in φ. Hence, profits depend on the firm's productivity, which determines the organizational structure described below.

A firm can operate multiple product lines.[17] If the firm operates n lines, it allocates the entrepreneur's managerial time T across lines and can hire outside managers m per line at wage $w_{M,r}$. Effective managerial services per line are

$$e = \frac{T}{n} + \alpha m,$$

where $\alpha > 0$ indexes the effectiveness of outside managers. Hence, as product line number n increases, each line gets less time of the entrepreneur's managerial time T. As shown later, this dilution of managerial time creates incentives to hire managers as n increases.

Total profits net of managerial payments for a firm with productivity φ operating n lines are

$$\Pi(n; \varphi) = n \max_{m \geq 0} \left\{ A_r \varphi^{\varepsilon-1} \left(\frac{T}{n} + \alpha m \right)^{\sigma} - w_{M,r} m \right\}.$$

This maximization problem determines the firm's optimal demand for managerial inputs and its profit for a given scope n. It is possible that multi-product firms ($n > 1$) choose not to hire outside managers ($m = 0$) if the entrepreneur's time constraint is not yet binding. However, the incentive to hire managers depends directly on scope n. As the firm adds product lines, the entrepreneur's fixed time endowment T is spread more thinly across lines, reducing effective managerial input per line ($e = T/n$). Because per-line profit $\pi(\varphi, e) = A\, \varphi^{\varepsilon-1} e^{\sigma}$ is

[16] The derivation is in Section D.

[17] As explained later, firms can operate multiple lines only when they choose to be modern firms after paying a fixed cost. Hence, the description here only applies to modern firms who paid the fixed cost. On the other hand, traditional firms are restricted to $n = 1$.

concave in managerial services, the marginal return to managerial services rises as e falls. Specifically, without hiring, effective services are T/n. As n increases, T/n decreases, causing the marginal profit $\pi'(\varphi, T/n)$ to rise. Consequently, the marginal benefit of hiring outside managers increases with firm scope. In other words, the entrepreneur's limited time T creates an extensive margin for managerial hiring. A firm hires outside managers only if its scope n exceeds an endogenous delegation cutoff $n^*(\varphi)$. Namely,

$$n \geq n^*(\varphi), \qquad n^*(\varphi) = T\left(\frac{w_{M,r}}{\sigma\alpha A_r \varphi^{\varepsilon-1}}\right)^{\frac{1}{1-\sigma}}.$$

Hence, small firms rely exclusively on the owner's time and only start delegating once they reach size $n > n^*(\varphi)$. The cutoff $n^*(\varphi)$ is decreasing in φ, so delegation occurs with smaller n when the firm is more productive.

Next, it is straightforward to verify that optimal manager demand per line, conditional on hiring managers, is

$$m(n, \varphi) = \frac{1}{\alpha}\left(\frac{\sigma\alpha A_r \varphi^{\varepsilon-1}}{w_{M,r}}\right)^{\frac{1}{1-\sigma}} - \frac{T}{\alpha n}, \qquad \text{for } n \geq n^*(\varphi).$$

Manager demand per line is increasing in n. Larger firms hire more outside managers per line to compensate for the dilution of entrepreneur time T/n. Thus the demand for outside managers is non-homothetic, in the sense that larger firms use managers more intensively. Also, the manager demand is increasing in productivity φ and hence, more productive firms demand more managers.

The total profit is a piecewise function of n:

$$\Pi(n; \varphi) = \begin{cases} A_r \varphi^{\varepsilon-1} T^{\sigma} n^{1-\sigma}, & n < n^*(\varphi), \\ \frac{w_{M,r}}{\alpha} T + (1-\sigma) A_r \varphi^{\varepsilon-1} \left(\frac{\sigma\alpha A_r \varphi^{\varepsilon-1}}{w_{M,r}}\right)^{\frac{\sigma}{1-\sigma}} n, & n \geq n^*(\varphi). \end{cases}$$

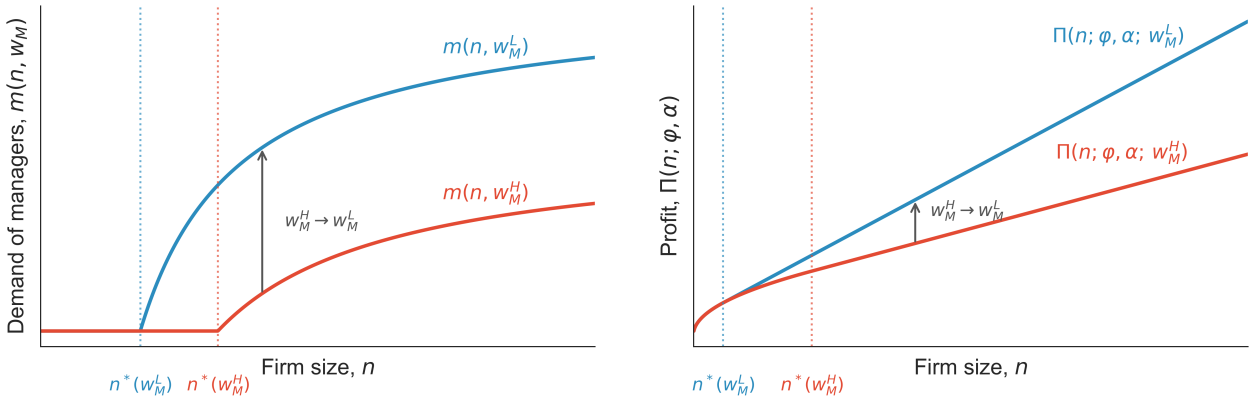
This profit function summarizes the firm's span of control, that is, the return to expanding into an additional product line. Importantly, the possibility of delegation endogenizes the span of control. Before delegation, marginal profits are declining in n. Once the firm delegates, profits become linear in n, and both the cutoff $n^*(\varphi)$ and the slope in the linear region depend on the manager wage $w_{M,rt}$ and productivity φ. Modern firms choose n to maximize profits given this piecewise profit function.

Panel A of Figure 5 shows the manager demand over the number of products for two different manager wages. Since higher manager wages mean higher cost of hiring managers and profits are increasing in manager services, firms demand more managers with lower

manager wages.

Panel B of Figure 5 shows total profits of firms with size n for two different manager wages. Before hiring managers, total profits are concave in n. After the threshold, the profits become linear and the threshold is lower with lower manager wages and the slope of the total profits are larger with lower manager wages.

FIGURE 5: MANAGER DEMAND AND PROFIT AS FUNCTIONS OF SCOPE



(A) MANAGER DEMAND $m(n)$ (B) PROFIT $\Pi(n)$

Notes: This figure shows manager demand (Panel A) and total profit (Panel B) as functions of firm scope n. In Panel A, manager demand is zero until the delegation cutoff $n^*(\varphi)$ and then increases. In Panel B, profits are concave in the non-delegation region ($n < n^*(\varphi)$) and become linear in the delegation region ($n \geq n^*(\varphi)$). The blue lines correspond to a low manager wage (w_M^L) and the red dashed lines to a high manager wage (w_M^H).

Organizational forms and modernization. Firms choose between a traditional and a modern organizational form. Traditional firms operate a single line and do not hire outside managers and pay overhead cost f units of non-agricultural goods:

$$n = 1, \qquad m = 0.$$

Per-line (or total) profit for traditional firms is hence $\pi(\varphi, T) = A\varphi^{\varepsilon-1}T^{\sigma}$. Thus traditional profits after paying overhead cost f are

$$\Pi^T(\varphi) = A\varphi^{\varepsilon-1}T^{\sigma} - f.$$

This implies that firms with low productivity can have negative profits if $A\varphi^{\varepsilon-1}T^{\sigma} < f$. Firms with negative profits exit the market. The exit cutoff productivity level φ^* is defined by $\Pi^T(\varphi^*) = 0$.

Modern firms pay a fixed adoption cost ηf in terms of non-agricultural goods and $\eta > 1$ and then choose scope $n \geq 1$ and manager demand $m \geq 0$. Operating a multi-line organization

entails a convex scope cost in terms of non-agricultural goods:

$$C(n) = \frac{\kappa}{2}(n-1)^2, \qquad \kappa > 0.$$

The modern firms that hire outside managers ($n \geq n^*(\varphi)$) choose n:[18]

$$\max_{n \geq n^*(\varphi)} \frac{w_M}{\alpha} T + \underbrace{(1-\sigma) A \varphi^{\varepsilon-1} \left(\frac{\sigma \alpha A \varphi^{\varepsilon-1}}{w_M} \right)^{\frac{\sigma}{1-\sigma}}}_{\equiv \Lambda(\varphi; w_M)} n - \frac{\kappa}{2}(n-1)^2 - \eta f,$$

hence, the optimal delegation region scope choice is

$$n^M(\varphi) = 1 + \frac{\Lambda(\varphi; w_M)}{\kappa}.$$

Note that the number of product lines increases with productivity and hence, more productive firms are larger in terms of the number of product lines. Let $V^M(\varphi)$ denote the maximized value of the modern firm net of the convex scope cost. A firm adopts the modern form if and only if

$$V^M(\varphi) - \eta f \geq \Pi^T(\varphi),$$

where $\Pi^T(\varphi)$ is traditional profit. Adoption follows a cutoff rule. There exists $\bar{\varphi}$ such that low-productivity firms remain traditional and high-productivity firms adopt the modern form. Each operating firm contributes a number of varieties equal to its scope choice:

$$n(\varphi) = \begin{cases} 1, & \varphi \in [\varphi^*, \bar{\varphi}), \\ n^M(\varphi), & \varphi \geq \bar{\varphi}. \end{cases}$$

Firms with productivity lower than φ^* exit the market and operate zero product line. Traditional firms ($\varphi \in [\varphi^*, \bar{\varphi})$) operate a single product without outside managers using only owners' time T. Lastly, modern firms operate multiple products which increase in productivity.

4.2 Labor Supply and Occupational Choice

Each individual supplies one efficiency unit of production labor and has managerial human capital h. In region r, an individual chooses between production work at wage $w_{P,rt}$ and outside management earning $h\, w_{M,rt}$. The occupational cutoff is $\bar{h}_{rt} = w_{P,rt}/w_{M,rt}$. Aggregate

[18] Note that there are firms that choose modern forms but do not hire managers. In the Appendix, I derive the condition under which all the modern firms hire managers. All the analyses here assume that all the modern firms hire managers.

effective supply of outside managers is

$$H_r^S(w_{M,r}, w_{P,r}) = \int_{h \geq \bar{h}_r} h\, g(h)\, dh.$$

Assume h is Pareto with shape $\kappa^h > 1$ and mean μ_M. Then managerial supply is increasing in the relative wage $w_{M,r}/w_{P,r}$ with elasticity $\kappa^h - 1$, and is increasing in the mean manager human capital μ_M. An inflow of high-skilled repatriates increases μ_M, shifting out managerial supply and tending to reduce $w_{M,r}$ relative to $w_{P,r}$.

4.3 Preferences and Mobility

Households in region r consume agricultural and non-agricultural composites with Cobb–Douglas preferences,

$$U_r = C_{A,r}^{\nu}\, C_{M,r}^{1-\nu}, \qquad \nu \in (0,1).$$

Let P_A denote the agricultural price and let P_M denote the non-agricultural price. Note that since I assume that regions are small open economies, these prices are fixed. Optimal demands imply the Cobb–Douglas unit expenditure index

$$P_r \equiv \frac{P_A^{\nu} P_M^{1-\nu}}{\nu^{\nu}(1-\nu)^{1-\nu}},$$

so indirect utility is proportional to real income,

$$u_r = \frac{E_r}{P_r}.$$

Expected income with occupational choice. Individuals differ in managerial human capital h. Upon residing in region r, an individual supplies production labor at wage $w_{P,r}$ or supplies outside management at wage $w_{M,r}$ per unit of h. Income is therefore

$$E_r(h) = \max\{w_{P,r},\, h\, w_{M,r}\}.$$

Let $\bar{h}_r \equiv w_{P,r}/w_{M,r}$ denote the occupation cutoff. Since h is Pareto with shape $\kappa^h > 1$ and scale $h_{\min} = \frac{\kappa^h - 1}{\kappa^h}\mu_M$, $\mathbb{E}[h] = \mu_M$. Then, for $\bar{h}_r \geq h_{\min}$, expected income has the closed form

$$\mathbb{E}[E_r] = w_{P,r}\left[1 + \frac{(\kappa^h - 1)^{\kappa^h - 1}}{(\kappa^h)^{\kappa^h}} \left(\frac{\mu_M w_{M,r}}{w_{P,r}}\right)^{\kappa^h}\right].$$

Expected indirect utility in region r is therefore

$$\mathbb{E}[u_r] = \frac{\mathbb{E}[E_r]}{P_r},$$

which is increasing in $w_{P,r}$, $w_{M,r}$, and μ_M.

Spatial mobility. Individuals are mobile across regions subject to bilateral moving frictions τ_{jr}, region amenities Z_r, and idiosyncratic destination taste shocks. An individual currently in region j who considers destination r at time t obtains

$$U_{jr} = Z_r \, \tau_{jr} \, \mathbb{E}[u_r] \, \xi_{ir},$$

where ξ_{ir} is i.i.d. Fréchet across individuals and destinations with shape parameter $\psi > 0$. The implied migration share from origin j to destination r is the standard gravity expression

$$m_{jr} = \frac{\left(Z_r \tau_{jr} \mathbb{E}[u_r]\right)^{\psi}}{\sum_d \left(Z_d \tau_{jd} \mathbb{E}[u_d]\right)^{\psi}}.$$

Then, the inflow into region r increases with expected utility which increases with wages and average managerial human capital. I assume that τ_{jr} is a function of distance $d_{jr}^{\kappa^d}$.

4.4 Comparative Statics

Empirical evidence shows that the inflow of managers modernized the organization of production by decreasing the share of self-employed and increasing the share of managers and the number of establishments per firm.[19] Furthermore, the inflow of managers also increases the share of non-agriculture and the output per worker. Proposition 1 shows the impacts of the inflow of managers on these characteristics of firm modernization and economic development.

Proposition 1. *An increase in the average managerial human capital μ_M implies:*

(i) lower traditional firm share.

(ii) higher manager share.

(iii) more product lines per firm.

(iv) lower agriculture share.

[19] In the empirical analysis, I use the share of self-employed as a proxy for the share of traditional firms. This is because traditional firms in the model are single-product firms that do not hire outside managers ($m = 0$), relying solely on the entrepreneur's time endowment ($e = T$), which aligns with the definition of "own-account" workers or non-employer firms in the data.

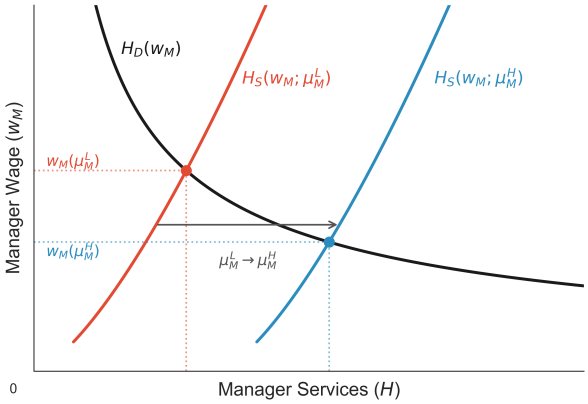
(v) higher output per worker.

Proof. Proof is in Section D.13 □

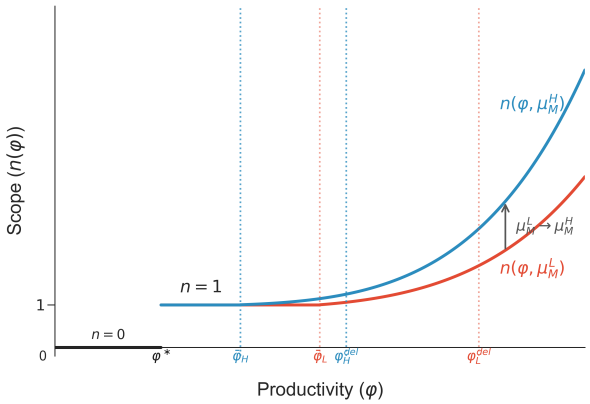
Proposition 1 matches my key empirical findings. As shown in Figure 6, high-skilled repatriates brought back managerial human capital higher than local average, increasing the average human capital. This higher human capital decreases manager wage and hence increases incentives for firms to hire more managers and produce more product lines. The model predicts that this increase in average human capital lowers the share of traditional firms since more firms decided to choose modern forms.[20] Furthermore, since more firms start hiring managers and become larger, they demand more production labor. This increase in the production labor demand raises production wages. Since production labor wages are equal across sectors, agriculture sector hires less production workers due to the rise in hiring costs and hence, agriculture employment share decreases.

[20] Figure 3 in Akcigit et al. (2021) numerically shows the relationship between delegation efficiency α and the shares of traditional firms and managers, noting they "currently do not have an analytical proof." Proposition 1 provides this missing analytical characterization since the increase in α and the decrease in manager wage w_M are quantitatively the same.

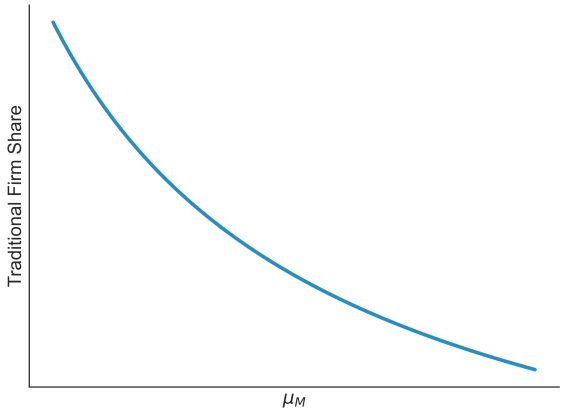
FIGURE 6: IMPACT OF MANAGER INFLOW ON LABOR MARKET, FIRMS' SCOPE, AND TRADITIONAL FIRM AND MANAGER SHARES



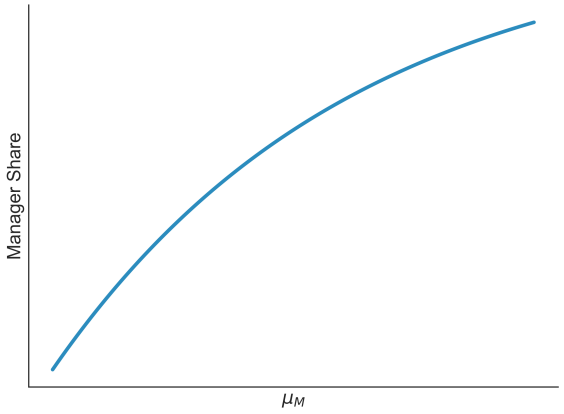
(A) MANAGER LABOR MARKET EQUILIBRIUM



(B) FIRM SCOPE FUNCTION CHANGE



(C) TRADITIONAL FIRM SHARE



(D) MANAGER SHARE

Notes: Panel (A) shows the manager labor market. An increase in the supply of managers (from μ_M^L to μ_M^H) shifts the supply curve to the right, lowering the equilibrium manager wage w_M. Panel (B) shows the firm scope function $n(\varphi)$. The lower manager wage increases the optimal scope for modern firms (blue curve shifts up from red curve). This induces traditional firms (who have $n = 1$) in the range $[\varphi_H^*, \varphi_L^*]$ to switch to the modern form, employing managers and expanding product lines. Panel (C) shows the share of traditional firms decreasing as the average manager human capital μ_M increases. Panel (D) shows the share of managers (headcount) increasing as μ_M increases.

5 Structural Estimation and Counterfactual Analysis

This section estimates the model and conducts counterfactual analysis. Section 5.1 outlines the estimation strategy. Section 5.2 reports the estimation results. Section 5.3 describes the counterfactual analysis.

5.1 Estimation

There are 13 parameters to be estimated in total. There are mainly two types of parameters; regional fundamentals $\{Q_r, Z_r, \mu_{M,r}\}$ and 10 structural parameters that are constant across regions. I estimate the following structural parameters:

$$\Omega = \{\underbrace{\zeta_\varphi, \alpha, T, f, \eta, \kappa, \sigma}_{\text{Firm Organization}}, \underbrace{\kappa^h}_{\text{Skills}}, \underbrace{\nu}_{\text{Preferences}}, \underbrace{\psi, \kappa^d}_{\text{Location Choice}}\}$$

Migration and Location Choice Parameters (ψ and κ^d). I estimate the dispersion parameter ψ and the distance elasticity of migration costs κ^d using repatriate household micro data that record the district of residence in 1950 and the district of residence in 1964. I assume that repatriates and natives draw idiosyncratic destination taste shocks from the same i.i.d. Fréchet distribution with common shape parameter ψ. Under this assumption, repatriate moves are draws from the model's common location choice rule, so repatriate origin destination flows identify the location choice elasticity relevant for the overall population. I follow a two step procedure in the spirit of Monte et al. (2018). In the first step, I estimate the distance component of migration costs by fitting a PPML gravity equation on origin destination flow counts with origin and destination fixed effects, so that the distance coefficient identifies $\theta_d \equiv \psi\kappa^d$ while absorbing all destination attractiveness into fixed effects. In the second step, I use the estimated destination fixed effects and relate them to a model consistent proxy for $\ln \mathbb{E}[u_r]$, constructed from local revenue per worker and the district manager share, to recover ψ. I then obtain κ^d as $\kappa^d = \theta_d/\psi$.[21]

Skills (κ^h and μ_M). I estimate κ^h using the repatriate micro data on pre war income. I assume that natives and repatriates share the same tail thickness of managerial skill, so the repatriate income tail identifies κ^h. I estimate κ^h from the upper tail of pre war incomes using a standard Hill tail index estimator after trimming extreme outliers.

Agriculture Parameter and Preferences (γ and ν). I estimate ν and γ using expenditure and production data. With Cobb–Douglas preferences over agriculture and non agriculture composites, the agriculture expenditure share equals ν, so I set ν to match the spending share on food in the data. I estimate γ from district level variation in agricultural income, agricultural labor, and cultivated land in 1960 by exploiting the log linear implication of the agriculture production function,

$$\ln Y_r^A = \ln Q_r + \gamma \ln L_r^{PA} + (1-\gamma)\ln \mathcal{T}_r,$$

[21] Details are in Section C.

and use the resulting estimate as the baseline agriculture technology parameter γ.

