An Anatomy of Multinational Production: Evidence from Affiliate Labor Composition*

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Abstract

A multinational firm can use its ideas in every country where it operates, while other firms cannot. What carries these ideas to its foreign affiliates: goods shipped from the parent, or people from the home country? Surveys of Korean foreign affiliates, which record both channels, point to people. Expats, the Korean nationals employed at an affiliate, hold executive or managerial jobs in 79.5% of affiliate-years, whereas imports from the parent occur in 42.7%. Most affiliates have expats from their first year, and these expats stay as local management expands. Relative to local managers, expats are more common in richer and more distant host countries, and expat managers are more common in industries with greater management requirements. The pattern is consistent with expats handling communication between headquarters and the affiliate. We develop a multinational production model with knowledge hierarchies to quantify how much cross-border communication costs contribute to cross-country differences in output per worker.

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1 Introduction

A central property of ideas is that they are non-rival: using an idea in one location does not prevent its use elsewhere (Romer, 1990). Models of multinational production make a narrower assumption. A firm can use its ideas in every country where it operates, but other firms cannot, so ideas are embodied in the firm (Helpman, Melitz, and Yeaple, 2004; Ramondo and Rodríguez-Clare, 2013; Arkolakis, Ramondo, Rodríguez-Clare, and Yeaple, 2018).

Most of these models do not specify what inside the firm carries an idea across a border. One candidate is goods: the parent ships machines or intermediate inputs that embody the idea, and the affiliate can produce once it has them. The other is people: the parent sends managers who know how to use the idea, and the affiliate cannot produce without them. The answer matters for how ideas spread across countries and for what a government that wants foreign production should target: the entry of skilled people, or imports of inputs.

We study this question using surveys of Korean foreign affiliates, which record both channels for the same affiliates. For goods, the surveys record each affiliate's exports to and imports from its Korean parent and other Korean counterparties. For people, they record employment by nationality and occupation: Korean and local executives, managers, and field workers, where field workers are sales and production workers. We call the Korean nationals employed at an affiliate expats. The surveys also record sales, ownership, entry mode, and capital payments to the parent, which include dividends, interest, and other payments. We ask whether expats are the main channel and, if they are, how they contribute to productivity and output per worker abroad.

Our first contribution is to compare these two channels directly, and the evidence points to people. At least one expat executive or manager is present in 79.5% of affiliate-year observations, whereas imports from the parent are present in 42.7%. Trade and capital payments are less common and more concentrated among large affiliates, so this gap narrows with affiliate sales. Expats work mostly as executives and managers rather than as field workers. They are in place early and they stay: 80.8% of affiliates have expat executives or managers in their first year of operation, and when an affiliate adds local executives or managers, these expats remain in 89.7% of cases.

Our second contribution is to show where affiliates use more expats relative to local employees. We organize this analysis with a knowledge hierarchy (Garicano, 2000; Caliendo and Rossi-Hansberg, 2012), in which knowledge is the range of production problems a worker can solve and a worker passes any other problem up to the layer above. In this framework, the ratio of expat executives and managers to local managers is higher

when local managers know less or when passing a problem up to these expats takes more time. Across host countries, this ratio is higher in richer destinations and in more distant destinations. The distance pattern is consistent with expat staffing mitigating cross-border communication costs. Across industries, the ratio of expat managers to local managers is higher where management and administration requirements are greater, and the ratio of local managers to local field workers is higher where client and training requirements are greater. Together, these patterns are consistent with expats handling communication between headquarters and the affiliate.

We then develop a model to study what these staffing patterns imply for cross-country productivity differences. Because the evidence points to people, ideas in the model reach foreign affiliates through expats, not through imported goods. The model embeds a knowledge hierarchy in the multinational production framework of Alviarez, Cravino, and Ramondo (2023), who distinguish firm-embedded productivity, which moves with the firm across countries, from productivity tied to the host country, using multinational firms' cross-country market shares. Higher communication costs between expats and local workers raise the ratio of expats to local workers and lower firm-embedded productivity abroad. We will use the model to quantify how much cross-border differences in communication costs contribute to cross-country differences in aggregate firm-embedded productivity and output per worker.

Literature. The paper contributes to three literatures. First, research on ownership and intra-firm trade shows that common ownership need not entail large internal shipments (Atalay, Hortaçsu, and Syverson, 2014; Ramondo, Rappoport, and Ruhl, 2016). We compare expats directly with trade and capital payments for the same affiliates. Closest to this comparison, Debaere, Lee, and Lee (2013) show that affiliates of Korean firms source more within the firm as the share of Korean employees rises. Coethnic business networks can also facilitate cross-border information and contracting (Rauch and Trindade, 2002); our data allow us to observe the corresponding link inside the affiliate rather than only an aggregate network.

Second, it builds on the knowledge-hierarchy, management, and delegation literature (Garicano, 2000; Garicano and Rossi-Hansberg, 2006; Caliendo and Rossi-Hansberg, 2012; Bloom and Van Reenen, 2007; Bloom, Sadun, and Van Reenen, 2012; Chen and Suen, 2019). We use observed employment by nationality and occupation to study delegation and the composition of employment inside multinational affiliates. Third, more broadly, the paper relates to models of multinational production and firm-embedded productivity (Helpman, Melitz, and Yeaple, 2004; Ramondo and Rodríguez-Clare, 2013; Tintelnot, 2017; Arkolakis, Ramondo, Rodríguez-Clare, and Yeaple, 2018). We add evidence on what carries a firm's

ideas to its foreign affiliates, and we separate expat executives and managers from local managers and field workers.

Existing work infers productivity differences from aggregate multinational activity (Burstein and Monge-Naranjo, 2009) and market shares (Alviarez, Cravino, and Ramondo, 2023). These approaches do not directly show what carries a firm's ideas to its affiliates. For our analysis, the closest benchmark is the latter study. We bring their distinction between firm-embedded and country-embedded productivity inside the foreign affiliate, where staffing ratios separate expat executives and managers from local managers and field workers. The country and industry analyses then examine how these ratios vary with host-country characteristics and task requirements. The planned quantitative analysis will combine these staffing data with estimates of aggregate firm-embedded productivity from multinational market shares. The paper also extends Cho (2018), who documents parent-manager transfers and their association with affiliate productivity, by distinguishing expat executives, expat managers, local managers, and local field workers, and by showing how staffing varies across host countries and industries.

The theoretical benchmark is Antràs, Garicano, and Rossi-Hansberg (2008), who model how local middle managers shield source-country managers from routine problems when cross-border communication is costly. Field workers, local managers, and expat executives and managers form the same kind of hierarchy, in which a problem moves up until someone can solve it. Whereas they model offshoring at the country level, we observe staffing by nationality and occupation within individual foreign affiliates. Gumpert (2018) studies how cross-border communication costs affect where multinational firms acquire knowledge and, through that organization, foreign-plant sales. We complement this work by showing who works at each level inside the affiliate. Guillouët, Khandelwal, Macchiavello, Malhotra, and Teachout (2026) show that language barriers impede interaction between foreign and domestic managers and the transfer of management knowledge. We document how affiliates staff the positions through which such transfers can take place.

Our empirical benchmark is Caliendo, Monte, and Rossi-Hansberg (2015), who show, for French firms, that occupation-based layers are economically meaningful: firms with more layers are larger, and layer additions and drops are systematically associated with expansion and contraction. We bring this approach to foreign affiliates, where nationality separates expat executives and managers from local managers and field workers. We document when each layer is present, how long it stays, how large it is relative to other layers, and how these patterns relate to sales growth and vary across host countries and industries.

The remainder of the paper proceeds as follows. Section 2 describes the data and the

groups of employees we study. Section 3 compares expats with imports and other links to the origin country, Korea, and documents which jobs expats hold and how long they stay. Section 4 measures staffing ratios and examines how they vary across host countries and industries. Section 5 presents the model and its counterfactual. Section 6 explains how we will quantify the model. Section 7 concludes.

2 Data

This section explains the key dataset used in the analysis: Korean foreign affiliate surveys. See Appendix A.1 for country, industry, and bilateral gravity variables.

2.1 Korean foreign affiliate surveys

We use the Benchmark Survey of Korean Multinational Affiliates Abroad conducted by the Export-Import Bank of Korea from 2006 through 2011. It records sales, ownership, entry mode, industry, host country, intra-firm transactions, and employment by worker nationality and occupational layer. The survey does not record wages or hours.

The survey covers non-financial foreign affiliates with accumulated Korean investment above one million U.S. dollars. The survey captures a meaningful share of Korean multinational activity, although the investment threshold tilts the sample toward larger affiliates. It covers 11.0% of non-financial Korean foreign affiliates and 69.3% of their accumulated outward-investment balance at the end of 2010 (Export-Import Bank of Korea, 2011). We exclude affiliate-years that do not report strictly positive affiliate sales.[1] Table 1 reports summary statistics for the leading host countries in 2010. China is the largest host, followed by the United States, Vietnam, Japan, and Indonesia. For more details, see Appendix B.1.

The unit of observation is an affiliate-year, indexed by a, t. Each affiliate belongs to Korean parent $p(a)$, operates in host country $c(a)$, and is assigned affiliate industry $j(a)$. We classify affiliate industries at the three-digit level of the Korean Standard Industrial Classification (KSIC). We use this classification to construct host-country-industry-year fixed effects and industry task measures.

Employee groups and notation The survey reports employment for six groups of employees: Korean and local executives, managers, and field workers. We use K and L for Korean and local employees and B, M, S, and P for executives, managers, sales workers

[1] Among the 20,595 affiliate-years with the required labor records during 2006–11, 3,537 (17.2%) do not meet this requirement. The analysis sample therefore contains 17,058 affiliate-years.

Table 1: Major host countries, 2010

Host country	Parents	Affiliates	Sales ($ million)	Employment	Korean employment share (%)
China	969	1,317	131,400	531,449	1.9
United States	365	415	73,025	33,611	7.6
Vietnam	219	258	6,891	263,176	0.9
Japan	108	123	22,953	7,290	7.3
Indonesia	91	112	12,151	134,837	0.5
All hosts	1,729	3,182	478,811	1,279,308	1.7

Notes: The table reports the five largest host countries by affiliate count in the 2010 sample. Korean employment share is Korean employment divided by total employment. The all-host parent count counts each Korean parent once, including parents operating in multiple hosts.

(wholesale and retail), and production workers (manufacturing), respectively. Field workers are the sum of sales and production workers, $N = S + P$. We write KB, KM, and LM for Korean executives, Korean managers, and local managers, and from here on N denotes local field workers. We report all six groups in the descriptive analysis.[2]

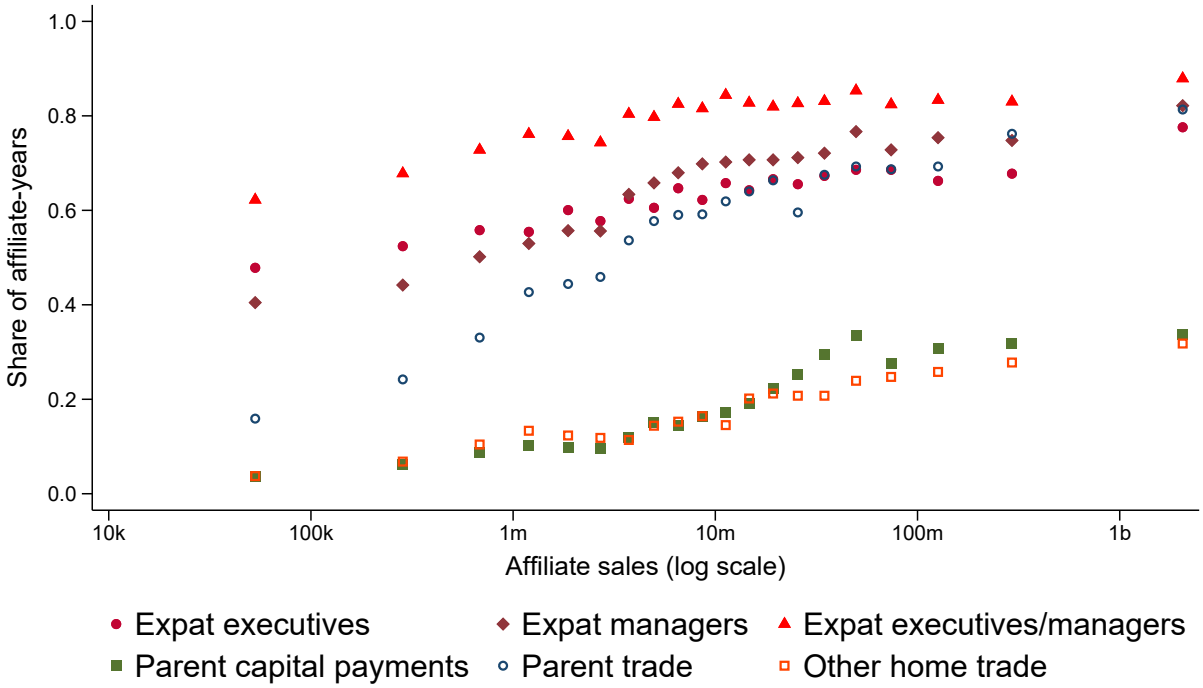
The 2006–11 period is a particularly informative window for observing Korean human-capital flows within multinational enterprises. Under Korea's Nationality Act, voluntarily acquiring a foreign nationality generally entails loss of Korean nationality. The reform effective in 2011 expanded eligibility for multiple nationality in specified cases.[3] The survey therefore distinguishes Korean nationals from foreign nationals of Korean ancestry, although nationality alone does not distinguish personnel transferred from Korea from Korean nationals hired locally. Against this institutional background, we call the survey's Korean national employees expats.

Entry timing and operating age We define affiliate entry using the reported operating-start year. When the operating-start record is missing or internally inconsistent, we use the establishment year as a fallback. Operating age is the number of years since this entry date. When we investigate entries, we exclude records classified as entry if the same affiliate has an earlier positive-sales observation.

[2]Employment can be zero in any of the six groups. For example, an affiliate can employ executives but no managers, or managers but no field workers.

[3]Our results are robust to excluding 2011.

Figure 1: Links to Korea by affiliate sales



Notes: Each point is the share of affiliate-years with the stated link within a sales bin. Transactions with parents are with Korean investors; other home transactions are with other Korean counterparties. An affiliate has a trade link when either exports or imports with the stated counterpart are positive. Capital payments include dividends, interest, and other payments. Sales are in U.S. dollars.

3 Facts on People and Goods in Foreign Affiliates

This section establishes three facts about how Korean foreign affiliates are linked to Korea and how they are staffed.

3.1 Affiliates have expats more often than they import from the parent

A foreign affiliate can be linked to Korea through people, goods, or capital payments. We start with people and goods. At least one expat executive or manager is present in 79.5% of affiliate-years and in 89.0% of sales-weighted affiliate-years. Imports from the direct parent (the Korean investor), by comparison, are present in 42.7% of affiliate-years and in 78.8% of sales-weighted affiliate-years. These unweighted shares imply that at least 36.8% of affiliate-years have expat executives or managers but no imports from the direct parent, and at most 20.5% have imports from the direct parent but no expat executives or managers. Figure 1 plots the share of affiliate-years with each link against affiliate sales.

Table 2: Employment by nationality and occupation

	Expat workers			Local workers		
	Executives	Managers	Field workers	Executives	Managers	Field workers
Panel A. All six employee groups						
Positive employment (%)	62.9	65.1	28.3	22.6	75.7	73.6
Median employment, when positive	1	3	3	2	17	118
Panel B. Two combined groups	Expat executives and managers $KB + KM$			Local managers and field workers $LM + N$		
Positive employment (%)	79.5			84.1		
Median employment, when positive	3			110		
Affiliate-years	17,058					

Notes: Panel A reports the six employee groups. Panel B combines expat executives and managers and, separately, local managers and field workers. Median employment is calculated among affiliate-years with positive employment in the stated group.

Expat executives and expat managers are each common throughout the sales distribution. Together they are more common than trade with the parent at every sales level, and the gap is largest among small affiliates. Appendix Table B.2 reports the corresponding unweighted and sales-weighted shares.

Other links are less common. Capital payments and exports to the direct parent are present in 18.8% and 36.5% of affiliate-years, respectively; their sales-weighted shares are 31.6% and 48.4%. Exports to and imports from other Korean counterparties are present in only 8.5% and 13.1% of affiliate-years, respectively, and in 16.1% and 26.8% of sales-weighted affiliate-years. The gap between unweighted and sales-weighted shares shows that these links are concentrated in large affiliates (Ramondo, Rappoport, and Ruhl, 2016). This pattern complements the argument that common ownership facilitates transfers of intangible inputs even when intra-firm trade is limited (Atalay, Hortaçsu, and Syverson, 2014).