Firm Organization Parameters (ζ_φ). I estimate the Pareto tail parameter of firm productivity, ζ_φ, from the upper tail of the firm size distribution in the 1970 firm micro data. Under the CES demand system with constant markups, firm sales and employment scale with productivity as $R_i \propto \varphi_i^{\varepsilon-1}$. This implies a one to one mapping between the Pareto tail index of firm size and the Pareto tail index of productivity, $\zeta_\varphi = (\varepsilon - 1)\zeta_R$. I estimate the tail index of sales and employment using a Hill estimator on the top tail after trimming extreme outliers, and map the resulting estimate into ζ_φ using the implied scaling.

Regional Fundamentals Q_r and Z_r. I recover district fundamentals Q_r and Z_r by inverting the model's equilibrium conditions given the estimated structural parameters. First, I back out agricultural productivity Q_r from the agriculture block using 1960 district data on cultivated land and agricultural labor together with a proxy for revenue per worker. The agriculture first order condition implies $w_{P,r} = P_A \gamma Q_r (T_r / L_r^{PA})^{1-\gamma}$, so Q_r is obtained mechanically as $Q_r = \frac{w_{P,r}}{P_A \gamma}(L_r^{PA}/T_r)^{1-\gamma}$. Second, I recover amenities Z_r from repatriate origin destination flows by treating the estimated mobility parameters ψ and $\theta_d = \psi\kappa^d$ as given and fitting a PPML gravity equation with origin and destination fixed effects. The resulting destination fixed effects capture the residual destination attractiveness and map to amenities via $\widehat{Z}_r \propto \exp(\widehat{\delta}_r/\psi)$, which I normalize to have mean one.

Firm Organization Parameters ($\sigma, \alpha, \kappa, T, f, \eta$). I estimate the remaining six structural parameters governing firm organization using the simulated method of moments (SMM). I choose these parameters to minimize the distance between model-simulated moments and their data counterparts. The targeted moments include the share of modern firms (defined as firms with multiple establishments), the aggregate manager employment share, and the firm size distribution (specifically the mean and 99th percentile of establishments per firm). Intuitively, the modern firm share identifies the modernization cost multiplier η and fixed cost f. The manager share pinpoints the returns to managerial services σ. And the firm size distribution (mean and tail) pins down the scope cost parameters κ and the span of control α.

Repatriate Skill Advantage (ξ). I estimate district-level mean managerial skill $\mu_{M,r}$ in 1970 using indirect inference. The key insight is that repatriates and natives share the same Pareto shape parameter κ^h, but repatriates may differ in their mean skill level by a factor ξ, so that $\mu_M^{\text{rep}} = \xi \cdot \mu_M^{\text{native}}$. Given this structure, district r's mean managerial skill in 1970

depends on its 1950 baseline and the local share of high-skilled repatriates $s_{H,r}$:

$$\mu_{M,r}^{1970} = \mu_{M,r}^{1950} \cdot \left[(1 - s_{H,r}) + s_{H,r} \cdot \xi^{\kappa^h} \right]^{1/\kappa^h}$$

I estimate ξ by indirect inference. For a candidate value of ξ, I compute each district's implied $\mu_{M,r}^{1970}$, solve the full equilibrium model for 1950 and 1970, and regress the simulated change in the manager employment share on $s_{H,r}$. The indirect inference procedure searches for ξ such that the simulated regression coefficient matches the reduced-form estimate from Table 4. Once ξ is identified, I recover district-level $\mu_{M,r}^{1970}$ directly from the mapping above.

5.2 Estimation Results

Table 6 reports the estimated structural parameters. The dispersion of location tastes, $\psi = 1.58$, falls within the range of migration elasticities in Monte et al. (2018) and is close to Peters (2022). The distance elasticity $\kappa^d = -1.02$ likewise matches the benchmark of -1.1 in Peters (2022). For managerial human capital, $\kappa^h = 1.5$ aligns with Akcigit et al. (2021). The span of control $\sigma = 0.261$ is notably smaller than their 0.468, implying steeper returns to managerial scope in post-war Japan. The delegation efficiency $\alpha = 0.474$ is close to their 0.433.

Table 6: Structural Parameter Estimates

Parameter	Description	Estimate
Migration and Location Choice		
ψ	Fréchet shape parameter	1.58
κ^d	Distance elasticity	-1.02
Skills		
κ^h	Managerial skill shape	1.50
Preferences and Technology		
ν	Agriculture preference	0.194
γ	Agriculture labor share	0.614
Firm Organization		
ζ_ϕ	Firm productivity tail	5.12
σ	Span of control	0.261
α	Delegation efficiency	0.474
f	Overhead cost	0.100
η	Modernization cost	2.00
κ	Scope cost level	0.207
ρ	Scope cost curvature	1.51
T	Entrepreneur time	0.107

Notes: This table reports structural parameter estimates. Migration parameters (ψ, κ^d) are estimated from repatriate origin–destination flows using a gravity framework. The managerial skill shape (κ^h) is estimated from the upper tail of repatriate prewar incomes. Preference (ν) and agriculture (γ) parameters are calibrated to expenditure shares and district production data. Firm organization parameters (σ, α, f, η, κ, ρ, T) are estimated via Simulated Method of Moments targeting the modern-firm share, manager employment share, and firm-size distribution. The productivity tail (ζ_ϕ) is estimated from the firm size distribution using a Hill estimator. See Section C for details.

5.3 Counterfactual Exercises

What is the aggregate impact of the high-skill repatriate inflow on economic growth? To answer this question, I hold regional fundamentals $(Q_r, \mathcal{T}_r, Z_r)$ and migration frictions fixed and solve the spatial general equilibrium with endogenous regional populations and wages. The baseline equilibrium uses the estimated $\mu_{M,r}^{1970}$, which is driven by the high-skill repatriate inflow. The "no-high-skilled repatriate" counterfactual sets $\mu_{M,r}$ back to its 1950 level while leaving all other fundamentals at their 1970 values. Comparing these equilibria isolates the aggregate impact of the high-skill repatriate inflow through the managerial-human-capital channel. Under this identification, removing high-skill repatriates lowers aggregate output

per worker by about 13.6 percent and reduces the non-agricultural employment share by about 12.6 percentage points, indicating that the repatriate-induced increase in μ_M is an important driver of structural transformation and income growth.

6 Conclusion

This paper studies the role of population inflow in economic development by analyzing Japan's post-World War II repatriation, one of the largest forced migrations in modern history. Six million Japanese nationals, equivalent to nearly 9% of the home population, returned from the former colonies in a short period. I classify repatriates into high- and low-skilled groups based on their colonial occupations. High-skilled workers had accumulated managerial human capital through administrative and supervisory roles in colonial governments and firms. Exploiting predetermined family registry locations and the Allied repatriation logistics as instruments, I identify the differential effects of population shocks on local economic outcomes.

The empirical analysis reveals three main findings. First, high-skilled repatriates triggered structural transformation and economic growth. Districts receiving more high-skilled returnees experienced declines in agricultural employment, expansions in manufacturing and services, and an increase in output per worker. Low-skilled repatriates did not generate similar effects. Second, the mechanism operated through firm modernization. High-skilled exposure shifted local production from self-employed and family labor toward wage workers and outside managers, indicating a transition from traditional firms to modern firms. At the firm level, high-skilled exposure raised employment, capital, and the number of establishments per firm. Third, neither group affected patenting, suggesting that the growth effects operated through managerial execution and organizational upgrading rather than innovation. High-skilled repatriates provided the "visible hands" to local firms, enabling them to modernize and expand (Chandler, 1977).

I develop a spatial two-sector model that rationalizes these findings. The economy consists of agriculture, which uses production labor and fixed land, and a non-agricultural sector where firms can operate in traditional or modern forms. Traditional firms are run by owner-managers with limited span of control, while modern firms hire outside managers to oversee multiple product lines. The key friction is delegation cost. Hiring outside managers requires costly monitoring and coordination. An inflow of managerial human capital reduces the cost of delegation by expanding the local supply of qualified managers, lowering the manager wage. This enables more firms to adopt modern organizational forms, expand their scope of operations, and hire professional managers. As firms modernize, they become more

productive and labor demand rises, which attracts workers from the agricultural sector within the region and draws in migrants from other areas. The resulting structural transformation is not driven by technological innovation, but by the relaxation of organizational constraints that previously limited firm scale and productivity.

The Japanese historical setting offers clean identification but may limit external validity to contemporary contexts. However, post-World War II Japan shared key features with today's low-income countries. The economy was predominantly agricultural, firms were organized as small family enterprises, and professional managers were scarce. In this sense, the findings offer insights for developing economies where traditional firm structures dominate and managerial constraints limit growth. The results suggest that policies expanding the supply of managerial human capital through education, training programs, or skilled migration could help firms transition from traditional to modern organizational forms, enabling productivity gains, structural transformation, and economic growth.

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A Data

This section details the construction of the primary datasets used in the analysis. The project relies on three main data sources: (1) novel microdata on repatriates digitized from archival survey records, (2) firm-level microdata digitized from business directories, and (3) district-level economic and demographic data from the Population Census and other government statistics. Table A1 summarizes these datasets.

Table A1: Summary of Data Sources

Dataset	Years	Sample/Coverage	Source
Repatriation and Firm Microdata			
Repatriate Survey	1964	460,000 households	Kanagawa Archives
Teikoku Directory	1957, 1964, 1970	All registered firms	TDB-CAREE
Census and Establishment Data			
Population Census	1920–1970	All districts	Statistics Bureau
Census of Commerce	1952, 1960	All establishments	METI
Census of Manufactures	1950, 1960	Estab. with 4+ employees	METI
Prefectural Yearbooks	1950	All districts	J-DAC
Other Data Sources			
Tax Statistics	1934	All tax districts	Ministry of Finance
IIP Patent Database	1964–1970	All applications	IIP
War Damage	1945	All districts	ESB (1949)
Transportation	1920–1970	All stations/exits	MLIT
Universities	1920–1970	All universities	MEXT
NSFIE	1989–2014	National sample	Statistics Bureau

Notes: J-DAC = Japan Digital Archives Center (Prefectural Statistical Online). METI = Ministry of Economy, Trade and Industry. ESB = Economic Stabilization Board. IIP = Institute of Intellectual Property. MLIT = Ministry of Land, Infrastructure, Transport and Tourism. MEXT = Ministry of Education, Culture, Sports, Science and Technology. NSFIE = National Survey of Family Income and Expenditure. TDB-CAREE = Teikoku Databank Center for Advanced Empirical Research on Enterprise and Economy.

A.1 Repatriation Microdata

I construct a novel dataset of repatriates by digitizing the *Zaigai Shiyu Zaisan Jittai Chosa Hyo* (Survey on the Actual Status of Overseas Private Assets) stored at the Kanagawa Prefectural Archives. This survey was conducted in November 1964 by the National Federation of Repatriate Organizations (*Hikiagesha Dantai Zenkoku Rengo-kai*). Its primary purpose was to document the assets left behind by Japanese nationals in the former colonies to inform compensation policies. As described in Teikoku Databank Museum (2019), the original survey slips were stored in cardboard boxes at the Federation's office before being transferred

to the archives, where they were eventually organized and digitized. The sample covers approximately 460,000 households. Unfortunately, the Kanagawa Prefectural Archives do not contain records for Kagoshima and Yamanashi prefectures. I randomly chose and digitized 15% of total households.

Although the survey was conducted in 1964, it provides detailed information on each household's status as of August 15, 1945 (the end of World War II). Key variables include the name of the household head, their occupation in the colonies, their last address abroad, their family registry (*honseki*), and their post-repatriation settlement location in Japan.

A.2 Firm and Establishment Data

Firm-Level Data. To measure firm modernization and organizational structure, I use the *Teikoku Ginkou Kaisha Yoroku* (Teikoku Bank and Company Directory) for the years 1957, 1964, and 1970. The data for available prefectures (Osaka, Kyoto, Hyogo, Fukuoka, Aichi, Shizuoka, Nagano, and Gunma) were obtained from the Teikoku Databank Center for Advanced Empirical Research on Enterprise and Economy (TDB-CAREE) database at Hitotsubashi University. For prefectures not covered by the database, I digitized the corresponding directories to create a complete national dataset. I digitized randomly selected firms in each page of the *Teikoku Ginkou Kaisha Yoroku*. This directory is a comprehensive credit registry compiled by Teikoku Koshinsho (now Teikoku Databank), the leading credit reporting agency in Japan. It covers joint-stock companies (*Kabushiki Kaisha*), limited partnerships (*Goshi Kaisha*), and unlimited partnerships (*Gomei Kaisha*). The directory lists firms meeting a minimum capital threshold, which varies by year (e.g., 50,000 yen in 1938 and generally 1 million yen in 1957). Thus, it covers the universe of medium and large enterprises but excludes smaller firms. Crucially, starting from the post-war editions (such as 1957), the directory includes the number of employees and annual sales, in addition to standard financial and organizational variables like capital, board members, and establishment year. I use this data to construct measures of firm scale (employees, capital) and scope (number of establishments).

Manufacturing Establishments (1950). To measure the post-war recovery of the business sector, I use data on the number of manufacturing establishments in 1950. These data are digitized from the *Prefectural Statistical Yearbooks* (*Ken Tokei Sho*), accessed through the Prefectural Statistical Online database. The *Ken Tokei Sho* are fundamental statistical documents published annually by each prefecture since the Meiji era. They provide comprehensive coverage of regional socio-economic conditions, including detailed statistics on population, agriculture, manufacturing, and commerce at the municipality level.

Service Establishments (1952). To measure the service sector capacity, I use the number of service establishments from the *Shogyo Tokei Hyo* (Census of Commerce) for 1952 (Ministry of International Trade and Industry, 1952). The Census of Commerce is a statistical survey started in 1952 to clarify the actual state of commerce in Japan. It targets all establishments nationwide belonging to the wholesale and retail trade industries. The 1952 survey provides the earliest comprehensive baseline for commercial activity in the post-war period.

Service and Manufacturing Establishments and Output (1960). For 1960, I use the number of establishments and output in the service and manufacturing sectors. Data for service establishments and output are obtained from the *Shogyo Tokei Hyo* (Census of Commerce) for 1960 (Ministry of International Trade and Industry, 1960). As with the 1952 survey, this census covers all wholesale and retail establishments and provides detailed data on the number of employees and annual sales (output). Manufacturing establishment counts and output are digitized from the *Kogyo Tokei Chosa* (Census of Manufactures) for 1960, accessed via the Ministry of Economy, Trade and Industry archives (Ministry of Economy, Trade and Industry, 1960). The Census of Manufactures aims to clarify the actual status of Japan's manufacturing industry. It covers all manufacturing establishments with 4 or more employees. Crucially, the 1960 survey is the earliest edition that provides data at the municipality level, allowing for consistent district-level analysis.

A.3 Regional Economic Data

Population Census. Data on relevant local economic outcomes come from the Population Census of Japan (*Kokusei Chosa*). I use the Census to construct a panel of sectoral employment shares (agriculture, manufacturing, and services) for the years 1920, 1930, 1940, 1950, 1960, and 1970. Additionally, I use the 1950 and 1970 Censuses to measure employment status, specifically the shares of self-employed workers, family labor, wage workers, and managers. The information on these variables is available only after WWII. The data are aggregated to the 1960 district (*gun* or *shi*) boundaries using the procedure described in Section B.8.

Pre-World War II Output Data. I obtain pre-war output data from the *Zeimu Tokei Sho* (Tax Statistics) for the 1934 fiscal year (Ministry of Finance, 1934). This publication is a comprehensive annual statistical report on national taxation in Japan, published by the *Shuzei-kyoku* (Tax Bureau) of the Ministry of Finance. The series began in 1882 and served as the primary source of detailed tax data until the National Tax Agency assumed responsibility after World War II. Specifically, I use the *Eigyo Shueki Zei* (Business Profits Tax), which was introduced in 1926 and levied on the net profits of commercial and industrial enterprises.

The data reports the number of taxpayers and the amount of taxable profits at the prefecture, city (*shi*), and county (*gun*) levels. This data serves as a proxy for local non-agricultural economic activity before the war. The historical volumes are archived at the National Diet Library and available via the Digital Collections (https://dl.ndl.go.jp/).

Patents. I obtain patent data from the Institute of Intellectual Property (IIP) Patent Database 2020 edition (*IIP Patent Database 2020-nen ban*) (Nakamura, 2016). This database covers approximately 12.7 million patent applications filed since 1964. I use the number of patent applications filed by residents of each district to measure local innovation output between 1964 and 1970.

Household Consumption and Income. I use anonymized microdata from the National Survey of Family Income and Expenditure (*Zenkoku Shohi Jittai Chosa*) for 1989, 1994, 1999, 2004, 2009, and 2014. This statistic was independently created and processed using anonymized data from the National Survey of Family Income and Expenditure (Ministry of Internal Affairs and Communications) provided by the National Statistics Center under the Statistics Act (National Statistics Center, 2024). I use this data to estimate the income elasticity and the elasticity of substitution.

A.4 Geography and Infrastructure

War Damage. To control for the destruction caused by WWII, I use data on buildings destroyed by air raids. The data are originally from Economic Stabilization Board (1949), which I obtain via Davis and Weinstein (2002).

Transportation Infrastructure. I construct a district-level panel of transportation infrastructure, specifically the number of railway stations and highway interchanges. The data are obtained from the National Land Numerical Information download service provided by the Ministry of Land, Infrastructure, Transport and Tourism (Ministry of Land, Infrastructure, Transport and Tourism, 2024).

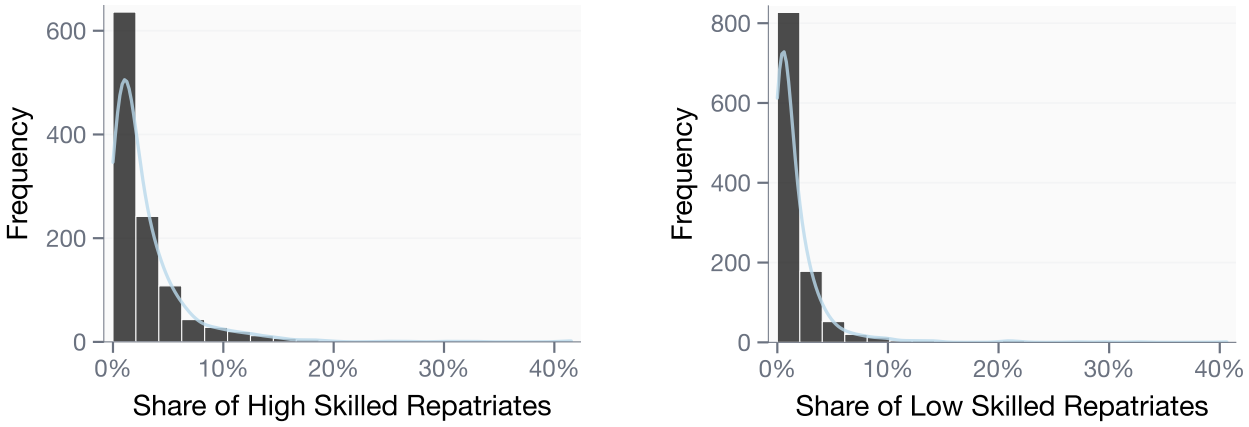
Universities. Data on the location and establishment year of universities are collected from the *Zenkoku Daigaku Ichiran* (National List of Universities) (Ministry of Education, Culture, Sports, Science and Technology, 2023). I use this to count the stock of universities in each district over time.

B Additional Empirical Results

B.1 Repatriate Share Distribution

Figure A1 plots the distribution of high- and low-skilled repatriate inflows normalized by the 1940 district labor force. Both distributions show geographic heterogeneity. Although the majority of districts received inflows below 5%, the distributions are characterized by a pronounced right skew, with a long tail of districts absorbing significantly larger population shocks. This cross-sectional variation in exposure intensities for both skill groups serves as the primary source of identification.

FIGURE A1: REPATRIATE SHARE DISTRIBUTION



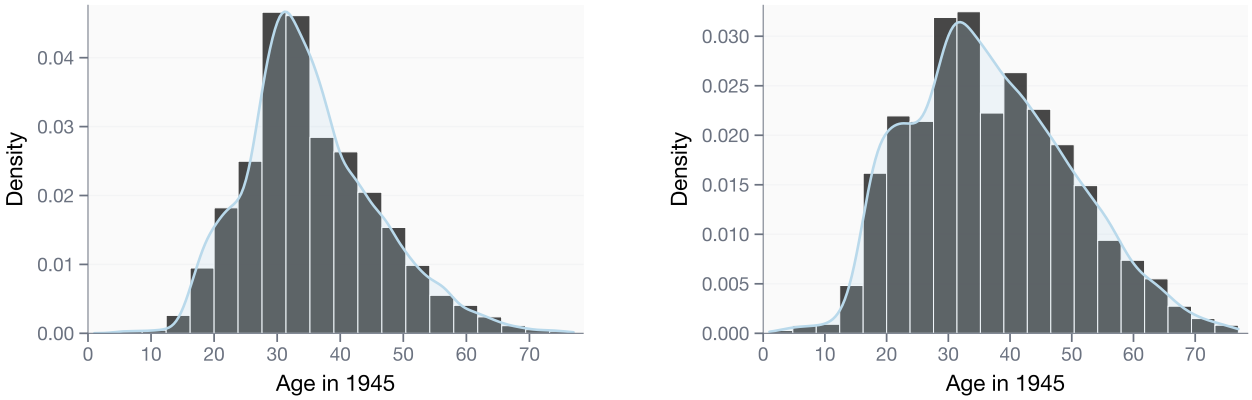
(A) HIGH-SKILLED (B) LOW-SKILLED

Notes: This figure plots the distribution of high-skilled (Panel A) and low-skilled (Panel B) repatriates in 1945. The histograms show the density of individuals in each age bin, and the curves represent kernel density estimates.

B.2 Repatriate Age Distribution

This section compares the age structure of high- and low-skilled repatriates. Figure A2 presents the age distributions for both groups. Both high- and low-skilled repatriates were predominantly working-age adults, with the distribution concentrated between ages 20 and 40. The similarity in age profiles suggests that the divergent economic impacts of these two groups are not driven by differences in age or lifecycle stages, but rather by their distinct human capital and occupational skills.