3.2 Expats are mostly executives and managers

Expats work mostly as executives and managers, not as a broad foreign workforce. Table 2 reports the six employee groups in Panel A and two combined groups in Panel B. Expat executives and managers are present in 62.9% and 65.1% of affiliate-years, whereas expat field workers are present in only 28.3%. Local executives are present in 22.6% of affiliate-years, while local managers and local field workers are present in 75.7% and

Table 3: Executives and managers at entry, and expat retention

Outcome	Observations	Share
First year of operation: entrants (1,085 affiliates)		
Expat and local executives or managers	1,085	64.2%
Expat executives or managers only	1,085	16.6%
Local executives or managers only	1,085	8.6%
Neither	1,085	10.6%
Retention when local executives or managers are added		
Expat executives remain	304	81.6%
Expat managers remain	357	80.4%
Expat executives or managers remain	416	89.7%

Notes: The retention rows use consecutive-year observations from 2006 through 2011 in which an affiliate employs local executives or managers after employing none in the previous year. Each row includes affiliates employing the stated expats in the initial year and reports the share still employing them in the following year. Both observations must have positive sales and complete labor records.

73.6%, respectively. Where a group is present, median local employment rises from two executives to 17 managers and 118 field workers; the corresponding medians for expats are one, three, and three. Expat executives and managers are already in place in an affiliate's first year of operation. Among 1,085 affiliates observed in their first year, 80.8% employ expat executives or managers: 64.2% also employ local executives or managers, and 16.6% do not.

Expat employment is therefore concentrated among executives and managers, whereas local employees supply both local management and most field work. Because expat field workers and local executives are much less common, the rest of the analysis focuses on four layers: expat executives, expat managers, local managers, and local field workers. We call the set of these layers with positive employment an affiliate's layer composition.

3.3 Expat executives and managers stay as local management expands

Affiliates rarely lose their expat executives and managers. Among affiliates employing them, 7.7% no longer do so in the following year (655 of 8,477 consecutive-year observations). When an affiliate adds local executives or managers, these expats remain in 89.7% of 416 observations (Table 3). The remaining transition analyses focus on affiliates that keep expat executives or managers into the following year.

We consider two kinds of change: changes in the set of layers with positive employment, and changes in employment within those layers. Both connect our analysis to the

literature on production hierarchies, in which the set of layers changes as firms grow and reorganize (Garicano, 2000; Caliendo and Rossi-Hansberg, 2012; Caliendo, Monte, and Rossi-Hansberg, 2015; Gumpert, Steimer, and Antoni, 2022).[4] Among affiliates that add exactly one layer, the move from one to two layers is rare (22 cases) and additions are mixed. In the move from two to three layers, local managers and local field workers account for 40.6% and 28.9% of additions, respectively. In the move from three to four layers, expat executives and managers account for 37.4% and 32.9% of additions. Thus, local layers are most often added when an affiliate has two layers, and the missing expat layer when it has three.

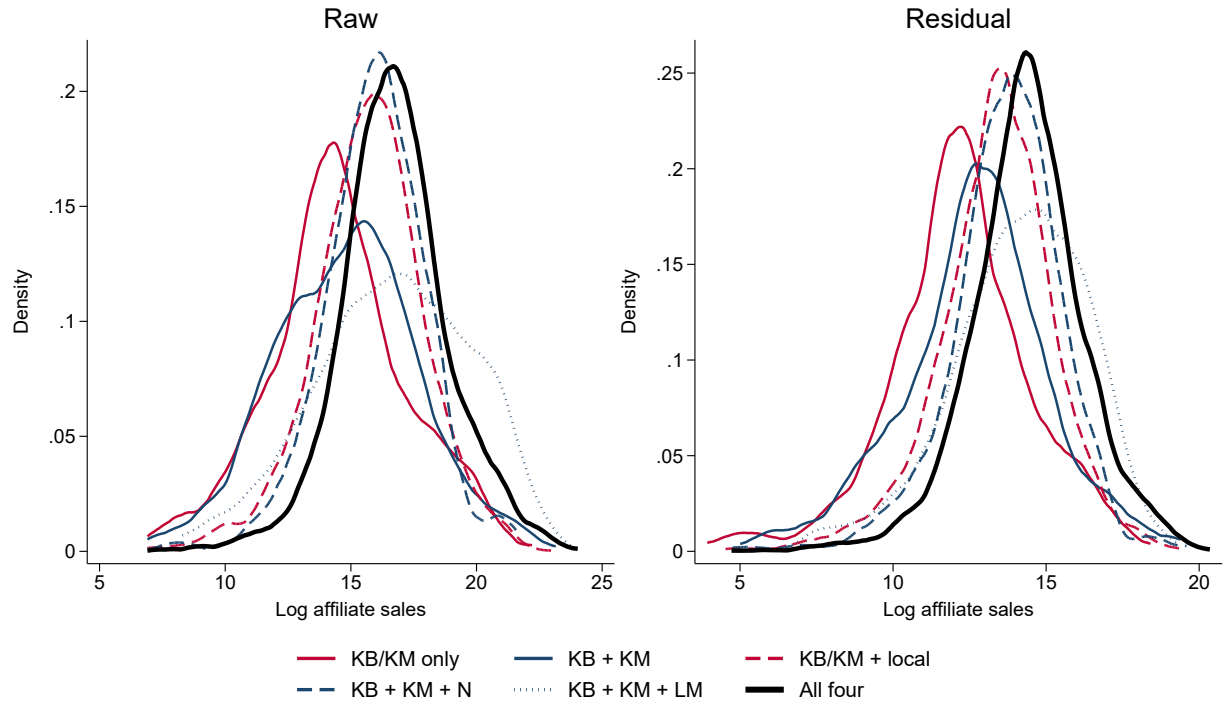
The four layers allow twelve layer compositions with at least one expat executive or manager. We group them into six: expat executives or expat managers, but not both, and no local employees; both expat layers and no local employees; one expat layer with local employees; both expat layers with local field workers; both expat layers with local managers; and all four layers. Figure 2 shows that, among affiliates with expat executives or managers, sales are higher in compositions with more layers. Compositions with one expat layer and no local employees have the lowest sales. Compositions that include local managers or field workers have sales distributions shifted to the right. Affiliates with all four layers have the highest mean log sales.

Figure 3 relates changes in layers and employment to sales growth. Residual sales growth is sales growth after removing initial log sales, three-digit-industry fixed effects, and country-year fixed effects. Panel A reports residual sales growth for each move between layer compositions. Moves toward all four layers generally show higher residual sales growth: affiliates moving from one expat layer with local employees to all four layers have mean residual growth of 0.068, compared with -0.086 for those that remain with one expat layer and local employees. Panel B shows whether employment within layers that remain in place increases, remains unchanged, or decreases with residual sales growth.

To summarize, expat executives and managers persist from year to year. Employment responds differently to sales across the four layers: expat executive employment responds only weakly to affiliate sales, whereas expat manager, local manager, and local field worker employment rise progressively more strongly with sales. The evidence therefore suggests that expat executives are closer to a fixed requirement that recurs each year.

[4]Appendix Table C.1 gives the full matrix of transitions between layer compositions. Appendix Table B.3 reports regressions of whether a layer has positive employment, and of log employment where it does, on affiliate sales and operating age. Operating age has no systematic association with either outcome, whereas affiliate sales are positively associated with both. We therefore organize the evidence below around affiliate sales.

Figure 2: Sales across layer compositions



Notes: The left panel plots raw densities of log affiliate sales. The right panel removes three-digit-industry and country-year effects from log sales. KB/KM only denotes expat executives or expat managers, but not both, and no local employees. KB/KM + local denotes expat executives or expat managers, but not both, with local employees. KB, KM, LM, and N denote expat executives, expat managers, local managers, and local field workers.

4 Where Affiliates Use More Expats

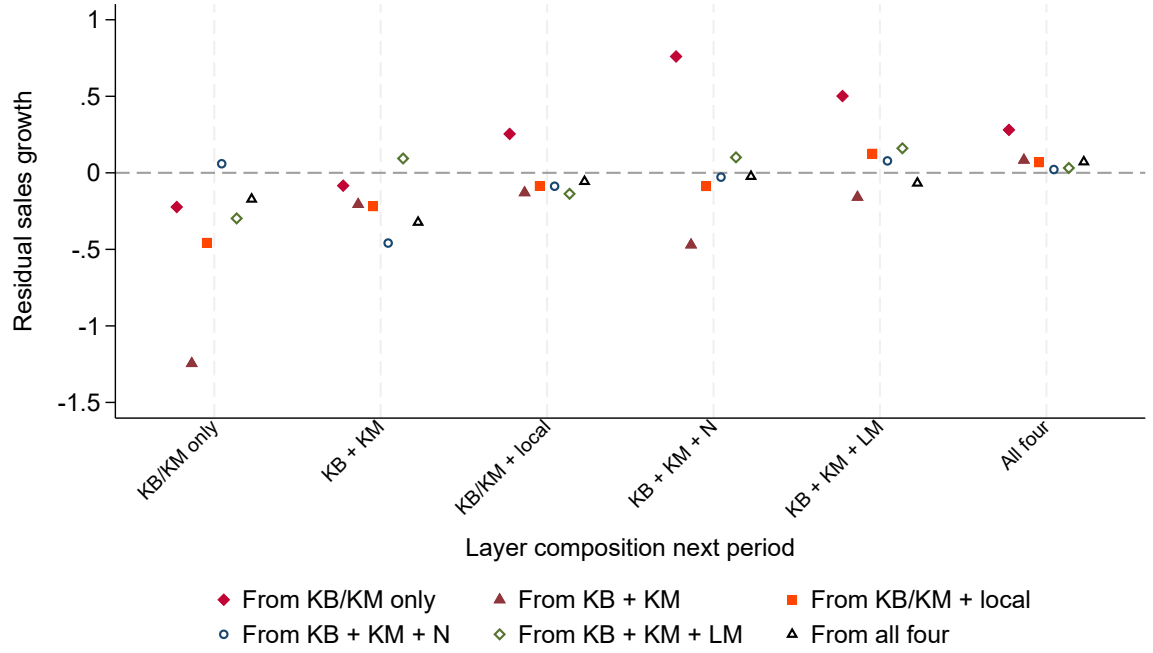
The previous section documents three facts. First, affiliates have expat executives or managers more often than they import from the parent. Second, expats are concentrated in executive and manager jobs rather than field work. Third, these expats typically stay as local management expands.

We now study where affiliates use more expats relative to local employees. A knowledge hierarchy links expat and local staffing to knowledge and the costs of solving production problems. These relationships guide the staffing ratios we measure and help us understand how the ratios vary across host countries and industries.

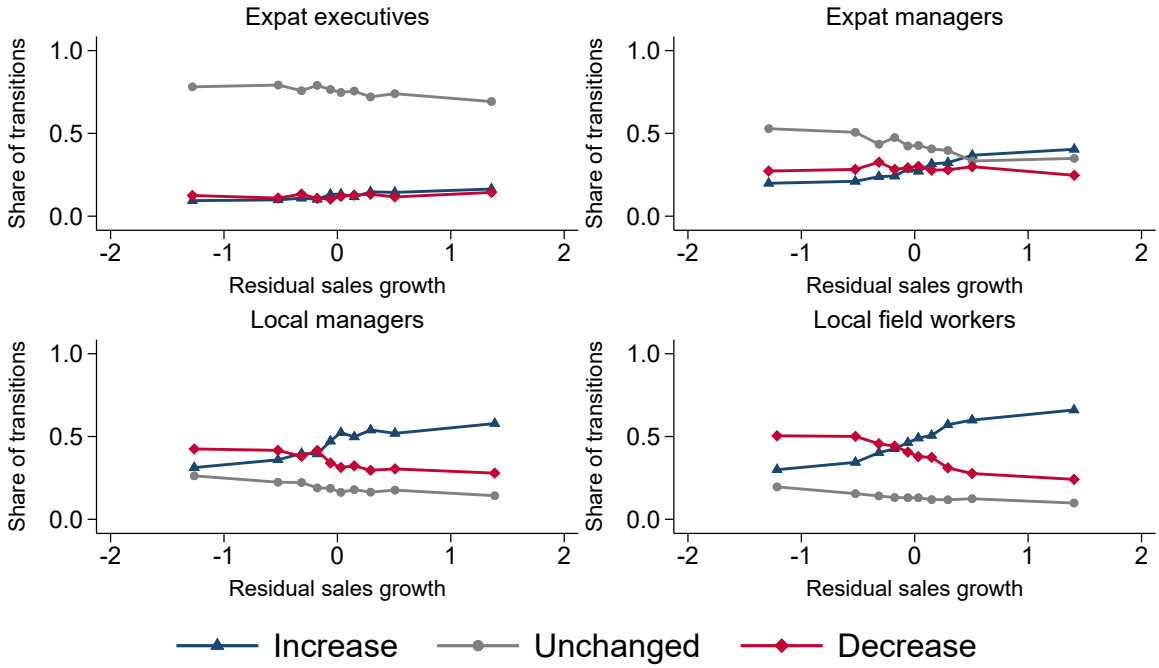
Our main hypothesis is that expats are more likely than local employees to handle communication with headquarters (HQ), control, problem solving, monitoring, and coordination across production stages.

Figure 3: Sales growth and changes in layers

Panel A. Layer-composition transitions



Panel B. Changes in employment within layers



Notes: Panel A reports residual sales growth for each transition between layer compositions. Panel B reports the shares of employment increases, no changes, and decreases within sales-growth bins, conditional on the stated layer having positive employment in both years. Sales growth is residualized on initial log sales, three-digit-industry fixed effects, and country-year fixed effects.

4.1 A knowledge hierarchy

We first link staffing ratios to communication costs and local knowledge. We use Caliendo and Rossi-Hansberg (2012) as an organizing benchmark. A firm with worker layer 0 and highest managerial layer L converts worker time n_L^0 into output according to:

$$q = \varphi \left(1 - e^{-\lambda \Psi_L^L}\right) n_L^0, \qquad \Psi_L^\ell = \sum_{r=0}^{\ell} \psi_L^r,$$

where ψ_L^ℓ is the knowledge held at layer ℓ, that is, the range of production problems that layer can solve. Here, $\varphi > 0$ is production efficiency, $\lambda > 0$ is the rate parameter of the exponential distribution of problem difficulty, and $h > 0$ is the managerial time required per referred problem. Communication constraints imply

$$n_L^\ell = n_L^0 h e^{-\lambda \Psi_L^{\ell-1}}, \qquad L \geq \ell > 0.$$

These communication constraints motivate the staffing ratios below. Let $K^H = KB + KM$ denote expat executives and managers and $L^O = LM + N$ denote local managers and field workers. We measure staffing with four sets of log ratios, from coarsest to most detailed, shown in Table 4. Our main decomposition, in Panel C of the table, splits local employees into managers and field workers: $\ln(K^H/N) = \ln(K^H/LM) + \ln(LM/N)$. We call the left-hand side the expat-to-field-worker ratio, the first term on the right the expat-to-local-manager ratio, and the second term the local-manager-to-field-worker ratio. This decomposition is defined when $K^H > 0$, $LM > 0$, and $N > 0$. When K^H and N are positive but $LM = 0$, the expat-to-field-worker ratio is observed but cannot be split into the two terms. When $K^H = 0$ or $N = 0$, that ratio is itself undefined. Appendix Table B.4 reports how often each of these cases occurs.

Panels B and D also separate expat executives from expat managers. When all four layers are present, the expat-to-local-manager ratio is the sum of two terms, $\ln(K^H/LM) = \ln(K^H/KM) + \ln(KM/LM)$. The first term equals $\ln(1 + KB/KM)$ and rises with the number of expat executives per expat manager. The second term is the expat-manager-to-local-manager ratio. The comparative statics below apply to expat executives and managers as a whole.

For our main decomposition, we map the hierarchy into three groups: local field workers solve routine operating problems, local managers solve problems passed up by field workers, and expat executives and managers solve problems that local employees cannot solve. In the notation above, let $n^0 = N$, $n^1 = LM$, and $n^2 = K^H = KB + KM$.

Table 4: Staffing ratios

Panel	Ratio	Decomposition
A. Two groups	$\ln(K^H/L^O)$	Expat executives and managers relative to local managers and field workers
B. Split expats	$\ln(K^H/L^O)$	$\ln(K^H/L^O) = \ln(K^H/KM) + \ln(KM/L^O)$
C. Split local employees	$\ln(K^H/N)$	$\ln(K^H/N) = \ln(K^H/LM) + \ln(LM/N)$
D. Split both	$\ln(K^H/N)$	$\ln(K^H/N) =$ $\ln(K^H/KM) + \ln(KM/LM) + \ln(LM/N)$

Notes: Each panel uses affiliate-years with positive employment in its stated layers. Panel C is our main decomposition; Panels B and D also separate expat executives from expat managers.

Let h_M denote the time a local manager needs to address a problem passed up by a field worker, and let h_K denote the time expat executives and managers need to address a problem passed up from local managers. Let ψ_N and ψ_{LM} denote the knowledge of field workers and local managers. The hierarchy conditions imply $LM = h_M N e^{-\lambda\psi_N}$, $K^H = h_K N e^{-\lambda(\psi_N+\psi_{LM})}$. The observed staffing ratios therefore have a direct interpretation in the hierarchy:

$$\ln\left(\frac{K^H}{LM}\right) = \ln\left(\frac{h_K}{h_M}\right) - \lambda\psi_{LM},$$
$$\ln\left(\frac{LM}{N}\right) = \ln h_M - \lambda\psi_N.$$

Thus, the expat-to-local-manager ratio is higher when expat executives and managers need more time per problem relative to local managers, or when local managers know less.