Figure A2: Repatriate Age Distribution



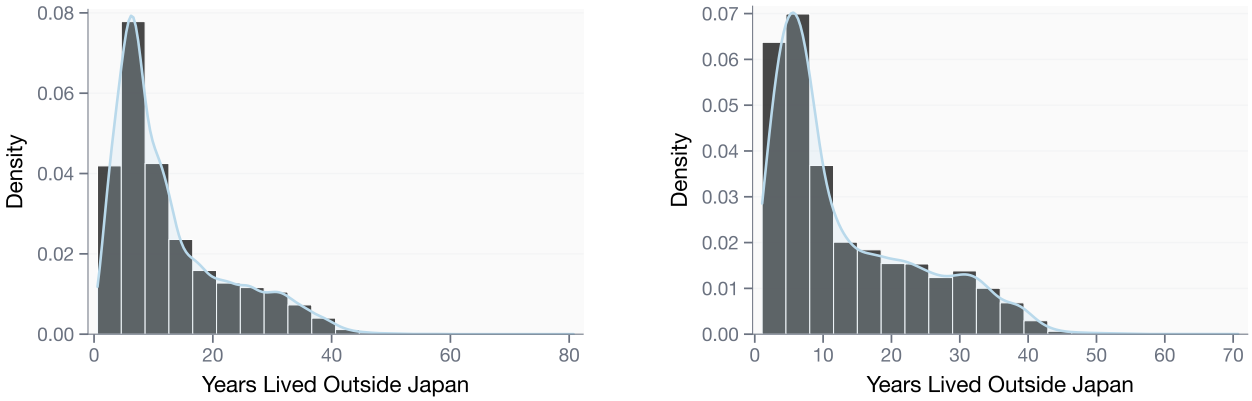
(A) High-skilled (B) Low-skilled

Notes: This figure plots the age distribution of high-skilled (Panel A) and low-skilled (Panel B) repatriates in 1945. The histograms show the density of individuals in each age bin, and the curves represent kernel density estimates.

B.3 Repatriate Length of Stay Distribution

Figure A3 shows the distribution of the length of stay in the colonies for high- and low-skilled repatriates. Many repatriates, especially high-skilled ones, lived abroad for several years. This long experience suggests they gained valuable skills and knowledge in the colonies, which they brought back to Japan.

Figure A3: Repatriate Length of Stay Distribution



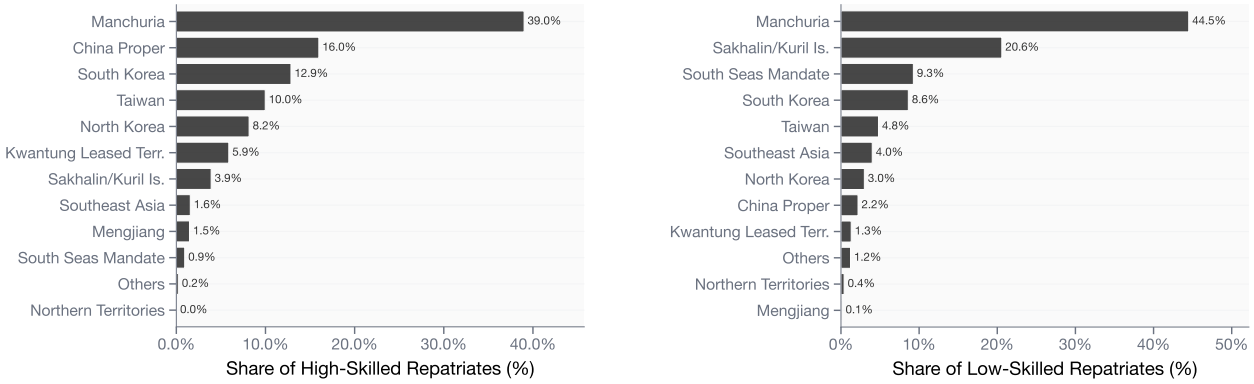
(A) High-skilled (B) Low-skilled

Notes: This figure plots the distribution of the number of years spent in the colonies/occupied territories for high-skilled (Panel A) and low-skilled (Panel B) repatriates. The histograms show the density of individuals by years of residence, and the curves represent kernel density estimates.

B.4 Distribution of Colonies

Figure A4 shows the distribution of high- and low-skilled repatriates by their region of origin. Manchuria was the single largest source for both groups, accounting for nearly 40% of all returnees. However, there are notable differences: high-skilled repatriates were more likely to return from Manchuria and North China, reflecting the administrative and industrial nature of Japan's presence there, whereas low-skilled repatriates were more dispersed across other regions.

FIGURE A4: COLONY DISTRIBUTION



(A) HIGH-SKILLED (B) LOW-SKILLED

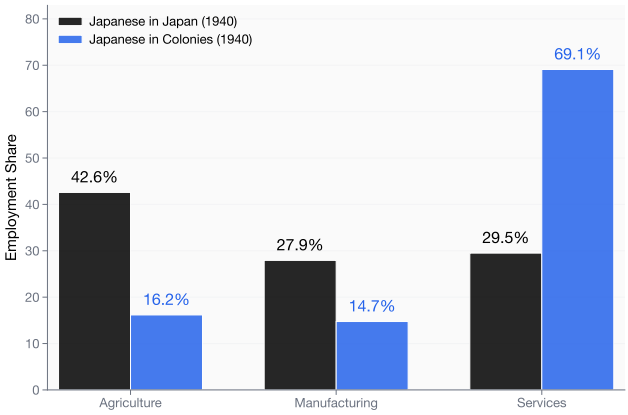
Notes: This figure displays the breakdown of high-skilled (Panel A) and low-skilled (Panel B) repatriates by their region of last residence. The horizontal bars represent the percentage of the group's population returning from each specific colony or occupied territory.

B.5 Japan Proper vs Repatriates

This section compares the sectoral employment structure of workers in Japan proper with that of Japanese repatriates who had been living in the colonies. In 1940, Japan proper was predominantly agricultural, with over 40% of the labor force employed in agriculture. Manufacturing and services together accounted for the remaining employment. By contrast, Japanese nationals residing in the colonies who would later return as repatriates were disproportionately employed in the service sector, which includes managerial, administrative, and professional occupations. Nearly 70% of colonial Japanese worked in services, while only about 16% were in agriculture. This stark difference reflects the colonial labor hierarchy. Japanese nationals occupied supervisory and white-collar positions, while native populations performed manual and agricultural work. Figure A5 displays these sectoral employment shares. The high concentration of repatriates in service-sector occupations explains why their return to Japan represented a substantial inflow of managerial and administrative human

capital.

FIGURE A5: SECTORAL EMPLOYMENT SHARES IN JAPAN PROPER AND REPATRIATES, 1940



Notes: This figure shows the sectoral employment shares in Japan proper and repatriates in 1940. Blue bars represent Japanese industry shares, while black bars represent repatriates industry shares. It shows that repatriates were overwhelmingly concentrated in service sector jobs compared to the labor force in Japan proper.

B.6 Overall Repatriate Effects

This section examines the aggregate effects of repatriation on local labor markets and structural transformation without distinguishing between high- and low-skilled returnees. The main text separates repatriates by skill to identify the distinct contributions of managerial human capital. Here I present results using the total repatriate share as the independent variable. Table A2 reports IV estimates of the relationship between the total repatriate share and changes in log labor force and sectoral employment shares between 1940 and 1960. Columns (4) and (5) report pre-trend specifications using earlier census years (1940–1930 and 1930–1920) to assess whether high-repatriate districts were already on differential trajectories prior to repatriation. The results show that total repatriates increased local labor force, reduced the agricultural employment share, and expanded manufacturing and service employment shares.

$$\Delta z_{r,1960-1940} = \beta_0 + \beta_1 \text{Total Rep.}_r + \boldsymbol{X}_r'\Gamma + \varepsilon_{r,t},$$

where $z_{r,t}$ represents either log labor force or sectoral employment shares (agriculture, manufacturing, or services) in district r at time t and $\boldsymbol{X}_r$ is a vector of control variables in district r. I analyze changes in these outcomes over the period 1940–1960. The denominator of the total repatriate share is the number of labor force in 1940. The specification includes controls for prefecture fixed effects, the extent of war damage, log density in 1940 and the

level of the dependent variable in 1940, following Peters (2022). I estimate this using the instrumental variable described below, only reporting the coefficient of interest β_1 for brevity.

TABLE A2: REPATRIATES AND LOCAL STRUCTURAL TRANSFORMATION (IV)

Panel A: Log Labor Force Change					
	1960-1940			1940-1930	1930-1920
	(1)	(2)	(3)	(4)	(5)
Repatriate Share$_{1950}$	3.758***	3.759***	1.749***	-0.865***	-0.008
	(0.314)	(0.314)	(0.197)	(0.334)	(0.068)
N	1,107	1,107	1,107	1,107	1,107
Panel B: Agriculture Emp. Share Change					
	1960-1940			1940-1930	1930-1920
	(1)	(2)	(3)	(4)	(5)
Repatriate Share$_{1950}$	-0.398***	-0.398***	-0.397***	-0.004	0.017
	(0.075)	(0.074)	(0.072)	(0.028)	(0.018)
N	1,107	1,107	1,107	1,107	1,107
Panel C: Manufacturing Emp. Share Change					
	1960-1940			1940-1930	1930-1920
	(1)	(2)	(3)	(4)	(5)
Repatriate Share$_{1950}$	0.178***	0.178***	0.174***	-0.001	-0.010
	(0.046)	(0.046)	(0.044)	(0.013)	(0.011)
N	1,107	1,107	1,107	1,107	1,107
Panel D: Service Emp. Share Change					
	1960-1940			1940-1930	1930-1920
	(1)	(2)	(3)	(4)	(5)
Repatriate Share$_{1950}$	0.220***	0.220***	0.221***	0.007	-0.008
	(0.039)	(0.039)	(0.038)	(0.019)	(0.009)
N	1,107	1,107	1,107	1,107	1,107
Pref FE	✓	✓	✓	✓	✓
Log Density$_{1940}$	✓	✓	✓	✓	✓
War Destruction		✓	✓	✓	✓
Level Dep.			✓	✓	✓

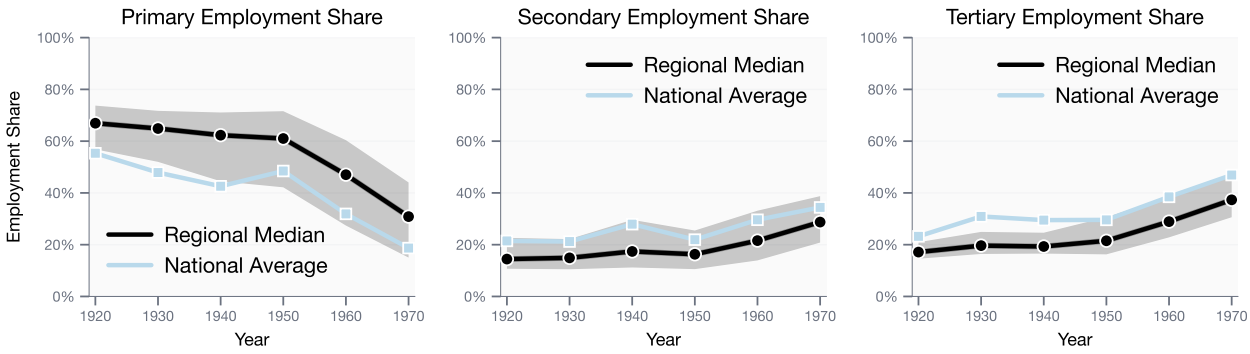
Notes: The table presents the estimation results of the relationship between the share of total repatriates and local economic outcomes, using the *Honseki* address as an instrumental variable. The dependent variables are changes in log labor force (Panel A) and sectoral employment shares (agriculture (Panel B), manufacturing (Panel C), or services (Panel D)) between 1940 and 1960. The independent variable is the share of total repatriates in district r at time 1950. The control variables include prefecture fixed effects (Pref FE), log density (Log Density$_{1940}$), war damage (War Destruction). Standard errors are clustered at the district level and reported in parentheses. $^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.1$.

B.7 Structural Transformation in Post-World War II Japan

Japan underwent rapid structural transformation in the decades following World War II. During the 1950s and 1960s, the economy shifted away from agriculture toward manufac-

turing and services, with changes occurring both within and across districts. As shown in Figure A6, the agricultural employment share fell from 48% in 1950 to 19% in 1970, while the tertiary-sector share rose from 30% to 47%. These changes reflect the emergence of modern, urban, and service-oriented economic activity during Japan's high-growth era. The structural transformation was not simply a national trend but happened heterogeneously across cities and towns.

FIGURE A6: SECTORAL EMPLOYMENT SHARES IN JAPAN, 1920–1970



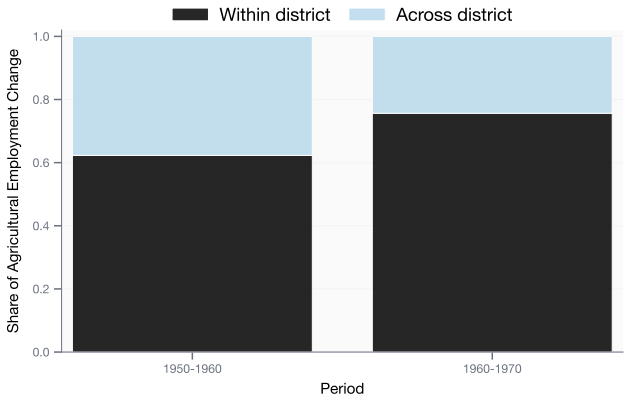
Notes: This figure shows the evolution of employment shares across three sectors (primary, secondary, and tertiary) in Japan from 1920 to 1970. Blue lines represent national rates, while grey lines show the median and grey shaded areas show the interquartile range of district-level employment shares.

Figure A7 quantifies the contribution of local structural transformation versus population reallocation by decomposing the aggregate decline in the agricultural employment share, s_t, into "Within" and "Across" components (Eckert et al., 2023):

$$\Delta s_t = \underbrace{\sum_{c=1}^{C} l_{ct} \Delta s_{ct}}_{\text{"Within"}} + \underbrace{\sum_{c=1}^{C} (s_{ct} \Delta l_{ct} + \Delta l_{ct} \Delta s_{ct})}_{\text{"Across"}} \tag{2}$$

where s_{ct} represents the agricultural share in district c at time t, and l_{ct} is the district's share of national employment. The "Within" term isolates the decline driven by falling agricultural shares within districts, holding the population distribution constant. On the other hand, the "Across" term accounts for population shifts toward less agricultural districts. As shown in the figure, the "Within" component accounts for nearly 60% of the aggregate decline, implying that structural transformation primarily occurred through adjustments within local economies rather than through the reallocation of labor to already-industrialized regions.

Figure A7: Agricultural Change Decomposition



Notes: This figure shows the decomposition of agricultural employment changes in Japan from 1950 to 1970 into "Within" and "Across" components, following Eckert et al. (2023) and Equation (2)). The "Within" (black) component represents the decline due to local structural transformation within districts, while the "Across" (blue) component represents the decline due to population reallocation across districts.

B.7.1 Employment Structure

Table A3 presents the evolution of employment structure in Japan between 1950 and 1970. The share of wage workers increased significantly, rising from 34.7% to 55.7%, while the shares of self-employed and family workers declined. This shift reflects the ongoing modernization and structural transformation of the Japanese economy. Additionally, the share of managers nearly doubled during this period, consistent with the expansion of managerial hierarchies in growing firms.

Table A3: Employment Shares in 1950 and 1970

	1950		1970	
Category	Mean	S.D.	Mean	S.D.
Employment Status				
Self-employed	0.272	(0.051)	0.219	(0.067)
Family workers	0.380	(0.134)	0.223	(0.098)
Wage workers	0.347	(0.171)	0.557	(0.160)
Occupation				
Managers	0.015	(0.012)	0.028	(0.017)

Notes: This table reports the mean and standard deviation (in parentheses) of employment shares by category across prefectures in 1950 and 1970. The data illustrate the structural shift from self-employment and family labor towards wage employment and managerial roles.

B.8 Geographic Crosswalks and Standardized Boundaries

To address the methodological challenges associated with changing administrative boundaries over time, I implement a spatial standardization procedure using 1960 district boundaries as the reference unit. Following Eckert et al. (2020), I construct geographic crosswalks by intersecting historical district boundaries with the 1960 reference map. This process generates a set of time-invariant spatial units, with area-based weights linking historical districts to their 1960 counterparts.

For a given historical year, weights are calculated as:

$$w_{ij} = \frac{A_{ij}}{A_j^{\text{hist}}} \quad \forall\, i \in I,\ j \in J,$$

where w_{ij} is the weight between district i in 1960 and district j in the historical year, A_{ij} is the intersection area between districts i and j, A_j^{hist} is the total area of historical district j, I is the set of 1960 districts (reference), and J is the set of historical districts.

For a historical variable X (e.g., population in 1940), its value in 1960 boundaries is:

$$X_i^{1960} = \sum_{j \in J} w_{ij} X_j^{1940}.$$

For example, consider a 1960 district i that overlaps with two 1940 districts: if 1940 District A has population 100 and 20% of its area overlaps with district i, and 1940 District B has population 10 and 100% of its area overlaps with district i, then the 1940 population for 1960 district i would be $X_i^{1960} = (100 \times 0.2) + (10 \times 1.0) = 30$. This area-weighted reallocation assigns 30 people from 1940 to the 1960 boundaries of district i.

B.9 Repatriate Settlement Discrete Choice Results

This section presents estimates from the conditional logit model used to construct the instrument for repatriate settlement. The model assumes that each repatriate i, routed to landing port j by colonial origin and Allied shipping logistics, chooses a final settlement destination k to maximize utility. The utility specification includes two key shifters: (i) an indicator for whether the destination matches the repatriate's ancestral *honseki* registry, capturing historically-rooted ties to ancestral places, and (ii) log distance from the assigned landing port to the destination, encoding repatriation logistics rather than post-war economic prospects. Both shifters are predetermined and plausibly exogenous to post-war local economic conditions. Table A4 reports maximum likelihood estimates. The large positive coefficient on

honseki indicates that repatriates were much more likely to settle in their ancestral home district, while the negative coefficient on log distance shows that settlement probability declined with distance from the landing port. These estimates are used to compute predicted settlement probabilities, which are then aggregated to construct the instrumental variable for district-level repatriate shares.

$$U_{ijk} = \underbrace{\beta_{\text{h}} \cdot \mathbf{1}\{k = \text{honseki}_i\}}_{\text{Institutional Ties}} + \underbrace{\beta_d \cdot \ln(\text{distance}_{jk})}_{\text{Geographic Constraints}} + \varepsilon_{ijk} \tag{3}$$

with $\varepsilon_{ijk} \sim$ i.i.d. Type-I extreme value. Conditional on the landing port, this delivers a conditional-logit probability for each destination.

Table A4: Discrete Choice Model of Repatriate Settlement

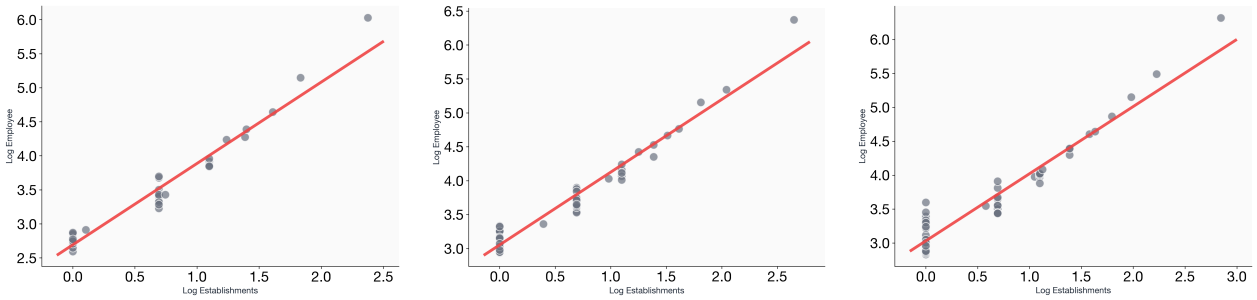
	(1)
Honseki	7.987***
	(0.011)
Log distance	-0.578***
	(0.006)

Notes: This table reports maximum likelihood estimates from the conditional logit model of repatriate settlement. The dependent variable is the final settlement choice. Independent variables include honseki ties, distance from port, and their interactions with pre-war income and age. Standard errors are clustered at the individual level. $^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.1$.

B.10 Firm-level Data

This section provides descriptive statistics using firm-level data from the *Teikoku Ginkou Kaisha Youroku* (Imperial Bank and Company Directory) for 1957, 1964, and 1970. This dataset captures the universe of medium and large enterprises in Japan, offering key insights into their organizational structures during the high-growth era. Figure A8 plots the relationship between firm size (total employment) and organizational scope (number of establishments). Across all three years, there is a tight, positive log-linear relationship: as firms scale up their workforce, they systematically extend their number of operating facilities. This evidence supports the view that firm growth involves a replication of production units, an extensive margin of expansion, rather than simply adding workers to a single location.

FIGURE A8: LOG EMPLOYEE VS LOG ESTABLISHMENTS



(A) 1957 (B) 1964 (C) 1970

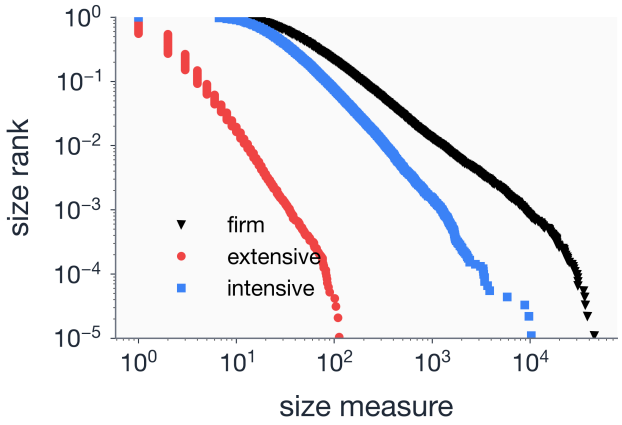
Notes: This figure shows binscatter plots of log employees against log establishments for firms in 1957, 1964, and 1970. Each point represents a binned average of firms. The data are sourced from the *Teikoku Ginkou Kaisha Youroku*.

To further characterize the firm size distribution in Japan, Figure A9 plots the relationship between firm size and rank. Following the approach of Cao et al. (2022), I decompose firm size into the extensive and intensive margins. Let N_{ft} be the total number of workers employed by firm f and E_{ft} be the total number of establishments owned and operated by firm f at time t. I define average establishment size within firm f as N_{ft}/E_{ft} so that I decompose size at the firm-level as

$$N_{ft} = \left(\frac{N_{ft}}{E_{ft}}\right) \times E_{ft} \tag{4}$$

Figure A9 examines these three measures: total employment (N_{ft}), the number of establishments (E_{ft}), and the average number of employees per establishment (N_{ft}/E_{ft}). The linear relationship in the log-log plot suggests that firm size in Japan follows a power law distribution. Moreover, the figure highlights that large firms achieve their scale through both increasing the number of establishments and expanding the size of individual establishments. This pattern is consistent with the findings in Cao et al. (2022).

FIGURE A9: FIRM SIZE DISTRIBUTION



Notes: This figure replicates Figure 1 in Cao et al. (2022) using Japanese firm-level data. It plots the relationship between firm size and rank. The x-axis shows the log of firm size (measured by number of establishments, employees, and employees per establishment), and the y-axis shows the log rank.

B.11 Other Channels

To see the impact of repatriate settlement on the development of universities and transportation infrastructure, I estimate the following difference-in-differences regression:

$$Y_{rt} = \beta_0 + \beta_1 \text{High-skilled}_r + \beta_2 \text{Low-skilled}_r + \lambda_t + \alpha_r + \lambda_p + \epsilon_{rt}$$

where Y_{rt} is the number of universities per capita and the number of stations and highway exits per capita, High-skilled_{rt} is high-skilled repatriate share, Low-skilled_{rt} is low-skilled repatriate share, λ_t denotes the time fixed effect, α_r denotes the district fixed effect, and λ_p denotes the prefecture fixed effect.

TABLE A5: IMPACTS ON UNIVERSITIES AND TRANSPORTATION

	Universities per capita	Stations+Highways per capita
	(1)	(2)
Low skilled Rep Share_{1950}	-0.000	-0.002***
	(0.000)	(0.001)
High skilled Rep Share_{1950}	-0.000	-0.001*
	(0.000)	(0.001)
N	6642	5535

Notes: This table reports the relationship between repatriate settlement and the development of universities and transportation infrastructure. The dependent variable is the number of universities per capita and the number of stations and highway exits per 100,000 population. Standard errors are clustered at the district level. $^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.1$.

Next, I examine the impact of repatriate settlement on patenting. I estimate the following difference-in-differences regression:

$$P_{r1970-1964} = \beta_0 + \beta_1 \text{High-skilled}_r + \beta_2 \text{Low-skilled}_r + \mathbf{X}_{rt}\Gamma' + \lambda_p + \epsilon_{rt}$$

where $P_{r1970-1964}$ is the number of patents filed per capita in 1970–1964, High-skilled$_r$ is high-skilled repatriate share, Low-skilled$_r$ is low-skilled repatriate share, $\mathbf{X}_{rt}\Gamma'$ denotes the usual controls. λ_p is the prefecture fixed effect.

Table A6: Impacts on Patenting

	Patents pc	Patents pc
	(1)	(2)
Low-Skilled Rep$_{1950}$	-0.009	0.007
	(0.006)	(0.006)
High-Skilled Rep$_{1950}$	-0.005	-0.002
	(0.004)	(0.004)
N	1,107	1,107
R^2	-0.000	0.007
Pref FE	✓	✓
Log Density$_{1940}$		✓
War Destruction		✓

Notes: This table reports the relationship between patents filed per capita in 1970–1964 and high-skilled and low-skilled repatriate shares. Standard errors are clustered at the district level. $^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.1$.

B.12 OLS Results

This section presents Ordinary Least Squares (OLS) estimates for the results reported in the main text.

Table A7: Repatriates and Local Structural Transformation (OLS)

Panel A: Log Labor Force Change					
	1960-1940			1940-1930	1930-1920
	(1)	(2)	(3)	(4)	(5)
Low-Skilled Rep. $Share_{1950}$	2.616***	2.637***	1.531**	0.136	-0.645**
	(0.676)	(0.676)	(0.601)	(0.343)	(0.296)
High-Skilled Rep. $Share_{1950}$	7.194***	7.184***	4.312***	-1.022**	0.182
	(0.857)	(0.855)	(0.634)	(0.457)	(0.136)
R^2	0.335	0.336	0.522	0.245	0.441
N	1,107	1,107	1,107	1,107	1,107
Panel B: Agriculture Emp. Share Change					
	1960-1940			1940-1930	1930-1920
	(1)	(2)	(3)	(4)	(5)
Low-Skilled Rep. $Share_{1950}$	-0.002	-0.006	-0.008	-0.035	0.221***
	(0.271)	(0.272)	(0.271)	(0.071)	(0.068)
High-Skilled Rep. $Share_{1950}$	-1.096***	-1.094***	-1.098***	0.011	-0.076**
	(0.160)	(0.160)	(0.160)	(0.077)	(0.038)
R^2	0.194	0.195	0.207	0.336	0.373
N	1,107	1,107	1,107	1,107	1,107
Panel C: Manufacturing Emp. Share Change					
	1960-1940			1940-1930	1930-1920
	(1)	(2)	(3)	(4)	(5)
Low-Skilled Rep. $Share_{1950}$	0.145	0.148	0.131	0.027	-0.127***
	(0.151)	(0.151)	(0.148)	(0.033)	(0.042)
High-Skilled Rep. $Share_{1950}$	0.306***	0.305***	0.299***	-0.042	0.030
	(0.095)	(0.095)	(0.092)	(0.031)	(0.026)
R^2	0.188	0.190	0.227	0.592	0.255
N	1,107	1,107	1,107	1,107	1,107
Panel D: Service Emp. Share Change					
	1960-1940			1940-1930	1930-1920
	(1)	(2)	(3)	(4)	(5)
Low-Skilled Rep. $Share_{1950}$	-0.143	-0.141	-0.131	0.018	-0.098***
	(0.171)	(0.171)	(0.170)	(0.058)	(0.037)
High-Skilled Rep. $Share_{1950}$	0.789***	0.789***	0.795***	0.035	0.046**
	(0.121)	(0.121)	(0.121)	(0.058)	(0.021)
N	1,107	1,107	1,107	1,107	1,107
R^2	0.169	0.169	0.176	0.264	0.590
Pref FE	✓	✓	✓	✓	✓
Log $Density_{1940}$	✓	✓	✓	✓	✓
War Destruction		✓	✓	✓	✓
Level Dep.			✓	✓	✓

Notes: The table presents the estimation results of economic outcomes. The dependent variables are changes in log labor force (Panel A) and sectoral employment shares (agriculture (Panel B), manufacturing (Panel C), or services (Panel D)) between 1940 and 1960. The independent variable is the share of high- and low-skilled repatriates in district r at time 1950. The control variables include prefecture fixed effects (Pref FE), log density (Log $Density_{1940}$), war damage (War Destruction). To check pre-trends, I include the change in log labor force and sectoral employment shares between 1930 and 1940, between 1930 and 1920 and between 1940 and 1930 as additional dependent variables. Standard errors are clustered at the district level and reported in parentheses. $^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.1$.

Table A8: Productivity (1960–1950) and Output per Worker (1960–1940), OLS

	# of Establishment$_{1960-1950}$	Establishment Size$_{1960-1950}$	Output per Worker$_{1960-1940}$
	(1)	(2)	(3)
Low-Skilled Rep$_{1950}$	0.290	-0.850	-0.274
	(0.749)	(0.770)	(0.687)
High-Skilled Rep$_{1950}$	3.279***	2.290***	2.073***
	(0.607)	(0.620)	(0.475)
N	1,100	1,090	1,102
R^2	0.272	0.536	0.402
Pref FE	✓	✓	✓
Log Density$_{1940}$	✓	✓	✓
War Destruction	✓	✓	✓
Level Dep.	✓	✓	✓

Notes: This table presents the estimation results of the relationship between the share of high- and low-skilled repatriates and non-agricultural productivity. The dependent variable is the change in the number of establishments, the average employees per establishment, and the average revenue per employee in log between 1960 and 1950 or 1940. The independent variable is the share of high- and low-skilled repatriates in district r at time 1950. The control variables include prefecture fixed effects (Pref FE), log density (Log Density$_{1940}$), war damage (War Destruction), and level of the corresponding dependent variable in 1950 or 1940 (Level Dep). Standard errors are clustered at the district level and reported in parentheses. $^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.1$.

Table A9: Modernization of the Local Economy (1970–1950, OLS)

	Self-employed Share$_{1970-1950}$	Family Worker Share$_{1970-1950}$	Wage Worker Share$_{1970-1950}$	Manager Share$_{1970-1950}$
	(1)	(2)	(3)	(4)
Low-Skilled Rep$_{1950}$	0.045	0.078	-0.127	0.005
	(0.064)	(0.084)	(0.131)	(0.016)
High-Skilled Rep$_{1950}$	-0.246***	-0.128***	0.310***	0.026***
	(0.039)	(0.044)	(0.072)	(0.009)
N	1,107	1,107	1,107	1,107
R^2	0.415	0.603	0.359	0.276
Pref FE	✓	✓	✓	✓
Log Density$_{1940}$	✓	✓	✓	✓
War Destruction	✓	✓	✓	✓
Level Dep.	✓	✓	✓	✓

Notes: This table presents the estimation results of the relationship between the share of high- and low-skilled repatriates and the modernization of the local economy. The dependent variable is the change in the share of self-employed workers, the share of family workers, the share of wage workers and the change in the share of managers (including managers in public sector) between 1970 and 1950. The independent variable is the share of high- and low-skilled repatriates in district r at time 1950. The control variables include prefecture fixed effects (Pref FE), log density (Log Density$_{1940}$), war damage (War Destruction), and level of the corresponding dependent variable in 1950 (Level Dep). Standard errors are clustered at the district level and reported in parentheses. $^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.1$.

TABLE A10: MODERNIZATION OF FIRMS (1957, 1964, 1970, OLS)

	Log Employee	Log Capital	Log Shareholder	Log Establishment
	(1)	(2)	(3)	(4)
Low-Skilled Rep_{1950}	-2.472	-2.466	-3.619	-2.786**
	(2.739)	(2.166)	(2.270)	(1.234)
High-Skilled Rep_{1950}	0.900	0.981	1.120	0.602
	(0.746)	(0.753)	(0.756)	(0.459)
N	91,175	95,748	68,611	96,083
R^2	0.037	0.144	0.031	0.041
Pref FE	✓	✓	✓	✓
Log Density_{1940}	✓	✓	✓	✓
War Destruction	✓	✓	✓	✓

Notes: This table presents the estimation results of the relationship between the share of high- and low-skilled repatriates and the modernization of firms. The dependent variable is firm employment, capital, number of shareholders or number of establishments in a firm in log in 1957, 1964, and 1970. The independent variable is the share of high- and low-skilled repatriates in district r at time 1950. The control variables include prefecture fixed effects (Pref FE), log density (Log Density_{1940}), and war damage (War Destruction). Standard errors are clustered at the district level and reported in parentheses. $^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.1$.

B.13 Composition Effects

This appendix explores the difference between *scale* and *composition* of the repatriation inflow, and how these objects relate to the baseline specification that separately includes high- and low-skilled repatriate inflows.

Let H_r denote high-skilled repatriates in district r, and U_r denote low-skilled repatriates. I define $R_r \equiv H_r + U_r$ and scale all inflows by the baseline labor force L_r (measured in 1940 in the main analysis) as done in the main analysis. The baseline IV specification in the paper is

$$Y_r = \alpha + \beta_H \frac{H_r}{L_r} + \beta_U \frac{U_r}{L_r} + X_r'\Gamma + \varepsilon_r.$$

This specification estimates the marginal effect of increasing high-skilled inflows holding low-skilled inflows fixed (β_H), and analogously for low-skilled inflows (β_U).

The terms *scale* and *composition* correspond to three distinct objects.

(1) **Scale holding managerial capacity fixed.** Increase total inflows by adding production worker repatriates while holding managerial inflows fixed: $\Delta(H_r/L_r) = 0$ and $\Delta(U_r/L_r) > 0$. In (B.13), this object is β_U. It captures the effect of a larger repatriation shock that does *not* relax managerial bottlenecks while increasing production labor.

(2) **Scale holding production labor fixed.** Increase total inflows by adding manager repatriates while holding production labor fixed: $\Delta(H_r/L_r) > 0$ and $\Delta(U_r/L_r) = 0$. In

(B.13), this object is β_H. It captures the effect of a larger repatriation shock that relaxes managerial bottlenecks while holding production labor fixed.

(3) **Composition holding total inflow fixed.** Hold total inflow fixed and increase managerial workers via a one-for-one swap: $\Delta(H_r/L_r) = +1$ and $\Delta(U_r/L_r) = -1$, so $\Delta(R_r/L_r) = 0$. In other words, it increases the number of managers while holding the total number of inflows fixed.

An equivalent way to write the decomposition is

$$Y_r = \alpha + \theta \frac{R_r}{L_r} + \phi \frac{H_r}{L_r} + X_r'\gamma + \varepsilon_r.$$

Using $R_r/L_r = H_r/L_r + U_r/L_r$, we have

$$\theta \frac{R_r}{L_r} + \phi \frac{H_r}{L_r} = (\theta + \phi)\frac{H_r}{L_r} + \theta \frac{U_r}{L_r}.$$

Therefore, the two parameterizations map one-to-one:

$$\theta = \beta_U, \qquad \phi = \beta_H - \beta_U, \qquad \beta_H = \theta + \phi.$$

In other words, estimating (B.13) and reporting the difference $\beta_H - \beta_U$ is equivalent to estimating (B.13). It is easy to see that β_H contains the "one more repatriate" component (scale, θ) and the "one more manager" component (composition, ϕ) while total inflow is held fixed.

Hence, which specification to use depends on the question of interest. If the goal is to estimate the marginal effect of increasing managerial capacity while holding the inflow of production workers fixed (and vice versa), the natural specification is

$$Y_r = \alpha + \beta_H \frac{H_r}{L_r} + \beta_U \frac{U_r}{L_r} + X_r'\Gamma + \varepsilon_r,$$

where β_H answers the counterfactual "one more manager per baseline worker holding U_r/L_r fixed," and β_U answers "one more production worker per baseline worker holding H_r/L_r fixed." This specification aligns with the mechanism emphasized in the paper: production-labor inflows expand the workforce but may fail to relax managerial bottlenecks, whereas managerial inflows can relax those constraints and enable firm scaling and modernization.

If instead the goal is to separate changes in the *size* of the repatriation shock from changes in its *composition*, it is convenient to use this specification

$$Y_r = \alpha + \theta \frac{R_r}{L_r} + \phi \frac{H_r}{L_r} + X_r'\Gamma + \varepsilon_r, \qquad R_r \equiv H_r + U_r,$$

where θ captures the effect of increasing total repatriation intensity holding managerial inflows fixed (i.e., increasing non-managerial inflows), and ϕ captures the additional effect of managerial repatriates relative to non-managerial repatriates holding total inflows fixed.

A practical concern with estimating (B.13) is that in my setting high-skilled repatriates constitute a large share of total repatriates, so $\frac{H_r}{L_r}$ and $\frac{R_r}{L_r}$ are mechanically highly correlated. Hence, standard errors for $\hat{\phi}$ can become large. This can be seen from the OLS variance formula. Let $Y = \beta_1 x_1 + \beta_2 x_2 + u$, with x_1, x_2 demeaned and no other controls (adding controls just means "residualize" first; same result). The OLS variance for $\hat{\beta}_1$ is:

$$\text{Var}(\hat{\beta}_1) = \frac{\sigma_u^2}{\sum_i (x_{1i} - \bar{x}_1)^2 \, (1 - \rho_{12}^2)},$$

where ρ_{12} is the sample correlation between x_1 and x_2. Symmetrically for $\hat{\beta}_2$. So as $|\rho_{12}| \to 1$, we have $(1 - \rho_{12}^2) \to 0$, hence $\text{Var}(\hat{\beta}_1) \to \infty$.

Below, I report the results of (B.13) specification.

Table A11: Repatriates and Local Structural Transformation (IV)

Panel A: Log Labor Force Change					
	1960-1940			1940-1930	1930-1920
	(1)	(2)	(3)	(4)	(5)
Total Rep. Share$_{1950}$	2.774***	2.537***	0.732	0.503	-0.344
	(0.855)	(0.820)	(0.861)	(0.567)	(0.347)
High-Skilled Rep. Share$_{1950}$	1.468	1.513	1.885	-2.446**	0.607
	(1.259)	(1.204)	(1.264)	(1.064)	(0.421)
N	1107	1107	1107	1107	1107
Panel B: Agriculture Emp. Share Change					
	1960-1940			1940-1930	1930-1920
	(1)	(2)	(3)	(4)	(5)
Total Rep. Share$_{1950}$	-0.146	-0.150	-0.141	-0.131	0.171**
	(0.342)	(0.343)	(0.337)	(0.113)	(0.070)
High-Skilled Rep. Share$_{1950}$	-0.828	-0.823	-0.839*	0.180	-0.205*
	(0.506)	(0.506)	(0.495)	(0.185)	(0.108)
N	1107	1107	1107	1107	1107
Panel C: Manufacturing Emp. Share Change					
	1960-1940			1940-1930	1930-1920
	(1)	(2)	(3)	(4)	(5)
Total Rep. Share$_{1950}$	0.381	0.384	0.379	0.028	-0.066
	(0.234)	(0.234)	(0.234)	(0.052)	(0.055)
High-Skilled Rep. Share$_{1950}$	-0.117	-0.121	-0.121	-0.043	0.071
	(0.317)	(0.317)	(0.311)	(0.080)	(0.076)
N	1107	1107	1107	1107	1107
Panel D: Service Emp. Share Change					
	1960-1940			1940-1930	1930-1920
	(1)	(2)	(3)	(4)	(5)
Total Rep. Share$_{1950}$	-0.236	-0.234	-0.238	0.105	-0.107***
	(0.157)	(0.157)	(0.154)	(0.087)	(0.035)
High-Skilled Rep. Share$_{1950}$	0.945***	0.943***	0.956***	-0.135	0.136**
	(0.258)	(0.258)	(0.256)	(0.133)	(0.055)
N	1,107	1,107	1,107	1,107	1,107
Pref FE	✓	✓	✓	✓	✓
Log Density$_{1940}$	✓	✓	✓	✓	✓
War Destruction		✓	✓	✓	✓
Level Dep.			✓	✓	✓

Notes: The table presents the estimation results of the relationship between the share of total and high-skilled repatriates and local economic outcomes, using the *Honseki* address as an instrumental variable. The dependent variables are changes in log labor force (Panel A) and sectoral employment shares (agriculture (Panel B), manufacturing (Panel C), or services (Panel D)) between 1940 and 1960. The independent variable is the share of total and high-skilled repatriates in district r at time 1950. The control variables include prefecture fixed effects (Pref FE), log density (Log Density$_{1940}$), war damage (War Destruction). To check pre-trends, I include the change in log labor force and sectoral employment shares between 1930 and 1940, between 1930 and 1920 and between 1940 and 1930 as additional dependent variables. Standard errors are clustered at the district level and reported in parentheses. $^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.1$.

Table A12: Productivity (1960–1950) and Output per Worker (1960–1940), IV

	# of Establishment$_{1960-1950}$	Establishment Size$_{1960-1950}$	Output per Worker$_{1960-1940}$
	(1)	(2)	(3)
Total Rep$_{1950}$	1.103	-1.230	-0.891
	(1.039)	(0.921)	(0.709)
High-Skilled Rep$_{1950}$	1.925	3.338**	2.778**
	(1.494)	(1.303)	(1.081)
N	1,100	1,090	1,102
Pref FE	✓	✓	✓
Log Density$_{1940}$	✓	✓	✓
War Destruction	✓	✓	✓
Level Dep.	✓	✓	✓

Notes: This table presents the estimation results of the relationship between the share of total and high-skilled repatriates and non-agricultural productivity. The dependent variable is the change in the number of establishments, the average employees per establishment, and the average revenue per employee in log between 1960 and 1950. The independent variable is the share of total and high-skilled repatriates in district r at time 1950. The control variables include prefecture fixed effects (Pref FE), log density (Log Density$_{1940}$), war damage (War Destruction), and level of the corresponding dependent variable in 1950 or 1940 (Level Dep). Standard errors are clustered at the district level and reported in parentheses. $^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.1$.

Table A13: Modernization of Local Economy (1970–1950, IV)

	Sole Proprietor Share$_{1970-1950}$	Family Worker Share$_{1970-1950}$	Wage Worker Share$_{1970-1950}$
	(1)	(2)	(3)
Total Rep$_{1950}$	0.080	0.143	-0.234
	(0.075)	(0.093)	(0.144)
High-Skilled Rep$_{1950}$	-0.349***	-0.275**	0.577***
	(0.105)	(0.119)	(0.191)
N	1,107	1,107	1,107
Pref FE	✓	✓	✓
Log Density$_{1940}$	✓	✓	✓
War Destruction	✓	✓	✓
Level Dep.	✓	✓	✓

Notes: This table presents the estimation results of the relationship between the share of total and high-skilled repatriates and the modernization of local economy. The dependent variable is the change in the share of sole proprietors, the share of family workers, and the share of wage workers in log between 1960 and 1950. The independent variable is the share of total and high-skilled repatriates in district r at time 1950. The control variables include prefecture fixed effects (Pref FE), log density (Log Density$_{1940}$), war damage (War Destruction), and level of the corresponding dependent variable in 1950 (Level Dep). Standard errors are clustered at the district level and reported in parentheses. $^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.1$.

TABLE A14: MODERNIZATION OF FIRMS (1957, 1964, 1970, IV)

	Log Employee	Log Capital	Log Shareholder
	(1)	(2)	(3)
Total Rep_{1950}	-6.318**	-6.487**	-5.925**
	(3.007)	(2.677)	(2.620)
High-Skilled Rep_{1950}	7.634**	7.922**	7.116**
	(3.531)	(3.324)	(3.197)
N	91,175	95,748	68,611
Pref FE	✓	✓	✓
Log $Density_{1940}$	✓	✓	✓
War Destruction	✓	✓	✓

Notes: This table presents the estimation results of the relationship between the share of total and high-skilled repatriates and the modernization of firms. The dependent variable is firm employment, capital, or number of shareholders in log in 1957, 1964, and 1970. The independent variable is the share of total and high-skilled repatriates in district r at time 1950. The control variables include prefecture fixed effects (Pref FE), log density (Log $Density_{1940}$), and war damage (War Destruction). Standard errors are clustered at the district level and reported in parentheses. $^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.1$.