The ratio in Panel A, which we call the expat-to-local ratio, is a coarser, two-layer version of the same logic. Let h_B denote the time expat executives and managers need to address a problem that local managers and field workers cannot solve, and let ψ_L denote the knowledge of these local employees. The two-layer hierarchy implies $K^H = h_B L^O e^{-\lambda\psi_L}$ and

$$\ln\left(\frac{K^H}{L^O}\right) = \ln h_B - \lambda\psi_L.$$

The hierarchy yields direct comparative statics.

Proposition. *(Communication costs and staffing). Holding local knowledge and the time local managers need per problem fixed, a higher time cost for expat executives and managers raises the*

ratio of these expats to local employees in both versions of the hierarchy:

$$\frac{\partial \ln \left(K^H/L^O\right)}{\partial \ln h_B} = 1,$$

and, in the three-layer version,

$$\frac{\partial \ln(K^H/LM)}{\partial \ln h_K} = \frac{\partial \ln(K^H/N)}{\partial \ln h_K} = 1,$$
$$\frac{\partial \ln(LM/N)}{\partial \ln h_K} = 0.$$

Proof. For the two-layer version, $\ln \left(K^H/L^O\right) = \ln h_B - \lambda \psi_L$, so holding ψ_L fixed gives $\partial \ln \left(K^H/L^O\right) / \partial \ln h_B = 1$. The hierarchy identities imply $\ln(K^H/LM) = \ln h_K - \ln h_M - \lambda \psi_{LM}$, $\ln(LM/N) = \ln h_M - \lambda \psi_N$, and therefore $\ln(K^H/N) = \ln h_K - \lambda(\psi_{LM} + \psi_N)$. Holding h_M, ψ_N, and ψ_{LM} fixed, differentiation with respect to $\ln h_K$ gives the three expressions. □

This framework can be interpreted more broadly. Expat executives and managers can reduce communication and coordination costs between HQ and the affiliate (Gumpert, 2018); transmit specialized knowledge and solve non-routine problems (Garicano, 2000; Caliendo and Rossi-Hansberg, 2012); monitor local operations (Calvo and Wellisz, 1978; Chen, 2017); and organize decision making across hierarchical levels (Chen and Suen, 2019). They may also provide complementary high-skill inputs in production (Kremer, 1993).

4.2 Geography and staffing ratios

We next examine how these staffing ratios vary across host countries among operating affiliates. For each log ratio r^s_{at}, with s indexing the ratios, we estimate:

$$r^s_{at} = \alpha_{p(a)t} + \alpha_{j(a)t} + \beta^s G_{c(a)t} + \varepsilon^s_{at},$$

where $\alpha_{p(a)t}$ and $\alpha_{j(a)t}$ are Korean-parent-year and three-digit-industry-year fixed effects and G includes log Gross Domestic Product (GDP) per capita, log population, log distance from Korea, an indicator for Korea's historical link with Japan, and Regional Trade Agreement (RTA) status. Standard errors are clustered by host country. Table 5 reports the results for the same four panels.

Table 5: Geography and staffing ratios

	A. Two groups	B. Split expats		C. Split local employees			D. Split both		
	$\ln \frac{K^H}{L^O}$	$\ln \frac{K^H}{KM}$	$\ln \frac{KM}{L^O}$	$\ln \frac{K^H}{N}$	$\ln \frac{K^H}{LM}$	$\ln \frac{LM}{N}$	$\ln \frac{K^H}{KM}$	$\ln \frac{KM}{LM}$	$\ln \frac{LM}{N}$
ln GDP per capita	0.338***	−0.004	0.350***	0.332***	0.228***	0.103**	−0.012	0.315***	0.036
	(0.037)	(0.010)	(0.045)	(0.042)	(0.039)	(0.048)	(0.012)	(0.061)	(0.067)
ln Population	0.023	−0.002	0.024	0.036	0.018	0.018	−0.004	0.048	−0.021
	(0.024)	(0.006)	(0.018)	(0.025)	(0.024)	(0.022)	(0.008)	(0.033)	(0.029)
ln Distance	0.060*	0.014	−0.027	0.052	0.086***	−0.035	0.017	0.017	−0.036
	(0.035)	(0.010)	(0.038)	(0.034)	(0.029)	(0.034)	(0.011)	(0.047)	(0.057)
Japan historical link	0.613***	0.035	0.504**	0.510***	0.550***	−0.040	0.118**	0.537**	−0.136
	(0.109)	(0.036)	(0.196)	(0.101)	(0.097)	(0.074)	(0.046)	(0.223)	(0.140)
RTA status	0.078	−0.032	0.151	0.141	−0.115*	0.256**	−0.043	−0.017	0.237**
	(0.106)	(0.031)	(0.117)	(0.134)	(0.059)	(0.119)	(0.036)	(0.106)	(0.104)
Observations	5,549	2,870	2,870	4,172	4,172	4,172	2,258	2,258	2,258
R^2	0.71	0.64	0.72	0.69	0.66	0.70	0.64	0.69	0.73

Notes: All regressions include Korean-parent-year and three-digit-industry-year fixed effects. Samples differ because each ratio requires positive employment in its stated layers. Samples also exclude singletons within the fixed effects; with Korean-parent-year fixed effects, the estimates use parents with more than one affiliate in a year. The panels are defined in Table 4. Standard errors clustered by host country are reported in parentheses. Significance: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$.

Richer host countries have higher ratios of expats to local employees in Panels A and C. In Panel C, the coefficient on log GDP per capita is 0.332 for the expat-to-field-worker ratio and 0.228 for the expat-to-local-manager ratio. Panel D locates this pattern in the expat-manager-to-local-manager ratio: its coefficient on log GDP per capita is 0.315, whereas the corresponding coefficient on expat executives relative to expat managers is small and statistically insignificant. The pattern is consistent with relative labor costs: local employees are more expensive relative to expats in richer destinations. Population has no robust association with these ratios.

The distance pattern accords with the comparative statics above. In Panel C, a one-log-point increase in distance is associated with a 0.086 increase in the log expat-to-local-manager ratio, whereas the corresponding coefficient for the local-manager-to-field-worker ratio is negative and statistically indistinguishable from zero. Because communication between local managers and field workers does not cross the border, this ratio serves as a benchmark. The positive association with the expat-to-local-manager ratio is consistent with expat staffing mitigating cross-border communication costs. In Panel D, which requires all four layers and uses about half the sample, the distance coefficients are imprecisely estimated but keep the same signs.

Table 6: Industry tasks and staffing ratios

	A. Two groups	B. Split expats		C. Split local employees			D. Split both		
	$\ln \frac{K^H}{L^O}$	$\ln \frac{K^H}{KM}$	$\ln \frac{KM}{L^O}$	$\ln \frac{K^H}{N}$	$\ln \frac{K^H}{LM}$	$\ln \frac{LM}{N}$	$\ln \frac{K^H}{KM}$	$\ln \frac{KM}{LM}$	$\ln \frac{LM}{N}$
Management/administration	0.173*	0.034	0.244**	0.252**	0.122	0.129	0.034	0.223***	0.135
requirement	(0.096)	(0.021)	(0.105)	(0.117)	(0.085)	(0.079)	(0.028)	(0.083)	(0.114)
Client and training	0.247**	−0.023	0.217*	0.239*	0.001	0.238***	−0.021	−0.072	0.302**
requirement	(0.111)	(0.017)	(0.119)	(0.131)	(0.077)	(0.084)	(0.020)	(0.069)	(0.134)
Observations	6,308	3,453	3,453	4,818	4,818	4,818	2,738	2,738	2,738
R^2	0.68	0.61	0.71	0.66	0.60	0.67	0.63	0.63	0.70

Notes: All regressions include Korean-parent-year and host-country-year fixed effects. Both standardized task-requirement measures enter jointly. Samples differ across panels because each ratio requires positive employment in its stated layers. Samples also exclude singletons within the fixed effects; with Korean-parent-year fixed effects, the estimates use parents with more than one affiliate in a year. The panels are defined in Table 4. Standard errors clustered by three-digit industry are reported in parentheses. Significance: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$.

4.3 Industry tasks and staffing ratios

We next examine the same four panels of staffing ratios across industries. We construct two task-requirement measures for three-digit industries using the Korean Network for Occupations and Workers and job-placement weights from the Korea Employment Information Service. The first measures the occupation-specific requirement level in management and administration. The second combines standardized industry-level customer-service and education-and-training scores; Appendix A.1 describes the construction. We estimate:

$$r^s_{at} = \alpha_{p(a)t} + \alpha_{c(a)t} + \beta^s_M \tau^{\text{Manager}}_{j(a)} + \beta^s_C \tau^{\text{Client}}_{j(a)} + \varepsilon^s_{at}.$$

Here, $\alpha_{p(a)t}$ and $\alpha_{c(a)t}$ are Korean-parent-year and host-country-year fixed effects, and $\tau^{\text{Manager}}_{j(a)}$ and $\tau^{\text{Client}}_{j(a)}$ are the two task-requirement measures, which enter jointly. Standard errors are clustered by three-digit industry.