C Structural Estimation Appendix

This section provides the detailed explanation of the structural estimation.

Migration and Location Choice Parameters (ψ and κ^d). I estimate the dispersion parameter ψ and the distance elasticity of migration costs κ^d using repatriate household micro data that record the district of residence in 1950 and the district of residence in 1964. I assume that repatriates and natives draw idiosyncratic destination taste shocks from the same i.i.d. Fréchet distribution with common shape parameter ψ. Under this assumption, repatriate moves are draws from the model's common location choice rule, so repatriate origin destination flows identify the location choice elasticity relevant for the overall population.

Individuals in origin district j choose destination r with choice probabilities

$$m_{jr} = \frac{\left(Z_r \tau_{jr} \mathbb{E}[u_r]\right)^{\psi}}{\sum_d \left(Z_d \tau_{jd} \mathbb{E}[u_d]\right)^{\psi}}, \qquad \tau_{jr} = d_{jr}^{-\kappa^d},$$

where d_{jr} is bilateral distance.

I aggregate the household micro data into district level origin destination flow counts n_{jr}. I then expand the dataset to the full origin destination matrix and set missing flows to zero, ensuring that each origin's choice set includes destinations with zero realized movers. I merge in bilateral distances from a district distance matrix and define $\ln d_{jr} \equiv \ln(1 + d_{jr})$. I keep stayers by including $j = r$ in the choice set and setting $d_{jj} = 0$, so that $\ln(1 + d_{jj}) = 0$.

Expected indirect utility satisfies $\mathbb{E}[u_r] = \mathbb{E}[E_r]/P_r$. I proxy $\ln w_{P,r}$ using non agriculture revenue per worker in 1960. For a given κ^h, the model implies

$$\mathbb{E}[E_r] = w_{P,r}\left(1 + \frac{s_{M,r}}{\kappa^h - 1}\right),$$

where $s_{M,r}$ is the manager share in district r. So I construct the model consistent indirect utility

$$\ln \widehat{u}_r = \ln w_{P,r} + \ln\left(1 + \frac{s_{M,r}}{\kappa^h - 1}\right),$$

and treat Z_r as absorbed into residual destination attractiveness.

I follow a two step procedure in the spirit of Monte et al. (2018). First, I estimate the distance component of migration costs using a PPML specification that absorbs both origin and destination fixed effects:

$$\mathbb{E}[n_{jr}] = \exp\left(\alpha_j + \delta_r - \theta_d \ln(1 + d_{jr})\right),$$

where α_j is an origin fixed effect and δ_r is a destination fixed effect. The coefficient on distance identifies $\theta_d \equiv \psi\kappa^d$ without imposing any structure on $\mathbb{E}[u_r]$.

Second, I map the estimated destination fixed effects to the model consistent utility shifter. The model implies

$$\delta_r = \psi \ln \widehat{u}_r + \psi \ln Z_r + \text{const},$$

so I estimate ψ from the slope in a destination level regression of δ_r on $\ln \widehat{u}_r$. To address potential endogeneity of wages and amenities, I instrument $\ln \widehat{u}_r$ using 1940 non agriculture revenue per worker.

Let $\widehat{\theta}_d$ denote the estimated distance elasticity from the first step and let $\widehat{\psi}$ denote the estimated slope from the second step. Then

$$\hat{\kappa}^d = \frac{\widehat{\theta}_d}{\widehat{\psi}}.$$

Skills (κ^h and μ_M). I assume that, in the upper tail, pre war income in levels is proportional to managerial ability, $y_i = c\, h_i$ for a constant $c > 0$. Since multiplicative scaling does not affect the Pareto tail index, the upper tail of y_i inherits the same shape parameter κ^h as h_i. I therefore estimate κ^h from the tail behavior of y_i.

I drop observations with missing or nonpositive pre war income. To reduce sensitivity to extreme outliers, I trim the income distribution at the 99.5th percentile, dropping observations with y_i above this cutoff. Let N denote the sample size after trimming. I set the tail share to $p = 0.02$, so the tail count is $m = \lfloor pN \rfloor$.

Let $y_{(1)} \geq \cdots \geq y_{(N)}$ denote trimmed incomes sorted in descending order and let $y_{(m+1)}$ be the threshold separating the top m observations from the rest. The Hill estimator is

$$\widehat{\kappa^h} = \left(\frac{1}{m} \sum_{i=1}^{m} \ln \frac{y_{(i)}}{y_{(m+1)}} \right)^{-1}.$$

Operationally, I compute $\ln(y_{(i)}/y_{(m+1)})$ using log income differences, average over the top m, and invert.

Agriculture Parameter and Preferences (γ and ν). I estimate ν using the spending share of food in 1960. I estimate γ as follows. Agriculture output in district r is

$$Y_r^A = Q_r \mathcal{T}_r^{1-\gamma} (L_r^{PA})^{\gamma}.$$

To estimate γ, I use district level variation in agricultural income Y_r^A, agricultural labor L_r^{PA}, and cultivated land $\mathcal{T}_r$ in 1960. Taking logs yields

$$\ln Y_r^A = \ln Q_r + \gamma \ln L_r^{PA} + (1-\gamma)\ln \mathcal{T}_r.$$

I estimate γ by OLS in the 1960 cross section.

Inversion of district fundamentals Q_r and Z_r. I recover district fundamentals in agriculture productivity Q_r and location amenities Z_r from district level outcomes and origin destination migration flows, taking as given the estimated structural parameters γ, κ^h, ψ, and $\theta_d \equiv \psi\kappa^d$.

Agriculture output is

$$Y_r^A = Q_r \, \mathcal{T}_r^{1-\gamma} (L_r^{PA})^{\gamma}.$$

Under competitive factor markets with agriculture price P_A, the marginal product condition implies

$$w_{P,r} = P_A \, \gamma \, Q_r \left(\frac{\mathcal{T}_r}{L_r^{PA}} \right)^{1-\gamma}.$$

Solving for Q_r yields the inversion formula

$$Q_r = \frac{w_{P,r}}{P_A \gamma} \left(\frac{L_r^{PA}}{\mathcal{T}_r} \right)^{1-\gamma}.$$

I implement this district by district using 1960 data on cultivated land $\mathcal{T}_r$, agricultural labor L_r^{PA}, and a district level proxy for the production wage $w_{P,r}$ using revenue per worker in 1960. I normalize Q_r by demeaning $\ln Q_r$ so that the geometric mean of Q_r equals one.

For the mobility inversion, I construct a destination shifter that corresponds to the log of expected nominal income implied by the managerial tail. Using the district manager share $s_{M,r}$ and the estimated κ^h, the model implies

$$\mathbb{E}[E_r] = w_{P,r} \left(1 + \frac{s_{M,r}}{\kappa^h - 1} \right),$$

so I define

$$\ln \widehat{u}_r \equiv \ln w_{P,r} + \ln \left(1 + \frac{s_{M,r}}{\kappa^h - 1} \right).$$

Let n_{jr} denote the number of repatriates observed moving from origin district j in 1950 to destination district r in 1964. Given the estimated mobility parameters, migration flows satisfy a gravity equation of the form

$$\ln \mathbb{E}[n_{jr}] = \alpha_j + \delta_r + \delta^{home} \mathbf{1}\{r = j\} + \psi \ln \widehat{u}_r - \theta_d \ln(1 + d_{jr}) \mathbf{1}\{r \neq j\},$$

where α_j is an origin fixed effect, d_{jr} is bilateral distance, and δ_r is a destination fixed effect capturing residual destination attractiveness. Taking ψ and θ_d as given, I treat

$$\text{offset}_{jr} \equiv \psi \ln \widehat{u}_r - \theta_d \ln(1 + d_{jr}) \mathbf{1}\{r \neq j\}$$

as known and estimate a Poisson model on flow counts

$$n_{jr} \sim \exp\Big(\alpha_j + \delta_r + \delta^{home} \mathbf{1}\{r = j\} + \text{offset}_{jr}\Big),$$

including origin and destination fixed effects. The estimated destination fixed effects $\widehat{\delta}_r$ are mapped into amenities using

$$\widehat{Z}_r \propto \exp\left(\frac{\widehat{\delta}_r}{\psi}\right),$$

and I normalize $\widehat{Z}_r$ to have mean one across districts.

Firm Organization Parameters (ζ_φ). Let firm productivity φ have an upper tail that is Pareto with shape parameter $\zeta_\varphi > 0$,

$$\Pr(\varphi > x) = \left(\frac{\varphi_{\min}}{x}\right)^{\zeta_\varphi}, \qquad x \geq \varphi_{\min}.$$

In the CES monopolistic competition block with elasticity of substitution $\varepsilon > 1$ and constant markups, firm revenue and labor demand are monotone power functions of productivity,

$$R_i = A_R \, \varphi_i^{\varepsilon - 1}, \qquad L_i = A_L \, \varphi_i^{\varepsilon - 1},$$

where A_R and A_L absorb common demand shifters and factor prices. Consider revenue. For any $r > 0$,

$$\Pr(R_i > r) = \Pr\left(\varphi_i > \left(\frac{r}{A_R}\right)^{1/(\varepsilon-1)}\right) = \left(\frac{\varphi_{\min}}{(r/A_R)^{1/(\varepsilon-1)}}\right)^{\zeta_\varphi} = C \, r^{-\zeta_\varphi/(\varepsilon-1)},$$

so the upper tail of revenue is Pareto with shape $\zeta_R = \zeta_\varphi/(\varepsilon - 1)$. Therefore,

$$\zeta_\varphi = (\varepsilon - 1)\zeta_R.$$

I estimate ζ_R from firm sales in the 1957 cross section using the Hill tail index estimator. Let X_i denote the size measure X in levels and let $X_{(1)} \geq \cdots \geq X_{(N)}$ be the sorted values after trimming the extreme top of the distribution at a high percentile. For a chosen tail share p,

let $m = \lfloor pN \rfloor$ and let $X_{(m+1)}$ be the threshold. The Hill estimator is

$$\widehat{\zeta}_X = \left(\frac{1}{m} \sum_{i=1}^{m} \ln \frac{X_{(i)}}{X_{(m+1)}} \right)^{-1}, \qquad se(\widehat{\zeta}_X) \approx \frac{\widehat{\zeta}_X}{\sqrt{m}}.$$

Finally, I recover the productivity tail parameter as

$$\widehat{\zeta_\varphi} = (\varepsilon - 1)\widehat{\zeta}_R.$$

Firm Organization Parameters ($\sigma, \alpha, \kappa, \rho, T, f, \eta$). I estimate the remaining seven structural parameters characterizing firm organization using the simulated method of moments (SMM). I simulate a large economy of firms by drawing $N = 200,000$ productivity shocks φ_i from the Pareto distribution with shape parameter $\zeta_\varphi = 5.12$, as estimated above. For each firm, I solve the static profit maximization problem to determine its optimal organizational form (Traditional vs. Modern) and, conditional on modernizing, its optimal scope (number of establishments n_i) and managerial employment.

The estimator minimizes the weighted squared distance between the model-implied moments and the corresponding moments calculated from the data. Let $m(\Omega)$ denote the vector of simulated moments given parameters Ω and m_{data} be the vector of data moments. The SMM estimator is

$$\widehat{\Omega} = \arg\min_{\Omega} \big(m(\Omega) - m_{data}\big)' \mathbf{W} \big(m(\Omega) - m_{data}\big),$$

where $\mathbf{W}$ is a diagonal weighting matrix.

The identification of these parameters relies on the intuitive mapping between specific moments and structural primitives:

- **Modern Share.** The share of firms operating with multiple establishments (Modern technology) primarily identifies the fixed cost of entry f and the modernization cost multiplier η. Higher fixed costs reduce the extensive margin of firm entry and modernization.
- **Manager Share.** The aggregate share of the workforce employed as managers identifies the span-of-control parameter σ. A higher σ implies a larger optimal ratio of managers to production workers.
- **Firm Size Distribution.** The parameters governing scope costs (κ, ρ) and delegation efficiency (α) are identified by the distribution of establishments per firm. I target the mean number of establishments for modern firms and the 90th and 99th percentiles of the establishment distribution. The curvature parameter ρ is particularly identified by the right tail of the firm size distribution: a higher ρ implies more convex scope costs, limiting

the maximum size of the most productive firms. The model requires $\rho \approx 1.5$ to match the observed maximum firm size (approx. 15 establishments) in the 1970 data.

– **Entrepreneur Time.** The entrepreneur's time endowment T acts as a minimum scale constraint and is identified by the size of the smallest active firms.

D Theoretical Appendix

This section provides the detailed derivation of the model.

D.1 Agriculture Producer

Assume competitive agriculture with world price P_A and technology

$$Y_r^A = Q_r \mathcal{T}_r^{1-\gamma} (L_r^{PA})^{\gamma}, \qquad \gamma \in (0,1),$$

where L_r^{PA} is production labor employed in agriculture, and $(Q_r, \mathcal{T}_r)$ are region shifters. A representative agricultural producer solves

$$\max_{L_r^{PA} \geq 0} \; P_A Y_r^A - w_P L_r^{PA}.$$

FOC:

$$w_{P,r} \;=\; P_A \frac{\partial Y_r^A}{\partial L_r^{PA}} \;=\; P_A \cdot \gamma Q_r \mathcal{T}_r^{1-\gamma} (L_r^{PA})^{\gamma-1}.$$

Invert to obtain agriculture labor demand:

$$L_r^{PA}(w_{P,r}) = \left(\frac{\gamma P_A Q_r \mathcal{T}_r^{1-\gamma}}{w_{P,r}} \right)^{\frac{1}{1-\gamma}}, \qquad \frac{dL_r^{PA}}{dw_{P,r}} < 0.$$

Hence, if w_P increases, labor demand in agriculture decreases.

D.2 Non-Agriculture Producer

In region r, a competitive non-agricultural good producer aggregates a set of active non-agricultural varieties Ω_r with measure

$$N_r \equiv \int_{\Omega_r} 1 \, dj.$$

The non-agricultural composite is CES:

$$Y_r^M = \left(\int_{\Omega_r} y_{jr}^{\frac{\varepsilon-1}{\varepsilon}} \, dj \right)^{\frac{\varepsilon}{\varepsilon-1}}, \qquad \varepsilon > 1.$$

Usual arguments yield the standard CES demand:

$$y_{jr} = \left(\frac{p_{jr}}{P_r^M}\right)^{-\varepsilon} \frac{E_r^M}{P_r^M}.$$

where E_r^M is total expenditure on the intermediate composite in region r and P_r^M is the CES price index.

D.3 Intermediate Goods Producer

Each variety is produced by a firm with heterogenous productivity φ (Pareto distributed) and effective managerial services per line e. There is free entry and, firms pay a fixed entry cost consisting of f_e units of non-agricultural goods.

Fix a region and suppress the region subscript to simplify notation. A firm with productivity φ and managerial services e produces output with production labor l according to

$$y = \varphi e^{\zeta} l, \qquad 0 < \zeta < 1.$$

Thus, producing one unit of output given e requires $1/(\varphi e^{\zeta})$ units of production labor, so with production wage w_P the marginal cost is

$$c(\varphi, e) = \frac{w_P}{\varphi e^{\zeta}}.$$

The intermediate firm's problem is to choose p to maximize operating profits given e

$$\max_p \ \pi(p) = (p - c)\, y(p) = (p - c) \left(\frac{p}{P}\right)^{-\varepsilon} \frac{E}{P}.$$

Let $K \equiv \frac{E}{P} P^{\varepsilon}$, so $y(p) = K\, p^{-\varepsilon}$. Then

$$\pi(p) = (p - c)\, K p^{-\varepsilon} = K \left(p^{1-\varepsilon} - c\, p^{-\varepsilon}\right).$$

Differentiate with respect to p:

$$\frac{d\pi}{dp} = K \left[(1 - \varepsilon) p^{-\varepsilon} + \varepsilon c\, p^{-\varepsilon - 1}\right] = K p^{-\varepsilon - 1} \left[(1 - \varepsilon) p + \varepsilon c\right].$$

Set the FOC to zero (and note $K p^{-\varepsilon - 1} > 0$):

$$(1 - \varepsilon) p + \varepsilon c = 0 \quad \Rightarrow \quad p = \frac{\varepsilon}{\varepsilon - 1}\, c.$$

Define the markup

$$\mu \equiv \frac{\varepsilon}{\varepsilon - 1} > 1,$$

so the optimal price is

$$p(\varphi, e) = \mu\, c(\varphi, e) = \frac{\varepsilon}{\varepsilon - 1} \cdot \frac{w_P}{\varphi e^{\zeta}}.$$

Revenue is $R(\varphi, e) = p\, y$. Substitute CES demand:

$$R(\varphi, e) = p(\varphi, e) \left(\frac{p(\varphi, e)}{P} \right)^{-\varepsilon} \frac{E}{P} = \frac{E}{P}\, p(\varphi, e)\, p(\varphi, e)^{-\varepsilon}\, P^{\varepsilon} = E \left(\frac{p(\varphi, e)}{P} \right)^{1-\varepsilon}.$$

Using $p(\varphi, e) = \mu\, \frac{w_P}{\varphi e^{\zeta}}$,

$$\left(\frac{p(\varphi, e)}{P} \right)^{1-\varepsilon} = \left(\frac{\mu w_P}{P} \right)^{1-\varepsilon} \left(\frac{1}{\varphi e^{\zeta}} \right)^{1-\varepsilon} = \left(\frac{\mu w_P}{P} \right)^{1-\varepsilon} \left(\varphi e^{\zeta} \right)^{\varepsilon - 1}.$$

Therefore

$$R(\varphi, e) = E \left(\frac{\mu w_P}{P} \right)^{1-\varepsilon} \varphi^{\varepsilon - 1} e^{\zeta(\varepsilon - 1)}.$$

Define the region level shifter

$$\mathcal{B} \equiv E \left(\frac{\mu w_P}{P} \right)^{1-\varepsilon},$$

so

$$R(\varphi, e) = \mathcal{B} \cdot \varphi^{\varepsilon - 1}\, e^{\zeta(\varepsilon - 1)}.$$

Variable cost is $c\, y$. Using $p = \mu c$,

$$c\, y = \frac{p}{\mu} y = \frac{1}{\mu} R.$$

Hence operating profits are

$$\pi(\varphi, e) = R(\varphi, e) - c\, y = R(\varphi, e) - \frac{1}{\mu} R(\varphi, e) = \left(1 - \frac{1}{\mu} \right) R(\varphi, e).$$

Since $1 - \frac{1}{\mu} = 1 - \frac{\varepsilon - 1}{\varepsilon} = \frac{1}{\varepsilon}$, we obtain

$$\pi(\varphi, e) = \frac{1}{\varepsilon} R(\varphi, e).$$

Therefore

$$\pi(\varphi, e) = \underbrace{\frac{\mathcal{B}}{\varepsilon}}_{\equiv A} \cdot \varphi^{\varepsilon - 1}\, e^{\zeta(\varepsilon - 1)}.$$

Define the parameter

$$\sigma \equiv \zeta(\varepsilon - 1).$$

Imposing $0 < \sigma < 1$ ensures profits are strictly concave in effective managerial services e, consistent with the delegation block in Akcigit et al. (2021). The per-line profit function excluding manager payment and fixed costs described below is then

$$\pi(\varphi, e) = A\,\varphi^{\varepsilon-1}\,e^{\sigma}, \qquad 0 < \sigma < 1.$$

Note that the difference from Akcigit et al. (2021) is that my operating profit incorporates heterogeneous productivity φ and is increasing in φ. Hence, operating profits depend on the firm's productivity, which determines the organizational structure described below.

D.4 Delegation and Effective Managerial Services

Let effective managerial services per line be

$$e = \frac{T}{n} + \alpha m,$$

where m is outside managers hired per line at wage w_M. A firm with n product lines chooses the same m for each line, so total profit net manager payment is[22]

$$\Pi(n;\varphi) = \max_{m\geq 0}\; n\Big[A\,\varphi^{\varepsilon-1}\Big(\frac{T}{n} + \alpha m\Big)^{\sigma} - w_M m\Big].$$

Define $B(\varphi) \equiv A\varphi^{\varepsilon-1}$. Then

$$\Pi(n;\varphi) = \max_{m\geq 0}\; n\Big[B(\varphi)\Big(\frac{T}{n} + \alpha m\Big)^{\sigma} - w_M m\Big].$$

Optimal delegation when $m > 0$. For a solution $m > 0$, the first-order condition is

$$n\Big[B(\varphi)\sigma\Big(\frac{T}{n} + \alpha m\Big)^{\sigma-1}\alpha - w_M\Big] = 0,$$

so

$$B(\varphi)\sigma\alpha\Big(\underbrace{\frac{T}{n} + \alpha m}_{e}\Big)^{\sigma-1} = w_M.$$

[22] Note that here I assume n is fixed. I also implicitly assume that firms considered here are all modern firms since they can choose m. I will define traditional and modern firms below.

Let the optimal target for effective services in the delegation region be

$$e^*(\varphi) \equiv \left(\frac{\sigma\alpha B(\varphi)}{w_M}\right)^{\frac{1}{1-\sigma}} = \left(\frac{\sigma\alpha A\varphi^{\varepsilon-1}}{w_M}\right)^{\frac{1}{1-\sigma}}.$$

Then the first-order condition implies

$$\frac{T}{n} + \alpha m = e^*(\varphi) \quad \Rightarrow \quad m(n,\varphi) = \frac{e^*(\varphi) - T/n}{\alpha}.$$

Note that this form is different from Akcigit et al. (2021) only for extra terms $A\varphi^{\varepsilon-1}$. Hence, as in Akcigit et al. (2021), the manager demand is increasing in delegation efficiency α and decreasing in manager wages w_M. Since I have the extra term $\varphi^{\varepsilon-1}$, the manager demand is also increasing in productivity φ. The more productive firms are, the more they demand managers.[23]

Delegation cutoff $n^*(\varphi)$. It is possible that some firms with $n > 1$ do not hire managers $m = 0$ since they do not hit the bottleneck yet. The number of products n determines the incentive to hire managers. As a firm adds product lines, the entrepreneur's time endowment T is diluted across lines (T/n decreases). Because per-line profit is concave in managerial services, the marginal product of managerial services rises as the entrepreneur's time becomes scarcer, increasing the return to hiring outside managers. This argument is easy to see by looking at $\pi(\varphi, e) = A\,\varphi^{\varepsilon-1}e^{\sigma}$. Since per-line profit without hiring managers is $\pi(\varphi, e) = A\,\varphi^{\varepsilon-1}(T/n)^{\sigma}$, as n increases, T/n decreases, and $\pi'(\varphi, T/n)$ increases. Hence, as n increases, the marginal benefit of hiring managers increases.

Delegation occurs if and only if the interior m is nonnegative (or e^* is larger than T/n, meaning that firms want to hire managers), that is $e^*(\varphi) \geq T/n$, which is equivalent to

$$n \geq n^*(\varphi), \qquad n^*(\varphi) \equiv \frac{T}{e^*(\varphi)} = T\left(\frac{w_M}{\sigma\alpha A\varphi^{\varepsilon-1}}\right)^{\frac{1}{1-\sigma}}.$$

This is the cutoff n over which firms hire managers. Note that between this cutoff and one, firms do not hire managers but are modern. Once again, my cutoff contains extra term $A\varphi^{\varepsilon-1}$ compared to Akcigit et al. (2021). Hence, more productive firms have lower cutoffs and these firms start hiring managers for fewer product lines.

Total profits, piecewise in n.

[23] Once again, I am describing modern firms here.

No delegation $n < n^*(\varphi)$**.** If $n < n^*(\varphi)$, then $m = 0$ and $e = T/n$. Total profit becomes

$$\Pi(n;\varphi) = n \cdot B\left(\frac{T}{n}\right)^{\sigma} = B\,T^{\sigma}\,n^{1-\sigma} = A\,\varphi^{\varepsilon-1}\,T^{\sigma}\,n^{1-\sigma}.$$

Here, it is easy to see that total profits are concave in n and hence, diminishing return. This diminishing return signifies managerial constraints.

Delegation $n \geq n^*(\varphi)$**.** If $n \geq n^*(\varphi)$, then $e = e^*(\varphi)$ and $m = (e^*(\varphi) - T/n)/\alpha$. Plugging into profits gives

$$\Pi(n;\varphi) = n\left[B(e^*)^{\sigma} - w_M\frac{e^* - T/n}{\alpha}\right] = \frac{w_M}{\alpha}T + n\left[B(e^*)^{\sigma} - \frac{w_M}{\alpha}e^*\right].$$

Use the first-order condition evaluated at e^*:

$$\frac{w_M}{\alpha} = B\sigma(e^*)^{\sigma-1} \quad \Rightarrow \quad \frac{w_M}{\alpha}e^* = \sigma B(e^*)^{\sigma}.$$

Therefore the bracket simplifies to

$$B(e^*)^{\sigma} - \frac{w_M}{\alpha}e^* = (1-\sigma)B(e^*)^{\sigma}.$$

So

$$\Pi(n;\varphi) = \frac{w_M}{\alpha}T + (1-\sigma)B(e^*)^{\sigma}n.$$

Finally substitute $(e^*)^{\sigma} = \left(\frac{\sigma\alpha B}{w_M}\right)^{\frac{\sigma}{1-\sigma}}$:

$$\Pi(n;\varphi) = \frac{w_M}{\alpha}T + (1-\sigma)\,A\varphi^{\varepsilon-1}\left(\frac{\sigma\alpha A\varphi^{\varepsilon-1}}{w_M}\right)^{\frac{\sigma}{1-\sigma}}n.$$

Let $n^*(\varphi) = T\left(\frac{w_M}{\sigma\alpha A\varphi^{\varepsilon-1}}\right)^{\frac{1}{1-\sigma}}$. Then

$$\Pi(n;\varphi) = \begin{cases} A\,\varphi^{\varepsilon-1}\,T^{\sigma}\,n^{1-\sigma}, & n < n^*(\varphi), \\ \frac{w_M}{\alpha}T + (1-\sigma)\,A\varphi^{\varepsilon-1}\left(\frac{\sigma\alpha A\varphi^{\varepsilon-1}}{w_M}\right)^{\frac{\sigma}{1-\sigma}}n, & n \geq n^*(\varphi). \end{cases}$$

Note that as described below, this is the profit as a function of n for modern firms since they can choose n. Modern firms with different value of φ optimally choose n. It is possible here that modern firms choose not to hire managers since φ is low and their profit is equal to $A\,\varphi^{\varepsilon-1}\,T^{\sigma}\,n^{1-\sigma}$. Traditional firms cannot choose n and it has to be one so its profit is $A\,\varphi^{\varepsilon-1}\,T^{\sigma}$.

D.5 Scope Choice and Modern Form Choice

To generate a discrete traditional versus modern margin, I assume firms can operate under one of two organizational forms; traditional or modern. Specifically, after entering the market, firms observe their productivity φ and then decide whether to exit or produce. Then, firms can choose to produce as a traditional firm or a modern firm. In order to be modern, firms have to pay a fixed cost ηf units of non-agricultural goods and $\eta > 1$ while traditional firms pay overhead cost f units of non-agricultural goods.

Traditional form. A traditional firm operates a single product line and does not hire outside managers:

$$n = 1, \qquad m = 0, \qquad e = T.$$

Per-line (or total) profit is hence $\pi(\varphi, T) = A\varphi^{\varepsilon-1}T^{\sigma}$. Thus traditional profits after paying overhead cost are

$$\Pi^{T}(\varphi) = \underbrace{A\varphi^{\varepsilon-1}T^{\sigma}}_{\tilde{V}_r^T(\varphi)} - f.$$

This implies that firms with low productivity could have negative profits if $A\varphi^{\varepsilon-1}T^{\sigma} < f$. Those firms exit the market as described below.

Modern form. A firm may instead adopt a modern organizational form by paying a fixed adoption cost $\eta f \geq 0$ and $\eta > 1$ and then choosing scope $n \geq 1$ and manager $m \geq 0$. To ensure finite optimal scope, I assume a convex scope cost in terms of non-agricultural goods

$$C(n) = \frac{\kappa}{2}(n-1)^2, \qquad \kappa > 0.$$

Given (φ, n), the firm chooses outside managers per line m as in the delegation block above, yielding operating profits $\Pi(n; \varphi)$. Modern profits are therefore

$$\Pi^{M}(\varphi) = \max_{n \geq 1} \; \Pi(n; \varphi) - \frac{\kappa}{2}(n-1)^2 - \eta f.$$

Optimal scope within the modern form. For the interior solution in the delegation region $n \geq n^*(\varphi)$, substitute the delegation region expression

$$\Pi(n; \varphi) = \frac{w_M}{\alpha}T + \underbrace{(1-\sigma)\, A\varphi^{\varepsilon-1}\left(\frac{\sigma\alpha A\varphi^{\varepsilon-1}}{w_M}\right)^{\frac{\sigma}{1-\sigma}}}_{\equiv\, \Lambda(\varphi; w_M)} n$$

to obtain the modern objective

$$\max_{n \geq n^*(\varphi)} \frac{w_M}{\alpha} T + \Lambda(\varphi; w_M)\, n - \frac{\kappa}{2}(n-1)^2 - \eta f$$

The first-order condition for an interior optimum is

$$\Lambda(\varphi; w_M) - \kappa(n-1) = 0,$$

hence the interior delegation region scope choice is

$$n^M(\varphi) = 1 + \frac{\Lambda(\varphi; w_M)}{\kappa}.$$

Since $\Lambda(\varphi; w_M)$ is increasing in φ, the optimal scope within the modern form that hire managers is increasing in productivity.

In the non-delegation region $1 \leq n < n^*(\varphi)$, the modern firm sets $m = 0$ and $e = T/n$, so modern form profits as a function of n are

$$\max_{1 \leq n < n^*(\varphi)} A\varphi^{\varepsilon-1} T^{\sigma} n^{1-\sigma} - \frac{\kappa}{2}(n-1)^2 - \eta f,$$

which is strictly concave in n and likewise implies that the optimal non-delegation scope is increasing in φ.

Note that technically, when modern firms choose n, they are choosing from non-delegation and delegation region since the optimal n could be below n^*. However, I will assume that all modern firms hire managers and I will derive the condition for it.

Modern adoption decision and cutoff productivity. Define the value of operating the modern form as

$$V^M(\varphi) \equiv \max_{n \geq 1} \Pi(n; \varphi) - \frac{\kappa}{2}(n-1)^2.$$

A firm adopts the modern form if and only if

$$V^M(\varphi) - \eta f \;\geq\; \widetilde{V}^T(\varphi) - f \quad \Leftrightarrow \quad \Delta(\varphi) \;\geq\; (\eta - 1) f.$$

Because both $\widetilde{V}^T(\varphi)$ and $V^M(\varphi)$ are increasing in φ, and $V^M(\varphi)$ is steeper in φ (modern firms can scale scope and managerial services), there exists a cutoff $\bar{\varphi}$ such that

$$\varphi < \bar{\varphi} \;\Rightarrow\; \text{traditional } (n = 1, m = 0), \qquad \varphi \geq \bar{\varphi} \;\Rightarrow\; \text{modern } (n \geq 1,\; m \geq 0).$$

Exit cutoff φ^*. If the marginal operating firm is traditional, then the exit cutoff is pinned down by the zero-profit condition for the traditional form:

$$\Pi^T(\varphi^*) = 0.$$

Substituting $\Pi^T(\varphi) = A\varphi^{\varepsilon-1}T^\sigma - f$:

$$\begin{aligned} A(\varphi^*)^{\varepsilon-1}T^\sigma - f &= 0 \\ A(\varphi^*)^{\varepsilon-1}T^\sigma &= f \\ (\varphi^*)^{\varepsilon-1} &= \frac{f}{AT^\sigma}. \end{aligned}$$

Solving for φ^*:

$$\varphi^* = \left(\frac{f}{AT^\sigma}\right)^{\frac{1}{\varepsilon-1}}.$$

Then automatically, for any $\varphi < \varphi^*$, since $\Pi^T(\varphi)$ is increasing in φ, we have $\Pi^T(\varphi) < 0$ and these firms exit the market.

Condition for $\varphi^* < \bar{\varphi}$. Note that it is possible that φ^* is larger than $\bar{\varphi}$, in which case all the firms producing are modern and no traditional firms are present. Here, I derive the condition under which some firms producing are traditional.

Lemma 1. *Some firms producing are traditional if* $\Delta(\varphi^*) < (\eta - 1)f$.

Proof. Assume that at the exit cutoff, the firm does not want to adopt modern. Since at φ^* the traditional firm earns zero profit, this is equivalent to requiring that modern profit is negative at φ^*:

$$\Pi^M(\varphi^*) < 0.$$

Compute $\Pi^M(\varphi^*)$:

$$\Pi^M(\varphi^*) = V^M(\varphi^*) - \eta f.$$

Add and subtract $\widetilde{V}^T(\varphi^*)$:

$$\Pi^M(\varphi^*) = \left(\widetilde{V}^T(\varphi^*) + \Delta(\varphi^*)\right) - \eta f.$$

But from the zero-profit condition $\Pi^T(\varphi^*) = 0$,

$$\widetilde{V}^T(\varphi^*) - f = 0 \quad \Rightarrow \quad \widetilde{V}^T(\varphi^*) = f.$$

So

$$\Pi^M(\varphi^*) = \big(f + \Delta(\varphi^*)\big) - \eta f = \Delta(\varphi^*) - (\eta - 1)f.$$

Therefore

$$\Pi^M(\varphi^*) < 0 \quad \Longleftrightarrow \quad \Delta(\varphi^*) - (\eta - 1)f < 0 \quad \Longleftrightarrow \quad \Delta(\varphi^*) < (\eta - 1)f.$$

This is the condition guaranteeing $\bar{\varphi} > \varphi^*$:

(1) If $\Delta(\varphi^*) < (\eta - 1)f$, then at the margin firms enter/operate as traditional, and only sufficiently productive firms later cross the adoption cutoff; hence $\bar{\varphi} > \varphi^*$.

(2) If instead $\Delta(\varphi^*) \geq (\eta - 1)f$, then the marginal operating firm would (weakly) prefer modern already at φ^*. The "traditional-only" region collapses (i.e., essentially all operating firms modernize).

□

Each operating firm contributes a number of varieties equal to its scope choice assuming $\Delta(\varphi^*) < (\eta - 1)f$ and all modern firms hire managers:

$$n(\varphi) = \begin{cases} 1, & \varphi \in [\varphi^*, \bar{\varphi}), \\ n^M(\varphi), & \varphi \geq \bar{\varphi}. \end{cases}$$

D.6 When Do All Modern Firms Hire Managers?

It is possible that firms adopting the modern form do not delegate while having more than one product ($n > 1$). Below, I show the condition under which all modern firms hire managers.

Lemma 2. *Let the adoption rule be a cutoff: a firm adopts the modern form iff $\Delta(\varphi) \geq F$, where $\Delta(\varphi) \equiv V^M(\varphi) - \widetilde{V}^T(\varphi)$ is weakly increasing in φ, and let $\bar{\varphi}$ satisfy $\Delta(\bar{\varphi}) = F$. Define the delegation-region scope by $n^{del}(\varphi) \equiv 1 + \Lambda(\varphi)/\kappa$, and let φ_{del} be the unique type solving $n^{del}(\varphi_{del}) = n^*(\varphi_{del})$. If*

$$F \geq \Delta(\varphi_{del}),$$

then every modern adopter delegates, i.e.,

$$\forall\, \varphi \geq \bar{\varphi}, \qquad n(\varphi) \geq n^*(\varphi) \text{ and hence } m(\varphi) > 0.$$

Proof. **Step 1.** ($F \geq \Delta(\varphi_{del})$ implies $\bar{\varphi} \geq \varphi_{del}$.) Since $\Delta(\varphi)$ is weakly increasing and $\Delta(\bar{\varphi}) = F$, the condition $F \geq \Delta(\varphi_{del})$ implies $\Delta(\bar{\varphi}) \geq \Delta(\varphi_{del})$ and hence

$$\bar{\varphi} \geq \varphi_{del}.$$

Step 2. (For all adopters, $n^{del}(\varphi) \geq n^*(\varphi)$.) Take any modern adopter $\varphi \geq \bar{\varphi}$. By Step 1, $\varphi \geq \varphi_{del}$. Because $n^{del}(\varphi)$ is increasing in φ and $n^*(\varphi)$ is decreasing in φ, and because they cross at φ_{del}, it follows that for all $\varphi \geq \varphi_{del}$,

$$n^{del}(\varphi) \geq n^*(\varphi).$$

Step 3. (If $n^{del}(\varphi) \geq n^*(\varphi)$ then the modern optimum delegates.) Fix φ with $n^{del}(\varphi) \geq n^*(\varphi)$ and consider the modern objective (ignoring the additive fixed cost F):

$$F(n;\varphi) \equiv \Pi(n;\varphi) - \frac{\kappa}{2}(n-1)^2, \qquad n \geq 1,$$

where $\Pi(n;\varphi)$ is operating profit after optimizing over $m \geq 0$. For $n \geq n^*(\varphi)$, the optimal m is interior and operating profits are linear in scope:

$$\Pi(n;\varphi) = \frac{w_M}{\alpha} T + \Lambda(\varphi)\, n,$$

so the derivative of the modern objective on this region is

$$\frac{\partial F}{\partial n}(n;\varphi) = \Lambda(\varphi) - \kappa(n-1).$$

Evaluating at the boundary $n = n^*(\varphi)$ gives

$$\frac{\partial F}{\partial n}\big(n^*(\varphi);\varphi\big) = \Lambda(\varphi) - \kappa\big(n^*(\varphi) - 1\big) = \kappa\Big(n^{del}(\varphi) - n^*(\varphi)\Big) \geq 0,$$

where the last equality uses $n^{del}(\varphi) = 1 + \Lambda(\varphi)/\kappa$. Since on $n \geq n^*(\varphi)$ the objective is strictly concave in n (because the only curvature is $-\frac{\kappa}{2}(n-1)^2$), a nonnegative derivative at $n^*(\varphi)$ implies that the maximizer over $n \geq n^*(\varphi)$ satisfies $n(\varphi) \geq n^*(\varphi)$. Finally, $n(\varphi) \geq n^*(\varphi)$ is equivalent to choosing $m(\varphi) > 0$ by definition of $n^*(\varphi)$.

Combining Steps 1–3, every modern adopter $\varphi \geq \bar{\varphi}$ delegates. □

D.7 Mass of Varieties

Endogenous mass of active varieties. Let potential entrant productivity draws be Pareto on $[\varphi_{\min}, \infty)$ with tail parameter $\zeta_\varphi > 0$:

$$F_0(\varphi) = 1 - \left(\frac{\varphi_{\min}}{\varphi}\right)^{\zeta_\varphi}, \qquad f_0(\varphi) = \zeta_\varphi\, \varphi_{\min}^{\zeta_\varphi}\, \varphi^{-(\zeta_\varphi+1)}.$$

Firms operate iff $\varphi \geq \varphi^*$ and choose organization with cutoff $\bar{\varphi} > \varphi^*$.

Assume "all modern firms delegate" so that for $\varphi \geq \bar{\varphi}$ the modern scope choice is

$$n^M(\varphi) = 1 + \frac{\Lambda(\varphi)}{\kappa}, \qquad \Lambda(\varphi) = (1-\sigma)A\varphi^{\varepsilon-1}\left(\frac{\sigma\alpha A\varphi^{\varepsilon-1}}{w_M}\right)^{\frac{\sigma}{1-\sigma}}.$$

Define

$$q \equiv \frac{\varepsilon-1}{1-\sigma}, \qquad \delta \equiv \frac{\sigma}{1-\sigma}, \qquad K_\Lambda \equiv (1-\sigma)A(\sigma\alpha A)^\delta > 0,$$

so that $\Lambda(\varphi) = K_\Lambda\, \varphi^q\, w_M^{-\delta}$ and

$$n(\varphi) = \begin{cases} 0, & \varphi < \varphi^*, \\ 1, & \varphi \in [\varphi^*, \bar{\varphi}), \\ 1 + \dfrac{K_\Lambda}{\kappa}\varphi^q w_M^{-\delta}, & \varphi \geq \bar{\varphi}. \end{cases}$$

If M entrants pay the entry cost and draw $\varphi \sim F_0$, the expected number of *active* varieties per entrant is

$$\int_{\varphi^*}^{\infty} n(\varphi)\, f_0(\varphi)\, d\varphi.$$

Split the integral at $\bar{\varphi}$:

$$\int_{\varphi^*}^{\infty} n(\varphi) f_0(\varphi)\, d\varphi = \int_{\varphi^*}^{\bar{\varphi}} 1 \cdot f_0(\varphi)\, d\varphi + \int_{\bar{\varphi}}^{\infty} \left(1 + \frac{K_\Lambda}{\kappa}\varphi^q w_M^{-\delta}\right) f_0(\varphi)\, d\varphi.$$

Expand the second term:

$$= \int_{\varphi^*}^{\bar{\varphi}} f_0(\varphi)\, d\varphi + \int_{\bar{\varphi}}^{\infty} f_0(\varphi)\, d\varphi + \frac{K_\Lambda}{\kappa} w_M^{-\delta} \int_{\bar{\varphi}}^{\infty} \varphi^q f_0(\varphi)\, d\varphi.$$

The first two integrals add up to the probability of being above φ^*:

$$\int_{\varphi^*}^{\bar{\varphi}} f_0(\varphi)\, d\varphi + \int_{\bar{\varphi}}^{\infty} f_0(\varphi)\, d\varphi = \int_{\varphi^*}^{\infty} f_0(\varphi)\, d\varphi = \Pr(\varphi \geq \varphi^*).$$

So we obtain

$$\int_{\varphi^*}^{\infty} n(\varphi)\, f_0(\varphi)\, d\varphi = \Pr(\varphi \geq \varphi^*) + \frac{K_\Lambda}{\kappa} w_M^{-\delta} \int_{\bar{\varphi}}^{\infty} \varphi^q f_0(\varphi)\, d\varphi.$$

Using the Pareto tail moment (finite when $\zeta_\varphi > q$),

$$\int_a^\infty \varphi^x f_0(\varphi)\, d\varphi = \frac{\zeta_\varphi}{\zeta_\varphi - x}\, \varphi_{\min}^{\zeta_\varphi}\, a^{x-\zeta_\varphi} \qquad (x < \zeta_\varphi),$$

we obtain

$$\int_{\varphi^*}^\infty n(\varphi)\, f_0(\varphi)\, d\varphi = \left(\frac{\varphi_{\min}}{\varphi^*}\right)^{\zeta_\varphi} + \frac{K_\Lambda}{\kappa}\, w_M^{-\delta}\, \frac{\zeta_\varphi}{\zeta_\varphi - q}\, \varphi_{\min}^{\zeta_\varphi}\, \bar{\varphi}^{\,q-\zeta_\varphi}.$$

Therefore the total mass of active varieties is

$$N = M\left[\left(\frac{\varphi_{\min}}{\varphi^*}\right)^{\zeta_\varphi} + \frac{K_\Lambda}{\kappa}\, w_M^{-\delta}\, \frac{\zeta_\varphi}{\zeta_\varphi - q}\, \varphi_{\min}^{\zeta_\varphi}\, \bar{\varphi}^{\,q-\zeta_\varphi}\right], \qquad (\zeta_\varphi > q).$$

D.8 Aggregate Non-agriculture Production

CES demand is given by

$$y_{jr} = Y_r^M \left(\frac{p_{jr}}{P_r^M}\right)^{-\varepsilon}.$$

Given $y_{jr} = a_{jr} l_{jr}$ where $a_{jr} = \varphi e_j^\zeta$, marginal cost is $mc_{jr} = w_{P,r}/a_{jr}$. Under monopolistic competition with elasticity ε, the optimal price is a constant markup over marginal cost,

$$p_{jr} = \mu\, \frac{w_{P,r}}{a_{jr}}, \qquad \mu \equiv \frac{\varepsilon}{\varepsilon - 1}.$$

Using demand, production labor per line is

$$l_{jr} = \frac{y_{jr}}{a_{jr}} = \frac{Y_r^M}{a_{jr}} \left(\frac{p_{jr}}{P_r^M}\right)^{-\varepsilon}.$$

Plug in the pricing rule. First note that

$$P_r^M = \left(\int_{\Omega_r} \left(\mu \frac{w_{P,r}}{a_{jr}}\right)^{1-\varepsilon} dj\right)^{\frac{1}{1-\varepsilon}} = \mu w_{P,r} \left(\int_{\Omega_r} a_{jr}^{\varepsilon-1}\, dj\right)^{-\frac{1}{\varepsilon-1}}.$$