The two task measures are associated with different ratios in the hierarchy. Table 6 shows that management and administration requirements are associated with more expat managers relative to local managers: in Panel D, the coefficient is 0.223 for $\ln(KM/LM)$. Client and training requirements are positively associated with local-manager employment relative to local field-worker employment. The ratio $\ln(LM/N)$ rises by 0.238 in Panel C and by 0.302 in Panel D per standard deviation of the client and training requirement, while the coefficients on the two expat terms in Panel D are statistically insignificant. This pattern is consistent with local managers handling client-facing coordination and training.

5 A Model of Multinational Production with Expats and Knowledge Hierarchies

Section 3 shows that affiliates have expat executives and managers more often than they import from the parent. Section 4 shows staffing patterns consistent with expats handling communication between headquarters and the affiliate. We therefore develop a model of multinational production in which ideas reach foreign affiliates through people, not through imported goods. A knowledge hierarchy determines how expats affect aggregate firm-embedded productivity and output per worker. The upper layer of the model corresponds to expat managers in the data, and the lower layer corresponds to local managers and field workers. Expat executives enter through a fixed cost. The ratio of expat managers to local employees disciplines communication costs. The model then maps these costs and the resulting knowledge choices into firm-embedded productivity.

We build on the multinational production environment of Alviarez, Cravino, and Ramondo (2023), using a knowledge hierarchy following Caliendo and Rossi-Hansberg (2012) to explain the role of expats in technology transfer. Firms retain exogenous productivity heterogeneity, while bilateral communication costs shape their knowledge choices and the efficiency of foreign production.

5.1 Environment

Countries are indexed by i and n, and sectors by j. A firm originates in country i and may operate in multiple host countries n. Country i has a fixed supply E_i of upper-layer labor, used for managerial work, knowledge acquisition, and fixed executive requirements. Country n has an inelastic supply L_n of local operating labor. Firms choose knowledge and employment at each operating location and pay fixed costs to operate there. We suppress the sector index unless needed.

5.2 Households

Households own operating labor and managerial labor and consume a homogeneous internationally traded final good. Local operating labor in country n earns wage w_n. Upper-layer labor from origin i employed in destination n, including domestic employment, is E_{in} and earns wage v_{in}. We assume a destination labor supply system generated by logit destination choice, where $a_{in} > 0$ captures fixed destination attractiveness and $\eta > 0$

governs responsiveness to relative wages:

$$E_{in} = E_i \frac{a_{in} v_{in}^{\eta}}{\sum_m a_{im} v_{im}^{\eta}},$$

where $\sum_n E_{in} = E_i$.

A competitive final good producer combines non-traded sectoral composites according to:

$$Y_n = \prod_j \left(Y_n^j\right)^{\theta_n^j},$$

where $\theta_n^j > 0$ and $\sum_j \theta_n^j = 1$. Let P_n^j denote the price of the sector j composite in country n. We normalize the common final good price to one:

$$\prod_j \left(\frac{P_n^j}{\theta_n^j}\right)^{\theta_n^j} = 1.$$

Within each sector, a competitive producer aggregates the differentiated goods supplied by active firms:

$$Y_n^j = \left[\sum_i \int_{\Omega_{in}^j} \left(Q_{in}^j(\omega) Y_{in}^j(\omega)\right)^{\frac{\rho-1}{\rho}} d\omega\right]^{\frac{\rho}{\rho-1}},$$

where $\rho > 1$ is the elasticity of substitution across differentiated goods. Here, Ω_{in}^j is the set of firms from i operating in host n and sector j, and $Q_{in}^j(\omega)$ is product quality.

Households receive local labor income, the earnings of their origin-country upper-layer labor across destinations, and the net profits of firms headquartered in their country. All income is spent on the traded final good.

5.3 Production under a knowledge hierarchy

A firm ω from country i operating in country n employs l_{in} local workers and e_{in} origin-country managers. These managers are expats when $i \neq n$ and domestic managers when $i = n$. Let $\psi^0 \geq 0$ and $\psi^1 \geq 0$ denote knowledge acquired by the two layers, with cumulative knowledge $\Psi^1 = \psi^0 + \psi^1$. Firm and location subscripts are suppressed on employment and knowledge when no confusion arises.

Each local worker generates one production problem per unit of time. Problem difficulty

$x \geq 0$ has the following distribution:

$$F(x) = 1 - e^{-\lambda x},$$

where $\lambda > 0$. Local workers solve problems on $\left[0, \psi^0\right]$, and upper-layer managers solve referred problems on $\left(\psi^0, \Psi^1\right]$. The fraction referred to managers is $e^{-\lambda\psi^0}$. Each referral uses $h_{in} > 0$ units of managerial time, so

$$e_{in} = l_{in} h_{in} e^{-\lambda\psi^0}.$$

Bilateral communication costs h_{in} are common to firms within an origin-host-sector cell. Output is the number of problems solved by either layer, multiplied by the country productivity $Z_n > 0$ and firm productivity $\varphi(\omega) > 0$:

$$Y_{in}(\omega) = Z_n \varphi(\omega) \left(1 - e^{-\lambda\Psi^1}\right) l_{in}.$$

Then, the total production cost is:

$$C_{in} = w_n l_{in} \left(1 + c\psi^0\right) + v_{in} e_{in} \left(1 + c\psi^1\right) + \mathcal{F}_{in},$$

where $\mathcal{F}_{in} = w_n f \theta_n L_n + v_{in} f_{in}$. Here $c, f > 0$, $f_{in} \geq 0$, and $f_{nn} = 0$. Knowledge raises the cost of each worker: an employee with knowledge ψ requires $1 + c\psi$ efficiency units of the corresponding labor type. Each operating location requires $f\theta_n L_n$ units of local overhead labor. Foreign operations additionally require f_{in} units of origin-country executive labor; this additional requirement is zero for domestic operations.

Using the referral constraint, define:

$$\begin{aligned}
\ell_{in}^L &= l_{in} \left(1 + c\psi^0\right), \\
\ell_{in}^E &= e_{in} \left(1 + c\psi^1\right), \\
\Gamma_{in} &= 1 + c\psi^0 + \varpi_{in} h_{in} e^{-\lambda\psi^0} \left(1 + c\psi^1\right),
\end{aligned}$$

where $\varpi_{in} = v_{in}/w_n$. Then, variable cost equals $w_n l_{in} \Gamma_{in}$. From the production function, $l_{in} = Y_{in} / \left[Z_n \varphi(\omega) \left(1 - e^{-\lambda\Psi^1}\right)\right]$. Substituting l_{in} into the cost function gives:

$$C(Y_{in}) = \frac{w_n \Gamma_{in}}{Z_n \varphi(\omega) \left(1 - e^{-\lambda\Psi^1}\right)} Y_{in}(\omega) + \mathcal{F}_{in}.$$

The cost is linear in Y_{in}, so the marginal cost is constant. Since the fixed cost is independent of (ψ^0, ψ^1), the firm's problem reduces to minimizing unit variable cost:

$$\min_{\substack{\psi^0,\psi^1\geq 0\\ \psi^0+\psi^1>0}} \left\{\ln w_n + \ln \Gamma_{in} - \ln Z_n - \ln \varphi(\omega) - \ln\left(1 - e^{-\lambda\Psi^1}\right)\right\}.$$

Since w_n, Z_n, and $\varphi(\omega)$ are independent of (ψ^0, ψ^1), the cost-minimizing knowledge allocation is common to firms within the same origin-host-sector cell, regardless of their exogenous productivity draw. At an interior optimum, the knowledge choices satisfy:

$$\varpi_{in} h_{in} e^{-\lambda\psi^0} c = \frac{\lambda e^{-\lambda\Psi^1}}{1 - e^{-\lambda\Psi^1}} \Gamma_{in},$$
$$\varpi_{in} h_{in} e^{-\lambda\psi^0} \left(\lambda\left(1 + c\psi^1\right) + c\right) = c.$$

Define optimized hierarchy efficiency as:

$$g(h, \varpi) = \max_{\substack{\psi^0,\psi^1\geq 0\\ \psi^0+\psi^1>0}} \frac{1 - e^{-\lambda\left(\psi^0+\psi^1\right)}}{1 + c\psi^0 + \varpi h e^{-\lambda\psi^0}\left(1 + c\psi^1\right)}.$$

Write $g_{in} \equiv g(h_{in}, \varpi_{in})$ for simplicity. Optimized marginal cost and the manager-to-worker ratio are:

$$MC_{in}(\omega) = \frac{w_n}{Z_n X_{in}(\omega)},$$

where $X_{in}(\omega) = \varphi(\omega) g_{in}$ and

$$\frac{e_{in}}{l_{in}} = h_{in} e^{-\lambda\psi^{0*}} = \frac{c}{\varpi_{in}\left[\lambda\left(1 + c\psi^{1*}\right) + c\right]}.$$

A superscript $*$ denotes an optimal knowledge choice. The final equality for the staffing ratio applies at an interior optimum. At a boundary solution, staffing is determined directly by $e_{in}/l_{in} = h_{in} e^{-\lambda\psi^{0*}}$.