Define the endogenous non-agricultural productivity index

$$A_r^M \equiv \left(\int_{\Omega_r} a_{jr}^{\varepsilon-1}\, dj\right)^{\frac{1}{\varepsilon-1}}.$$

Then $P_r^M = \mu w_{P,r}/A_r^M$ and

$$\left(\frac{p_{jr}}{P_r^M}\right)^{-\varepsilon} = \left(\frac{\mu w_{P,r}/a_{jr}}{\mu w_{P,r}/A_r^M}\right)^{-\varepsilon} = \left(\frac{a_{jr}}{A_r^M}\right)^{\varepsilon}.$$

Therefore

$$l_{jr} = Y_r^M \frac{a_{jr}^{\varepsilon-1}}{\left(A_r^M\right)^{\varepsilon}}.$$

Aggregate non-agricultural production labor is $L_{P,r}^M \equiv \int_{\Omega_r} l_{jr} dj$, so

$$L_{P,r}^M = \frac{Y_r^M}{\left(A_r^M\right)^{\varepsilon}} \int_{\Omega_r} a_{jr}^{\varepsilon-1}\, dj = \frac{Y_r^M}{A_r^M}.$$

Hence the equilibrium aggregate non-agricultural production function is

$$Y_r^M = A_r^M\, L_{P,r}^M.$$

Since Ω_r has endogenous measure N_r and $\int_{\Omega_r} a_{jr}^{\varepsilon-1}\, dj = N_r \int a^{\varepsilon-1}\, dG_r(a) = N_r\, \mathbb{E}_{G_r}\left[a^{\varepsilon-1}\right]$, write

$$A_r^M = N_r^{\frac{1}{\varepsilon-1}} \tilde{a}_r.$$

where $\tilde{a}_r \equiv \left(\mathbb{E}\left[a^{\varepsilon-1}\right]\right)^{\frac{1}{\varepsilon-1}}$ So aggregate productivity increases through (i) a love of variety term $N_r^{1/(\varepsilon-1)}$ and (ii) an average of $a = \varphi e^{\zeta}$. Since we have $P_r^M = \mu w_{P,r}/A_r^M$, production wage is

$$w_{P,r} = P_r^M N_r^{\frac{1}{\varepsilon-1}} \tilde{a}_r.$$

D.9 Manager Labor Supply and Occupational Choice

Workers choose to be managers if $h w_M \geq w_P$, i.e. if $h \geq \bar{h} \equiv w_P/w_M$. With $h \sim \text{Pareto}(h_{\min}, \kappa^h)$, density $g(h) = \kappa^h h_{\min}^{\kappa^h} h^{-(\kappa^h+1)}$ for $h \geq h_{\min}$, the supply of *managerial efficiency units* is

$$H_S(w_M, w_P; \mu_M) \equiv \int_{\bar{h}}^{\infty} h\, g(h)\, dh = \kappa^h h_{\min}^{\kappa^h} \int_{\bar{h}}^{\infty} h^{-\kappa^h}\, dh = \frac{\kappa^h}{\kappa^h - 1} h_{\min}^{\kappa^h} \bar{h}^{\,1-\kappa^h}.$$

Using $\bar{h} = w_P/w_M$ and $h_{\min} = \frac{\kappa^h-1}{\kappa^h}\mu_M$ (from $\mu_M = \frac{\kappa^h}{\kappa^h-1}h_{\min}$),

$$H_S(w_M, w_P; \mu_M) = \frac{\kappa^h}{\kappa^h - 1}\left(\frac{\kappa^h - 1}{\kappa^h}\mu_M\right)^{\kappa^h}\left(\frac{w_P}{w_M}\right)^{1-\kappa^h} = C\ \mu_M^{\kappa^h}\left(\frac{w_M}{w_P}\right)^{\kappa^h-1},$$

where $C \equiv \frac{\kappa^h}{\kappa^h - 1}\left(\frac{\kappa^h - 1}{\kappa^h}\right)^{\kappa^h} > 0$ is a constant.

D.10 Production Labor Market

Using $y = \varphi e^{\zeta} l$ and the demand system,

$$l(\varphi, e) = \frac{y}{\varphi e^{\zeta}} = \left(\frac{p(\varphi, e)}{P^M}\right)^{-\varepsilon} \frac{E^M}{P^M} \cdot \frac{1}{\varphi e^{\zeta}}.$$

Substitute $p(\varphi, e) = \mu w_P / (\varphi e^{\zeta})$:

$$\begin{aligned} l(\varphi, e) &= \left(\frac{\mu w_P}{\varphi e^{\zeta} P^M}\right)^{-\varepsilon} \frac{E^M}{P^M} \cdot \frac{1}{\varphi e^{\zeta}} \\ &= E^M (\mu w_P)^{-\varepsilon} (P^M)^{\varepsilon - 1} \, (\varphi e^{\zeta})^{\varepsilon} \cdot \frac{1}{\varphi e^{\zeta}} \\ &= E^M (\mu w_P)^{-\varepsilon} (P^M)^{\varepsilon - 1} \, \varphi^{\varepsilon - 1} \, e^{\zeta(\varepsilon - 1)}. \end{aligned}$$

Using $\sigma \equiv \zeta(\varepsilon - 1) \in (0, 1)$,

$$l(\varphi, e) = E^M (\mu w_P)^{-\varepsilon} (P^M)^{\varepsilon - 1} \, \varphi^{\varepsilon - 1} e^{\sigma}.$$

This makes the comparative statics transparent: l falls in w_P and rises in (φ, e).

If a firm of type φ operates $n(\varphi)$ product lines and chooses the same $e(\varphi)$ per line, its total production labor is

$$L^P(\varphi) = n(\varphi) \, l(\varphi, e(\varphi)).$$

Aggregate non-agricultural production labor demand is then

$$L^{PM} = \int_{\varphi \geq \varphi^*} n(\varphi) \, l(\varphi, e(\varphi)) \, dM(\varphi),$$

where $M(\cdot)$ is the measure/distribution of operating firms. For any variety, revenue is

$$R \equiv py = \mu \, c \, y = \mu \, w_P l \quad \Rightarrow \quad w_P l = \frac{1}{\mu} R.$$

Summing over all varieties,

$$w_P L^{PM} = \frac{1}{\mu} \int_{\Omega} R_j \, dj.$$

But by definition, total spending on varieties equals total revenue:

$$\int_{\Omega} R_j \, dj = \int_{\Omega} p_j y_j \, dj = E^M.$$

Therefore,

$$L^{PM}(w_P) = \frac{E^M}{\mu \, w_P}.$$

Workers choose production work if $w_P \geq h w_M$, i.e. if $h < \bar{h} \equiv w_P / w_M$. Let $h \sim \text{Pareto}(h_{\min}, \kappa^h)$ with $\kappa^h > 1$:

$$\Pr(h \geq x) = \left(\frac{h_{\min}}{x} \right)^{\kappa^h}, \qquad x \geq h_{\min}.$$

If $\bar{h} \geq h_{\min}$, the production share is

$$\Pr(h < \bar{h}) = 1 - \left(\frac{h_{\min}}{\bar{h}} \right)^{\kappa^h} = 1 - \left(\frac{h_{\min} w_M}{w_P} \right)^{\kappa^h}.$$

Hence production labor supply is

$$L^{P,S}(w_P, w_M; \mu_M, L) = L \left[1 - \left(\frac{h_{\min} w_M}{w_P} \right)^{\kappa^h} \right].$$

Using normalization $h_{\min} = \frac{\kappa^h - 1}{\kappa^h} \mu_M$,

$$L^{P,S} = L \left[1 - \left(\frac{\kappa^h - 1}{\kappa^h} \frac{\mu_M w_M}{w_P} \right)^{\kappa^h} \right].$$

Equilibrium in the production labor market requires

$$L^{PA}(w_P) + L^{PM}(w_P; E^M) \;=\; L^{P,S}(w_P, w_M; \mu_M, L).$$

Substituting the closed forms,

$$\left(\frac{\gamma P_A Q_r \mathcal{T}_r^{1-\gamma}}{w_P} \right)^{\frac{1}{1-\gamma}} + \frac{E^M}{\mu \, w_P} \;=\; L \left[1 - \left(\frac{\kappa^h - 1}{\kappa^h} \frac{\mu_M w_M}{w_P} \right)^{\kappa^h} \right],$$

(valid when $\bar{h} = w_P / w_M \geq h_{\min}$ so both occupations are active).

Monotonicity: the LHS is strictly decreasing in w_P; the RHS is strictly increasing in w_P.

This gives existence/uniqueness of the equilibrium w_P for given (w_M, μ_M, E^M, L).

A convenient object is the sectoral employment ratio:

$$\frac{L^{PM}}{L^{PA}} = \frac{E^M}{\mu} \cdot \left(\gamma P_A Q_r \mathcal{T}_r^{1-\gamma}\right)^{-\frac{1}{1-\gamma}} \cdot w_P^{\frac{\gamma}{1-\gamma}}.$$

So non-agriculture's share rises with (i) higher manufacturing expenditure E^M and (ii) higher production wage w_P.

D.11 Traditional and Modern Firm Share

Let potential entrant productivity draws be Pareto on $[\varphi_{\min}, \infty)$ with tail parameter $\zeta_\varphi > 0$:

$$F_0(\varphi) = 1 - \left(\frac{\varphi_{\min}}{\varphi}\right)^{\zeta_\varphi}, \qquad f_0(\varphi) = \zeta_\varphi \, \varphi_{\min}^{\zeta_\varphi} \, \varphi^{-(\zeta_\varphi+1)}, \qquad \varphi \geq \varphi_{\min}.$$

Firms operate iff $\varphi \geq \varphi^*$. Thus the distribution of productivity *among operating firms* is the conditional (truncated) distribution

$$G(\varphi) \equiv \Pr(\Phi \leq \varphi \mid \Phi \geq \varphi^*) = \frac{F_0(\varphi) - F_0(\varphi^*)}{1 - F_0(\varphi^*)} = 1 - \left(\frac{\varphi^*}{\varphi}\right)^{\zeta_\varphi}, \qquad \varphi \geq \varphi^*,$$

with density

$$g(\varphi) = G'(\varphi) = \zeta_\varphi (\varphi^*)^{\zeta_\varphi} \varphi^{-(\zeta_\varphi+1)}, \qquad \varphi \geq \varphi^*.$$

Traditional firms are those with $\varphi \in [\varphi^*, \bar{\varphi})$, while modern firms are those with $\varphi \geq \bar{\varphi}$. Therefore the traditional share among operating firms is

$$s_T \equiv \Pr(\varphi < \bar{\varphi} \mid \varphi \geq \varphi^*) = \int_{\varphi^*}^{\bar{\varphi}} g(\varphi) \, d\varphi = G(\bar{\varphi}) - G(\varphi^*).$$

Since $G(\varphi^*) = 0$ under the conditional distribution, we obtain

$$s_T = G(\bar{\varphi}) = 1 - \left(\frac{\varphi^*}{\bar{\varphi}}\right)^{\zeta_\varphi}.$$

Equivalently, the modern share among operating firms is

$$s_M \equiv 1 - s_T = \Pr(\varphi \geq \bar{\varphi} \mid \varphi \geq \varphi^*) = \left(\frac{\varphi^*}{\bar{\varphi}}\right)^{\zeta_\varphi}.$$

D.12 Preferences

A representative household in region r consumes two sectoral composites, $C_{L,r}$ and $C_{H,r}$, with Cobb–Douglas preferences:

$$U_r \;=\; C_{L,r}^{\nu}\, C_{H,r}^{1-\nu}, \qquad \nu \in (0,1).$$

Let P_L and P_H denote the sectoral price indices. Given nominal expenditure (income) E_r, optimal demands are

$$C_{L,r} = \nu\, \frac{E_r}{P_L}, \qquad C_{H,r} = (1-\nu)\, \frac{E_r}{P_H}.$$

The corresponding indirect utility can be written as

$$u_r \;=\; \frac{E_r}{P_r}, \qquad P_r \;\equiv\; \frac{P_{L,r}^{\nu}\, P_{H,r}^{1-\nu}}{\nu^{\nu}(1-\nu)^{1-\nu}},$$

where P_r is the Cobb–Douglas unit expenditure function (up to the constant $\nu^{-\nu}(1-\nu)^{-(1-\nu)}$).

Individuals are heterogeneous in managerial human capital h and, upon residing in region r, choose between production work (wage $w_{P,r}$ per efficiency unit) and outside management (wage $w_{M,r}$ per unit of h). Income is therefore

$$E_r(h) = \max\{w_{P,r},\, h\, w_{M,r}\}.$$

Define the managerial cutoff

$$\bar{h}_r \equiv \frac{w_{P,r}}{w_{M,r}},$$

so that individuals with $h \geq \bar{h}_r$ work as outside managers.

Assume h is Pareto distributed with shape parameter $\kappa > 1$ and lower bound $h_{\min} > 0$:

$$\Pr(h \geq x) = \left(\frac{h_{\min}}{x}\right)^{\kappa}, \qquad x \geq h_{\min}.$$

Equivalently, the mean is $\mu_M = \mathbb{E}[h] = \frac{\kappa}{\kappa-1} h_{\min}$, so $h_{\min} = \frac{\kappa-1}{\kappa}\mu_M$.

If $\bar{h}_r \geq h_{\min}$, expected income in region r is

$$\mathbb{E}[E_r] = w_{P,r}\Pr(h < \bar{h}_r) + w_{M,r}\mathbb{E}\left[h\mathbf{1}\{h \geq \bar{h}_r\}\right],$$

which yields the closed form

$$\mathbb{E}[E_r] = w_{P,r}\left[1 - \left(\frac{h_{\min}}{\bar{h}_r}\right)^{\kappa}\right] + w_{M,r}\frac{\kappa}{\kappa - 1}\, h_{\min}^{\kappa}\, \bar{h}_r^{1-\kappa}.$$

Substituting $\bar{h}_r = w_{P,r}/w_{M,r}$ gives

$$\mathbb{E}[E_r] = w_{P,r}\left[1 + K\left(\frac{\mu_M w_{M,r}}{w_{P,r}}\right)^{\kappa^h}\right], \qquad K \equiv \frac{(\kappa^h - 1)^{\kappa^h - 1}}{\kappa^{h\kappa^h}}.$$

Expected indirect utility in region r is therefore

$$\mathbb{E}[u_r] = \frac{\mathbb{E}[E_r]}{P_r}.$$

Hence, expected utility in region r is

$$\mathbb{E}[u_r] = \frac{\mathbb{E}[E_r]}{P_r} = w_{P,r}\left[1 + K\left(\frac{\mu_M w_{M,r}}{w_{P,r}}\right)^{\kappa^h}\right]/P_r$$

Total regional nominal expenditure is

$$E_r = L_r \cdot \mathbb{E}[E_r],$$

and manufacturing expenditure is

$$E_r^M = (1 - \alpha) L_r \cdot \mathbb{E}[E_r].$$

Spatial mobility. Individuals are mobile across regions but face bilateral moving frictions and idiosyncratic location tastes. An individual currently in region j choosing destination r receives utility

$$U_{jr} = Z_r\, \tau_{jr}\, \mathbb{E}[u_r]\, \xi_{ir},$$

where Z_r is an amenity shifter in r, $\tau_{jr} \in (0, 1]$ captures moving costs from j to r, $\mathbb{E}[u_r] = \mathbb{E}[E_r]/P_r$ is expected indirect utility in r, and ξ_{ir} is i.i.d. Fréchet across individuals and destinations with shape parameter $\psi > 0$.

The resulting migration share from j to r is the standard gravity expression:

$$m_{jr} = \frac{\left(Z_r \tau_{jr} \mathbb{E}[u_r]\right)^{\psi}}{\sum_d \left(Z_d \tau_{jd} \mathbb{E}[u_d]\right)^{\psi}}.$$

Hence, total population in region r is

$$L_r = \sum_j m_{jr} L_j.$$

D.13 Proof of Proposition 1

Before proving Proposition 1, I first prove that higher average manager human capital decreases manager wages.

Lemma 3. *The increase in the average manager human capital lowers manager wages.*

Proof. The production labor market is characterized by

$$\left(\frac{\gamma P_A Q_r \mathcal{T}_r^{1-\gamma}}{w_P}\right)^{\frac{1}{1-\gamma}} + \frac{E^M}{\mu\, w_P} = L\left[1 - \left(\frac{\kappa^h - 1}{\kappa^h}\frac{\mu_M w_M}{w_P}\right)^{\kappa^h}\right].$$

Define

$$s \equiv \frac{\mu_M w_M}{w_P}, \qquad M \equiv \mu_M w_M, \qquad w_P = \frac{M}{s}.$$

Your closed form production labor clearing is

$$\left(\frac{\gamma P_A Q_r \mathcal{T}_r^{1-\gamma}}{w_P}\right)^{\frac{1}{1-\gamma}} + \frac{1}{\mu}\frac{E^M}{w_P} = L\left[1 - (cs)^{\kappa^h}\right], \qquad c \equiv \frac{\kappa^h - 1}{\kappa^h}.$$

We know that

$$E^M = (1-\alpha) L\, \mathbb{E}[E], \qquad \mathbb{E}[E] = w_P\left[1 + K s^{\kappa^h}\right],$$

so

$$\frac{1}{\mu}\frac{E^M}{w_P} = \frac{1-\alpha}{\mu} L\left[1 + K s^{\kappa^h}\right].$$

Let

$$A_0 \equiv (\gamma P_A Q_r \mathcal{T}_r^{1-\gamma})^{\frac{1}{1-\gamma}}, \qquad a \equiv \frac{1}{1-\gamma} > 1.$$

Then the production labor condition becomes

$$A_0 w_P^{-a} + \frac{1-\alpha}{\mu} L\left[1 + K s^{\kappa^h}\right] = L\left[1 - (cs)^{\kappa^h}\right].$$

Substitute $w_P = M/s$ and define

$$F(s, M) \equiv A_0 M^{-a} s^a + \frac{1-\alpha}{\mu} L\left[1 + K s^{\kappa^h}\right] - L + L(cs)^{\kappa^h}.$$

Equilibrium in the production labor market is exactly

$$F(s, M) = 0.$$

Compute partial derivatives:

$$F_M(s, M) = -aA_0 M^{-a-1} s^a < 0,$$

$$F_s(s, M) = aA_0 M^{-a} s^{a-1} + \kappa^h \Big(\frac{1-\alpha}{\mu} LK + Lc^{\kappa^h} \Big) s^{\kappa^h - 1} > 0.$$

By the implicit function theorem, there is a unique differentiable function $s = s(M)$ and

$$\frac{ds}{dM} = -\frac{F_M}{F_s} > 0.$$

So the ratio $s = \mu_M w_M / w_P$ is strictly increasing in $M = \mu_M w_M$.

With Pareto and a scale shift, efficiency unit manager supply is

$$H_S(\mu_M, w_P, w_M) = C\, \mu_M^{\kappa^h} \left(\frac{w_M}{w_P} \right)^{\kappa^h - 1}$$

for some constant $C > 0$. Using $w_P = M/s$ and $M = \mu_M w_M$,

$$\frac{w_M}{w_P} = \frac{w_M}{M/s} = \frac{s}{\mu_M}.$$

Therefore

$$H_S = C\, \mu_M^{\kappa^h} \left(\frac{s}{\mu_M} \right)^{\kappa^h - 1} = C\, \mu_M\, s^{\kappa^h - 1}.$$

Substitute the production labor equilibrium mapping $s = s(M) = s(\mu_M w_M)$. Define derived supply

$$\widetilde{H}_S(w_M; \mu_M) \equiv C\, \mu_M \left[s(\mu_M w_M) \right]^{\kappa^h - 1}.$$

Hold w_M fixed and increase μ_M. Then $M = \mu_M w_M$ rises, and since $s(\cdot)$ is strictly increasing, $\widetilde{H}_S$ strictly increases. Formally,

$$\frac{\partial \widetilde{H}_S}{\partial \mu_M} = C \left[s(\mu_M w_M) \right]^{\kappa^h - 1} + C\, \mu_M (\kappa^h - 1) \left[s(\mu_M w_M) \right]^{\kappa^h - 2} s'(\mu_M w_M)\, w_M > 0,$$

because $s'(\cdot) > 0$.

For a modern firm with productivity φ operating n lines,

$$e \;=\; \frac{T}{n} + \alpha m, \qquad \pi(\varphi, e) = A\,\varphi^{\varepsilon-1} e^{\sigma}, \;\; \sigma \in (0,1),$$

and (conditional on hiring $m > 0$) the optimal effective services per line are

$$e^*(\varphi, w_M) = \left(\frac{\sigma\alpha A \varphi^{\varepsilon-1}}{w_M}\right)^{\frac{1}{1-\sigma}}.$$

So e^* is strictly decreasing in w_M:

$$\frac{\partial e^*}{\partial w_M} = -\frac{1}{1-\sigma}\frac{e^*}{w_M} < 0.$$

In the delegation region, your optimal scope is

$$n^M(\varphi, w_M) = 1 + \frac{\Lambda(\varphi, w_M)}{\kappa},$$

with

$$\Lambda(\varphi, w_M) = (1-\sigma)\,A\,\varphi^{\varepsilon-1}\left(\frac{\sigma\alpha A \varphi^{\varepsilon-1}}{w_M}\right)^{\frac{\sigma}{1-\sigma}}.$$

Hence Λ is strictly decreasing in w_M, so

$$\frac{\partial n^M}{\partial w_M} = \frac{1}{\kappa}\frac{\partial \Lambda}{\partial w_M} < 0.$$

Now use your manager demand identity (in efficiency units). With $m = (e - T/n)/\alpha$, total manager demand by the firm is

$$d(\varphi, w_M) \;\equiv\; n^M(\varphi, w_M)\, m(\varphi, w_M) = \frac{n^M(\varphi, w_M)\, e^*(\varphi, w_M) - T}{\alpha}.$$

Differentiate:

$$\frac{\partial d}{\partial w_M} = \frac{1}{\alpha}\left(e^*\,\frac{\partial n^M}{\partial w_M} + n^M\,\frac{\partial e^*}{\partial w_M}\right).$$

Since $e^* > 0$, $n^M > 0$, and both $\partial n^M/\partial w_M < 0$ and $\partial e^*/\partial w_M < 0$, it follows immediately that

$$\frac{\partial d(\varphi, w_M)}{\partial w_M} < 0 \text{for every modern delegating firm.}$$

Modern cutoff $\bar{\varphi}(w_M)$ solves

$$\Delta\Pi(\bar{\varphi}, w_M) = 0, \qquad \Delta\Pi(\varphi, w_M) \equiv \Pi^M(\varphi, w_M) - \Pi^T(\varphi).$$

Traditional profits $\Pi^T(\varphi) = A\varphi^{\varepsilon-1}T^\sigma - f$ do not depend on w_M.