Firm-embedded productivity combines product quality and optimized production efficiency:

$$A_{in}(\omega) \equiv \left[Q_{in}(\omega) X_{in}(\omega)\right]^{\rho-1},$$
$$\phi_n = \sum_i \int_{\Omega_{in}} A_{in}(\omega) d\omega.$$

Define the technology transfer wedge by:

$$A_{in}(\omega) = A_{ii}(\omega) \exp\left(-\kappa_{in}(\omega)\right),$$

where $\kappa_{ii}(\omega) = 0$. Allowing product quality to differ across production locations, the technology transfer wedge is:

$$\kappa_{in}(\omega) = (\rho - 1)\left[\ln\left(\frac{Q_{ii}(\omega)}{Q_{in}(\omega)}\right) + \ln\left(\frac{g_{ii}}{g_{in}}\right)\right].$$

The exogenous production efficiency draw cancels, but quality differences can make the wedge firm-specific.

Let u_{in} denote the managerial share of variable labor payments at the optimum:

$$u_{in} = \frac{\varpi_{in} h_{in} e^{-\lambda\psi^{0*}}\left(1 + c\psi^{1*}\right)}{\Gamma_{in}^{*}}.$$

Then, we have the following proposition.

Proposition. *(Communication costs, knowledge allocation, and staffing ratio). Consider a foreign operation at an interior optimum, holding product quality, relative labor prices, and domestic efficiency fixed. With all terms evaluated at the optimum,*

$$\lambda\frac{\partial\psi^{1}}{\partial\ln h_{in}} = u_{in} - 1 < 0, \qquad \lambda\frac{\partial\psi^{0}}{\partial\ln h_{in}} = 1 + \frac{c}{\lambda\left(1 + c\psi^{1*}\right) + c}\left(u_{in} - 1\right) > 0.$$

Higher communication costs raise the manager-to-worker ratio and the technology transfer wedge:

$$\frac{\partial\ln\left(e_{in}/l_{in}\right)}{\partial\ln h_{in}} = \frac{c}{\lambda\left(1 + c\psi^{1*}\right) + c}\left(1 - u_{in}\right) > 0, \qquad \frac{\partial\kappa_{in}(\omega)}{\partial\ln h_{in}} = (\rho - 1)\, u_{in} > 0.$$

This ratio concerns variable staffing. Observed headcounts also include fixed executive and local overhead requirements, which do not depend on h_{in}. Knowledge choices depend on h_{in} and ϖ_{in} only through their product. A lower relative expat wage ϖ_{in} therefore also raises the manager-to-worker ratio: $\partial\ln\left(e_{in}/l_{in}\right)/\partial\ln\varpi_{in} = \frac{c}{\lambda(1+c\psi^{1*})+c}\left(1 - u_{in}\right) - 1 < 0$.

Proof. Log-differentiating $\varpi_{in} h_{in} e^{-\lambda\psi^{0}}\left(\lambda\left(1 + c\psi^{1*}\right) + c\right) = c$ gives:

$$\lambda\frac{\partial\psi^{0}}{\partial\ln h_{in}} = 1 + \left(\lambda\frac{c}{\lambda\left(1 + c\psi^{1*}\right) + c}\right)\frac{\partial\psi^{1}}{\partial\ln h_{in}}.$$

Differentiating the other first-order condition yields:

$$\lambda \frac{\partial \psi^1}{\partial \ln h_{in}} = u_{in} - 1.$$

The staffing result follows from $e_{in}/l_{in} = c/\left(\varpi_{in}\left(\lambda\left(1 + c\psi^{1*}\right) + c\right)\right)$, and the transfer-wedge result follows from the envelope theorem. □

Unlike the proposition in Section 4, which holds knowledge fixed, this proposition lets knowledge adjust: local workers learn more when communication costs rise, so the staffing response is smaller than one-for-one but keeps the same sign. Also, because local wages are higher in richer host countries, the relative-wage effect in the proposition is consistent with the higher ratio of expat managers to local managers there (Section 4.2).

5.4 Firm revenue and profit

Under Constant Elasticity of Substitution (CES) demand and monopolistic competition, the price is a constant markup over marginal cost:

$$P_{in}(\omega) = \frac{\rho}{\rho - 1} \frac{w_n}{Z_n X_{in}(\omega)}.$$

Aggregating across all firms operating in n, the CES price index is:

$$P_n = \left[\sum_i \int_{\omega \in \Omega_{in}} \left(\frac{P_{in}(\omega)}{Q_{in}(\omega)}\right)^{1-\rho} d\omega\right]^{\frac{1}{1-\rho}} = \frac{\rho}{\rho - 1} \frac{w_n}{Z_n} \phi_n^{-\frac{1}{\rho - 1}}.$$

The revenue share of firm ω in country n is:

$$S_{in}(\omega) = \frac{\left[Q_{in}(\omega)/P_{in}(\omega)\right]^{\rho-1}}{\sum_k \int_{\Omega_{kn}} \left[Q_{kn}(\widetilde{\omega})/P_{kn}(\widetilde{\omega})\right]^{\rho-1} d\widetilde{\omega}}.$$

The common markup and the destination-specific Z_n/w_n cancel out, yielding:

$$S_{in}(\omega) = \frac{A_{in}(\omega)}{\phi_n}.$$

Let R_n^j denote aggregate revenue in host country n and sector j. Operating profits before fixed costs are:

$$\pi_{in}^j(\omega) = \frac{S_{in}^j(\omega)R_n^j}{\rho} = \frac{R_n^j}{\rho}\frac{A_{in}^j(\omega)}{\phi_n^j}.$$

5.5 General equilibrium

We impose two assumptions to close the model. First, in each origin country i and sector j, there is an exogenous measure M_i^j of potential firms. The measure M_{in}^j operating in host n is endogenous and determined by the operating-profit cutoff. Second, for each origin-host-sector cell, the exogenous quality-adjusted productivity component has a Pareto distribution with common shape $\gamma > 1$ and cell-specific scale $B_{in}^j > 0$:

$$b_{in}^j(\omega) = \left[Q_{in}^j(\omega)\varphi^j(\omega)\right]^{\rho-1}, \qquad \Pr(b_{in}^j > b) = \left(\frac{B_{in}^j}{b}\right)^{\gamma}, \quad b \geq B_{in}^j.$$

Firm-embedded productivity is $A_{in}^j(\omega) = b_{in}^j(\omega)\left(g_{in}^j\right)^{\rho-1}$. The primitive production efficiency draw $\varphi^j(\omega)$ is common across the firm's production locations; the quality-adjusted productivity component $b_{in}^j(\omega)$ incorporates location-specific product quality.

Then, we can derive the entry cutoff. A firm operates when $b_{in}^j(\omega) \geq \bar{b}_{in}^j$, where:

$$\bar{b}_{in}^j = \frac{\rho \mathcal{F}_{in}^j \phi_n^j}{R_n^j\left(g_{in}^j\right)^{\rho-1}}.$$

With this cutoff, we derive aggregate outcomes. Maintaining $\bar{b}_{in}^j \geq B_{in}^j$ in the baseline and counterfactual equilibria, the mass of active firms and aggregate firm-embedded productivity satisfy:

$$\begin{aligned} M_{in}^j &= M_i^j\left(\frac{B_{in}^j}{\bar{b}_{in}^j}\right)^{\gamma}, \\ \phi_{in}^j &= \frac{\gamma}{\gamma-1}M_i^j\left(B_{in}^j\right)^{\gamma}\left(g_{in}^j\right)^{\rho-1}\left(\bar{b}_{in}^j\right)^{1-\gamma}, \end{aligned}$$

where $\phi_n^j = \sum_i \phi_{in}^j$. Substituting the entry cutoff gives:

$$\left(\phi_n^j\right)^{\gamma} = \frac{\gamma}{\gamma-1}\left(\frac{R_n^j}{\rho}\right)^{\gamma-1}\sum_i M_i^j\left(B_{in}^j\right)^{\gamma}\left(g_{in}^j\right)^{\gamma(\rho-1)}\left(\mathcal{F}_{in}^j\right)^{1-\gamma}.$$