For modern profits, we have:

$$\Pi^M(\varphi, w_M) = \max_{n\geq 1, m\geq 0} \left\{ n\left[A\varphi^{\varepsilon-1}\left(\frac{T}{n} + \alpha m\right)^\sigma - w_M m\right] - \frac{\kappa}{2}(n-1)^2 - \eta f \right\}.$$

By the envelope theorem, at the optimum

$$\frac{\partial \Pi^M(\varphi, w_M)}{\partial w_M} = -\, n^M(\varphi, w_M)\, m(\varphi, w_M) = -\, d(\varphi, w_M) \;\; < 0$$

(as long as the firm is in the delegation region, so $d > 0$). Therefore

$$\frac{\partial \Delta\Pi(\varphi, w_M)}{\partial w_M} < 0.$$

Again, by the envelope theorem,

$$\frac{\partial \Pi^M(\varphi, w_M)}{\partial \varphi} = n^M(\varphi, w_M) \cdot A(\varepsilon-1)\varphi^{\varepsilon-2}\left(\frac{T}{n^M(\varphi, w_M)} + \alpha m^M(\varphi, w_M)\right)^\sigma.$$

and

$$\frac{\partial \Pi^T(\varphi)}{\partial \varphi} = A(\varepsilon-1)\varphi^{\varepsilon-2}\, T^\sigma.$$

Hence,

$$\frac{\partial \Delta\Pi(\varphi, w_M)}{\partial \varphi} = A(\varepsilon-1)\varphi^{\varepsilon-2}\left[n^M(\varphi, w_M)\,(e^M(\varphi, w_M))^\sigma - T^\sigma\right].$$

Delegation means $m > 0 \Rightarrow e^* > T/n^M$. Since $\sigma \in (0,1)$,

$$(e^*)^\sigma > \left(\frac{T}{n^M}\right)^\sigma \quad \Rightarrow \quad n^M(e^*)^\sigma > n^M\left(\frac{T}{n^M}\right)^\sigma = (n^M)^{1-\sigma}T^\sigma \geq T^\sigma,$$

with strict inequality because $e^* > T/n^M$. Hence

$$\Delta\Pi_\varphi > 0.$$

The implicit function theorem gives

$$\bar{\varphi}'(w_M) = -\frac{\Delta\Pi_{w_M}}{\Delta\Pi_{\varphi}} > 0.$$

So higher manager wages shrink the set of modern/delegating firms.

Let $g(\varphi)$ be the density of operating firms, and let $M > 0$ be the mass of operating firms/entrants. Aggregate manager demand in efficiency units is

$$H_D(w_M) = M \int_{\bar{\varphi}(w_M)}^{\infty} d(\varphi, w_M)\, g(\varphi)\, d\varphi, \qquad d(\varphi, w_M) = \frac{n^M(\varphi, w_M) e^*(\varphi, w_M) - T}{\alpha}.$$

Differentiate using Leibniz:

$$H_D'(w_M) = M \int_{\bar{\varphi}(w_M)}^{\infty} \frac{\partial d(\varphi, w_M)}{\partial w_M}\, g(\varphi)\, d\varphi \;-\; M\, d(\bar{\varphi}(w_M), w_M)\, g(\bar{\varphi}(w_M))\, \bar{\varphi}'(w_M).$$

The integral term is strictly negative because $\partial d/\partial w_M < 0$ for each modern delegating firm. The boundary term is weakly negative because $d \geq 0$, $g \geq 0$, and $\bar{\varphi}'(w_M) > 0$.

Hence,

$$H_D'(w_M) < 0.$$

Since the manager labor supply equals the manager labor demand,

$$H_D(w_M) = \widetilde{H}_S(w_M; \mu_M).$$

Differentiate implicitly with respect to μ_M:

$$H_D'(w_M)\frac{dw_M}{d\mu_M} = \frac{\partial \widetilde{H}_S}{\partial \mu_M} + \frac{\partial \widetilde{H}_S}{\partial w_M}\frac{dw_M}{d\mu_M}.$$

Rearrange:

$$\frac{dw_M}{d\mu_M} = \frac{\frac{\partial \widetilde{H}_S}{\partial \mu_M}}{H_D'(w_M) - \frac{\partial \widetilde{H}_S}{\partial w_M}}.$$

We already have $\partial \widetilde{H}_S/\partial \mu_M > 0$. Also $\partial \widetilde{H}_S/\partial w_M > 0$ because $M = \mu_M w_M$ rises in w_M and $s(\cdot)$ rises in M. Therefore the denominator is negative since $H_D'(w_M) < 0$ and we subtract a positive term. Hence

$$\frac{dw_M}{d\mu_M} < 0.$$

□

Proposition 1. *An increase in the average managerial human capital μ_M implies:*
(i) *lower traditional firm share.*
(ii) *higher manager share.*
(iii) *more product lines per firm.*
(iv) *lower agriculture share.*
(v) *higher output per worker.*

Proof. **Part (i). Traditional firm share falls.** Traditional profits

$$\Pi^T(\varphi) = A\,T^\sigma\,\varphi^{\varepsilon-1} - f.$$

Modern profits under "all modern firms delegate" block

$$\Pi^M(\varphi, w_M) = \frac{w_M}{\alpha}T + \Lambda(\varphi, w_M) + \frac{\Lambda(\varphi, w_M)^2}{2\kappa} - \eta f.$$

Exit condition:

$$0 = \Pi^T(\varphi^*) = A\,T^\sigma\,(\varphi^*)^{\varepsilon-1} - f \quad \Rightarrow \quad A\,T^\sigma\,(\varphi^*)^{\varepsilon-1} = f.$$

So

$$A\,\varphi^{\varepsilon-1} = A\,(\varphi^*)^{\varepsilon-1}\left(\frac{\varphi}{\varphi^*}\right)^{\varepsilon-1} = \frac{f}{T^\sigma}\left(\frac{\varphi}{\varphi^*}\right)^{\varepsilon-1}.$$

Define

$$x \equiv \frac{\varphi}{\varphi^*}.$$

Then the key substitution is

$$A\,\varphi^{\varepsilon-1} = \frac{f}{T^\sigma}\,x^{\varepsilon-1}.$$

Plug the substitution into Π^T:

$$\Pi^T(\varphi) = T^\sigma\left(A\varphi^{\varepsilon-1}\right) - f = T^\sigma\left(\frac{f}{T^\sigma}x^{\varepsilon-1}\right) - f = f\left(x^{\varepsilon-1} - 1\right).$$

Start from

$$\Lambda(\varphi, w_M) = (1-\sigma)\,A\,\varphi^{\varepsilon-1}\left(\frac{\sigma\alpha\,A\,\varphi^{\varepsilon-1}}{w_M}\right)^{\frac{\sigma}{1-\sigma}}.$$

Let

$$\delta \equiv \frac{\sigma}{1-\sigma}, \qquad q \equiv (\varepsilon-1)(1+\delta) = \frac{\varepsilon-1}{1-\sigma}.$$

Use $A\varphi^{\varepsilon-1} = \frac{f}{T^\sigma}x^{\varepsilon-1}$:

$$\Lambda(\varphi, w_M) = (1-\sigma)\left(\frac{f}{T^\sigma}x^{\varepsilon-1}\right)\left(\frac{\sigma\alpha}{w_M}\cdot\frac{f}{T^\sigma}x^{\varepsilon-1}\right)^{\delta}.$$

Collect constants:

$$\Lambda(\varphi, w_M) = (1-\sigma)\left(\frac{f}{T^\sigma}\right)^{1+\delta}(\sigma\alpha)^{\delta}\, x^{(\varepsilon-1)(1+\delta)}\, w_M^{-\delta}.$$

Define

$$K_\Lambda \equiv (1-\sigma)\left(\frac{f}{T^\sigma}\right)^{1+\delta}(\sigma\alpha)^{\delta} > 0,$$

so

$$\Lambda(\varphi, w_M) = K_\Lambda\, x^q\, w_M^{-\delta}.$$

Plug the rewritten Λ into Π^M:

$$\Pi^M(\varphi, w_M) = \frac{w_M}{\alpha}T + K_\Lambda x^q w_M^{-\delta} + \frac{1}{2\kappa}\left(K_\Lambda x^q w_M^{-\delta}\right)^2 - \eta f.$$

So we can define a function $\Pi^M(x, w_M)$ by

$$\Pi^M(x, w_M) \equiv \frac{w_M}{\alpha}T + K_\Lambda x^q w_M^{-\delta} + \frac{K_\Lambda^2}{2\kappa}x^{2q}w_M^{-2\delta} - \eta f,$$

such that

$$\Pi^M(\varphi, w_M) = \Pi^M\left(\frac{\varphi}{\varphi^*}, w_M\right).$$

Define the normalized modernization cutoff

$$r \equiv \frac{\bar{\varphi}}{\varphi^*}.$$

The indifference condition is

$$0 = \Delta\Pi(\bar{\varphi}, w_M) = \Pi^M(\bar{\varphi}, w_M) - \Pi^T(\bar{\varphi}).$$

This becomes

$$0 = \Pi^M(r, w_M) - f\left(r^{\varepsilon-1} - 1\right).$$

Define

$$\Delta\Pi(r, w_M) \equiv \Pi^M(r, w_M) - f\left(r^{\varepsilon-1} - 1\right).$$

So the cutoff condition is exactly

$$\Delta\Pi(r, w_M) = 0,$$

which depends on r and w_M. Differentiate implicitly:

$$0 = \frac{\partial \Delta\Pi}{\partial r}\, dr + \frac{\partial \Delta\Pi}{\partial w_M}\, dw_M \quad \Rightarrow \quad \frac{dr}{dw_M} = -\frac{\partial \Delta\Pi / \partial w_M}{\partial \Delta\Pi / \partial r}.$$

We know that $\partial\Delta\Pi/\partial r > 0$ and $\partial\Delta\Pi/\partial w_M < 0$, so

$$\frac{dr}{dw_M} > 0.$$

Since from Lemma 3, we know that $\frac{dw_M}{d\mu_M} < 0$,

$$\frac{dr}{d\mu_M} < 0.$$

Now the traditional share among operating firms is

$$s_T = \Pr(1 \le x < r \mid x \ge 1) = 1 - \Pr(x \ge r \mid x \ge 1) = 1 - r^{-\zeta_\varphi}.$$

This is strictly increasing in r. Since r falls with μ_M, s_T falls with μ_M. That proves (i).

Part (iii). Average product lines per firm rises. Define scope as a function of (x, w_M) among operating firms:

$$n(x, w_M) = \begin{cases} 1, & 1 \le x < r(w_M), \\ n^M(x, w_M), & x \ge r(w_M). \end{cases}$$

We know that $\partial n^M / \partial w_M < 0$, so for any fixed $x \ge r(w_M)$, a fall in w_M raises n^M. Also, from part (i), $r(w_M)$ falls when w_M falls. So the set $\{x : x \ge r(w_M)\}$ expands. Therefore for every $x \ge 1$, $n(x, w_M)$ weakly increases when w_M falls, and it strictly increases on a set of positive measure because either some firms switch from 1 to modern scope or modern firms expand scope. Hence, the average scope among operating firms

$$\mathbb{E}[n(x, w_M) \mid x \ge 1]$$

increases when w_M falls, hence increases when μ_M rises. That proves (iii).

Part (ii). Manager share rises. Under Pareto managerial human capital with lower bound $h_{\min} = c\mu_M$ and $c \equiv (\kappa^h - 1)/\kappa^h$, occupational choice implies that the headcount share of

managers is

$$s_M^H = \Pr\left(h \geq \frac{w_P}{w_M}\right) = \left(\frac{h_{\min}}{w_P/w_M}\right)^{\kappa^h} = \left(c\,\frac{\mu_M w_M}{w_P}\right)^{\kappa^h} = (c\,s)^{\kappa^h}, \qquad s \equiv \frac{\mu_M w_M}{w_P}.$$

Thus it suffices to show that s is strictly increasing in μ_M. From Lemma 3, the production-labor market delivers a strictly increasing mapping

$$s = s(M), \qquad s'(M) > 0, \qquad M \equiv \mu_M w_M.$$

Hence $ds/d\mu_M$ has the sign of $dM/d\mu_M$.

Next write manager-market clearing using $w_M = M/\mu_M$ and $s = s(M)$. From Lemma 3, efficiency-unit supply can be written as

$$H_S = C\,\mu_M\, s(M)^{\kappa^h - 1},$$

so equilibrium in the manager market is

$$H_D\left(\frac{M}{\mu_M}\right) = C\,\mu_M\, s(M)^{\kappa^h - 1}. \tag{5}$$

Define $G(M, \mu_M) \equiv H_D(M/\mu_M) - C\,\mu_M\, s(M)^{\kappa^h - 1} = 0$. Then

$$G_M = \frac{1}{\mu_M} H_D'(w_M) - C\,\mu_M(\kappa^h - 1)s(M)^{\kappa^h - 2}s'(M) < 0$$

because $H_D'(w_M) < 0$ and $s'(M) > 0$. Also

$$G_{\mu_M} = -\frac{M}{\mu_M^2} H_D'(w_M) - C\,s(M)^{\kappa^h - 1} = \frac{-w_M H_D'(w_M) - H_D(w_M)}{\mu_M},$$

where the last equality uses (5) to substitute $C\,s(M)^{\kappa^h - 1} = H_D(w_M)/\mu_M$.

It remains to show that $-w_M H_D'(w_M) > H_D(w_M)$. Under delegation, a modern firm's manager demand in efficiency units can be written as

$$d(\varphi, w_M) = \frac{n^M(\varphi, w_M)e^*(\varphi, w_M) - T}{\alpha} = \frac{1}{\alpha}\Big(B_1(\varphi)\, w_M^{-(1+\delta)} + B_2(\varphi)\, w_M^{-(1+2\delta)} - T\Big), \qquad \delta \equiv \frac{\sigma}{1-\sigma} > 0,$$

for some $B_1(\varphi), B_2(\varphi) > 0$. Therefore, for every delegating firm,

$$-w_M \frac{\partial d(\varphi, w_M)}{\partial w_M} = \frac{1}{\alpha}\Big((1+\delta)B_1(\varphi)\, w_M^{-(1+\delta)} + (1+2\delta)B_2(\varphi)\, w_M^{-(1+2\delta)}\Big) > d(\varphi, w_M).$$

Aggregate demand is

$$H_D(w_M) = \int_{\bar{\varphi}(w_M)}^{\infty} d(\varphi, w_M)\, g(\varphi)\, d\varphi,$$

so,

$$H_D'(w_M) = \int_{\bar{\varphi}(w_M)}^{\infty} d_{w_M}(\varphi, w_M)\, g(\varphi)\, d\varphi - d(\bar{\varphi}(w_M), w_M)\, g(\bar{\varphi}(w_M))\, \bar{\varphi}'(w_M).$$

Multiplying by $-w_M$ and using $\bar{\varphi}'(w_M) > 0$ and $d(\bar{\varphi}, w_M) \geq 0$ gives

$$-w_M H_D'(w_M) \geq \int_{\bar{\varphi}(w_M)}^{\infty} \big(- w_M d_{w_M}(\varphi, w_M)\big)\, g(\varphi)\, d\varphi > \int_{\bar{\varphi}(w_M)}^{\infty} d(\varphi, w_M)\, g(\varphi)\, d\varphi = H_D(w_M).$$

Hence $G_{\mu_M} > 0$, and since $G_M < 0$,

$$\frac{dM}{d\mu_M} = -\frac{G_{\mu_M}}{G_M} > 0.$$

With $s'(M) > 0$, this implies $ds/d\mu_M > 0$. Therefore the manager headcount share $s_M^H = (cs)^{\kappa^h}$ is strictly increasing in μ_M.

Part (iv). Lower agriculture share due to higher production wages. Recall from Lemma 3 that the production-labor market implies a mapping $s = s(M)$ with $s'(M) > 0$, where $s \equiv \mu_M w_M / w_P$ and $M \equiv \mu_M w_M$, so that

$$w_P = \frac{M}{s(M)}.$$

Moreover, from the expression $s'(M) = -F_M/F_s$ in Lemma 3,

$$\varepsilon_{s,M} \equiv \frac{M}{s} s'(M) = \frac{a A_0 M^{-a} s^{a-1}}{F_s(s, M)} \in (0, 1),$$

since $F_s(s, M) = a A_0 M^{-a} s^{a-1} + \kappa^h \left(\frac{1-\alpha}{\mu} LK + Lc^{\kappa^h} \right) s^{\kappa^h - 1}$ strictly exceeds its first term. Hence

$$\frac{d \ln w_P}{d \ln M} = 1 - \varepsilon_{s,M} > 0,$$

so w_P is strictly increasing in M. From part (ii) we established $dM/d\mu_M > 0$. Therefore

$$\frac{dw_P}{d\mu_M} = \frac{dw_P}{dM} \frac{dM}{d\mu_M} > 0.$$

Agricultural production-labor demand is

$$L_P^A(w_P) = \left(\frac{\gamma P_A Q_r \mathcal{T}_r^{1-\gamma}}{w_P} \right)^{\frac{1}{1-\gamma}},$$

which is strictly decreasing in w_P, hence strictly decreasing in μ_M. Manufacturing production-labor demand is

$$L_P^M = \frac{E^M}{\mu w_P} = \frac{1-\alpha}{\mu} L\Big[1 + Ks^{\kappa^h}\Big],$$

which is strictly increasing in s. Since part (ii) showed $ds/d\mu_M > 0$, it follows that L_P^M is strictly increasing in μ_M. Define the agriculture share of production employment as

$$\lambda_A \equiv \frac{L_P^A}{L_P^A + L_P^M}.$$

Since L_P^A falls and L_P^M rises with μ_M, λ_A is strictly decreasing in μ_M. This proves (iv).
Part (v). Higher output per worker. Using aggregate non-agriculture production block:

$$Y_r^M = A_r^M L_{P,r}^M, \qquad A_r^M \equiv \Big(\int_{\Omega_r} a_{jr}^{\varepsilon-1} dj\Big)^{\frac{1}{\varepsilon-1}} = N_r^{\frac{1}{\varepsilon-1}} \tilde{a}_r, \qquad \tilde{a}_r \equiv \Big(\mathbb{E}_{G_r}[a^{\varepsilon-1}]\Big)^{\frac{1}{\varepsilon-1}}.$$

Hence non-agricultural output per production worker (labor productivity in M) is simply

$$\frac{Y_r^M}{L_{P,r}^M} = A_r^M.$$

It is enough to show A_r^M rises with μ_M:

$$\frac{d\ln A_r^M}{d\mu_M} = \frac{1}{\varepsilon-1}\frac{d\ln N_r}{d\mu_M} + \frac{d\ln \tilde{a}_r}{d\mu_M}.$$

(i) N_r rises in μ_M. If Ω_r's measure equals total product lines in the region, then N_r is proportional to average scope among operating firms. By Proposition 1(iii), average scope rises with μ_M, hence N_r rises with μ_M and $d\ln N_r/d\mu_M > 0$.
(ii) $\tilde{a}_r$ rises in μ_M. Here each product line j has

$$a_{jr} = \varphi_{jr} e_{jr}^{\zeta}, \qquad \Rightarrow \qquad a_{jr}^{\varepsilon-1} = \varphi_{jr}^{\varepsilon-1} e_{jr}^{\sigma}, \quad \sigma \equiv \zeta(\varepsilon-1) \in (0,1).$$

Thus the line-level productivity moment entering the CES aggregator is

$$\int_{\Omega_r} a_{jr}^{\varepsilon-1} dj = \int_{\Omega_r} \varphi_{jr}^{\varepsilon-1} e_{jr}^{\sigma} dj.$$

Since $A_r^M = \Big(\int_{\Omega_r} a_{jr}^{\varepsilon-1} dj\Big)^{\frac{1}{\varepsilon-1}}$ and $A_r^M = N_r^{\frac{1}{\varepsilon-1}} \tilde{a}_r$ with

$$\tilde{a}_r \equiv \Big(\mathbb{E}_{G_r}[a^{\varepsilon-1}]\Big)^{\frac{1}{\varepsilon-1}} = \Big(\mathbb{E}_{G_r}[\varphi^{\varepsilon-1} e^{\sigma}]\Big)^{\frac{1}{\varepsilon-1}},$$

it is enough to show that the line-level moment $\mathbb{E}_{G_r}[\varphi^{\varepsilon-1}e^{\sigma}]$ rises with μ_M. Under delegation, the optimal effective services per line are

$$e^*(\varphi, w_M) = \left(\frac{\sigma\alpha A\varphi^{\varepsilon-1}}{w_M}\right)^{\frac{1}{1-\sigma}}, \qquad \frac{\partial e^*(\varphi, w_M)}{\partial w_M} < 0.$$

From Lemma 3, $dw_M/d\mu_M < 0$, so

$$\frac{d}{d\mu_M} e^*(\varphi, w_M(\mu_M)) > 0.$$

Since $\varphi^{\varepsilon-1} > 0$ and $\sigma \in (0,1)$, the map $e \mapsto \varphi^{\varepsilon-1}e^{\sigma}$ is strictly increasing,

$$\frac{d}{d\mu_M}\left(\varphi^{\varepsilon-1}\left(e^*(\varphi, w_M(\mu_M))\right)^{\sigma}\right) > 0.$$

$\mathbb{E}_{G_r}[\varphi^{\varepsilon-1}e^{\sigma}]$ increases with μ_M, which implies $\tilde{a}_r = \left(\mathbb{E}_{G_r}[a^{\varepsilon-1}]\right)^{1/(\varepsilon-1)}$ strictly increases:

$$\frac{d\ln \tilde{a}_r}{d\mu_M} > 0.$$

Combining (i) and (ii) yields $dA_r^M/d\mu_M > 0$, hence

$$\frac{d}{d\mu_M}\left(\frac{Y_r^M}{L_{P,r}^M}\right) = \frac{dA_r^M}{d\mu_M} > 0.$$

□