Variable labor payments, fixed labor payments, and net profits are:

$$\frac{\rho-1}{\rho}R_n^j, \qquad \frac{\gamma-1}{\gamma\rho}R_n^j, \qquad \frac{1}{\gamma\rho}R_n^j,$$

respectively. The fixed-payment share follows from the Pareto distribution and the zero-profit operating cutoff. Let t_{in}^j denote the executive share of fixed payments:

$$t_{in}^j = \frac{v_{in}f_{in}^j}{\mathcal{F}_{in}^j}.$$

Within each origin-host-sector cell, total payments to each labor type, expressed as shares of total affiliate revenue, are the following, where the superscripts L and E distinguish these payment shares from the quality-adjusted productivity component $b_{in}^j(\omega)$:

$$b_{in}^{L,j} = \frac{\rho-1}{\rho}\left(1-u_{in}^j\right) + \frac{\gamma-1}{\gamma\rho}\left(1-t_{in}^j\right), \qquad b_{in}^{E,j} = \frac{\rho-1}{\rho}u_{in}^j + \frac{\gamma-1}{\gamma\rho}t_{in}^j.$$

With different labor prices, payment shares need not equal employment shares. Variable labor requirements in efficiency units are:

$$\ell_{in}^{L,j}(\omega) = \frac{\frac{\rho-1}{\rho}\left(1-u_{in}^j\right)R_n^j A_{in}^j(\omega)}{w_n\phi_n^j},$$
$$\ell_{in}^{E,j}(\omega) = \frac{\frac{\rho-1}{\rho}u_{in}^j R_n^j A_{in}^j(\omega)}{v_{in}\phi_n^j}.$$

Operating employment satisfies $l_{in} = \ell_{in}^L/\left(1+c\psi^{0*}\right)$ and $e_{in} = \ell_{in}^E/\left(1+c\psi^{1*}\right)$. Define $S_{in}^j = \phi_{in}^j/\phi_n^j$. Including fixed labor requirements, labor market clearing requires:

$$w_n L_n = \sum_{i,j} R_n^j S_{in}^j b_{in}^{L,j},$$
$$v_{in}E_{in} = \sum_j R_n^j S_{in}^j b_{in}^{E,j}.$$

With the final good price normalized to one, production revenues satisfy:

$$R_n = Y_n, \qquad R_n^j = \theta_n^j R_n.$$

Sectoral output and total labor used in host production satisfy:

$$Y_n^j = \frac{\rho-1}{\rho}\frac{R_n^j}{w_n}Z_n^j\left(\phi_n^j\right)^{1/(\rho-1)}, \qquad \mathcal{L}_n = L_n + \sum_i E_{in}.$$

Output per total worker is $Y_n/\mathcal{L}_n$, with labor measured in efficiency units, including fixed requirements.

Combining the sectoral price indices with the final good price normalization gives:

$$w_n = \frac{\rho-1}{\rho}\prod_j\left[\theta_n^j Z_n^j\left(\phi_n^j\right)^{1/(\rho-1)}\right]^{\theta_n^j}.$$

Household income and world final good market clearing therefore satisfy:

$$I_i = w_i L_i + \sum_n v_{in}E_{in} + \frac{1}{\gamma\rho}\sum_{n,j}R_n^j S_{in}^j,$$

where $\sum_i I_i = \sum_n Y_n$.

Equilibrium definition Given preferences, technologies, fixed labor requirements, potential firm masses $\left\{M_i^j\right\}$, and labor endowments $\{L_n, E_i\}$, an equilibrium is a collection $\left\{w_n, v_{in}, R_n^j, E_{in}, \psi_{in}^{0,j}, \psi_{in}^{1,j}, \bar{b}_{in}^j, \phi_n^j\right\}_{i,n,j}$ satisfying optimal knowledge choice and CES pricing, the entry and Pareto aggregation equations, the destination labor supply rule, and labor and final good market clearing.

Development accounting Following Alviarez, Cravino, and Ramondo (2023), we measure the contribution of aggregate firm-embedded productivity to cross-country differences in output per worker. The final-good price condition and $Y_n = R_n$ imply:

$$\ln\left(\frac{Y_n}{\mathcal{L}_n}\right) = \widetilde{\phi}_n + \widetilde{z}_n,$$

where n_0 denotes the reference country and

$$\widetilde{\phi}_n = \sum_j \frac{\theta_n^j}{\rho-1}\ln\left(\frac{\phi_n^j}{\phi_{n_0}^j}\right),$$

and

$$\widetilde{z}_n = \ln\left(\frac{\rho-1}{\rho}\right) + \sum_j \theta_n^j \ln\left[\theta_n^j Z_n^j \left(\phi_{n_0}^j\right)^{1/(\rho-1)}\right] + \ln\left(\frac{R_n}{w_n \mathcal{L}_n}\right).$$

The residual includes country productivity, sectoral composition, and relative-wage and employment-composition effects. Using equal weights across a fixed country sample, the accounting shares satisfy:

$$\frac{\mathrm{Cov}_n\left[\ln\left(Y_n/\mathcal{L}_n\right), \widetilde{\phi}_n\right]}{\mathrm{Var}_n\left[\ln\left(Y_n/\mathcal{L}_n\right)\right]} + \frac{\mathrm{Cov}_n\left[\ln\left(Y_n/\mathcal{L}_n\right), \widetilde{z}_n\right]}{\mathrm{Var}_n\left[\ln\left(Y_n/\mathcal{L}_n\right)\right]} = 1.$$

The first share captures all sources of firm-embedded productivity. The communication-cost experiment below measures the contribution of one of these sources: cross-border differences in communication costs operating through expats.

5.6 Communication-cost counterfactual

For a counterfactual, we use the exact hat algebra approach (Dekle, Eaton, and Kortum, 2008). Primes denote counterfactual values and hats denote counterfactual-to-baseline ratios. The experiment changes only the primitives specified below. To remove cross-border variation in communication costs explained by observable bilateral characteristics G_{in}, we project $\ln h_{in}^j$ on G_{in} and sector fixed effects across foreign operations, weighting by the number of active firms M_{in}^j, and denote the coefficients by β. For foreign operations, we set $\ln h_{in}^{j\prime} = \ln h_{in}^j - \left(G_{in} - \bar{G}^j\right)^\top \beta$, where $\bar{G}^j$ is the weighted mean of G_{in} in sector j. The projection residual is unchanged in the counterfactual.

For changes in hierarchy efficiency and fixed costs, define:

$$d_{in}^j = \left[\frac{g\left(h_{in}^{j\prime}, \varpi_{in}\widehat{v}_{in}/\widehat{w}_n\right)}{g(h_{in}^j, \varpi_{in})}\right]^{\rho-1}, \qquad t_{in}^{j\prime} = \frac{t_{in}^j \widehat{v}_{in}}{\widehat{\mathcal{F}}_{in}^j}, \qquad \widehat{\mathcal{F}}_{in}^j = \left(1 - t_{in}^j\right)\widehat{w}_n + t_{in}^j \widehat{v}_{in}.$$

Then, the counterfactual system is:

$$W_n^j = \sum_i S_{in}^j \left(d_{in}^j\right)^\gamma \left(\widehat{\mathcal{F}}_{in}^j\right)^{1-\gamma}, \quad \widehat{\phi}_n^j = \left[\left(\widehat{R}_n\right)^{\gamma-1} W_n^j\right]^{1/\gamma},$$
$$S_{in}^{j\prime} = \frac{S_{in}^j \left(d_{in}^j\right)^\gamma \left(\widehat{\mathcal{F}}_{in}^j\right)^{1-\gamma}}{W_n^j}, \qquad \widehat{M}_{in}^j = \left(\frac{\widehat{R}_n d_{in}^j}{\widehat{\mathcal{F}}_{in}^j \widehat{\phi}_n^j}\right)^\gamma,$$
$$\widehat{w}_n = \prod_j \left(\widehat{\phi}_n^j\right)^{\theta_n^j/(\rho-1)}, \qquad \widehat{Y}_n = \widehat{R}_n.$$

Wage changes also satisfy the labor market conditions in hats:

$$\widehat{w}_n = \frac{\sum_{i,j} R_n^j \widehat{R}_n S_{in}^{j\prime} b_{in}^{L,j\prime}}{\sum_{i,j} R_n^j S_{in}^j b_{in}^{L,j}},$$
$$\widehat{v}_{in}\widehat{E}_{in} = \frac{\sum_j R_n^j \widehat{R}_n S_{in}^{j\prime} b_{in}^{E,j\prime}}{\sum_j R_n^j S_{in}^j b_{in}^{E,j}},$$
$$\widehat{E}_{in} = \frac{\widehat{v}_{in}^\eta}{\sum_m \left(E_{im}/E_i\right) \widehat{v}_{im}^\eta},$$
$$\widehat{\mathcal{L}}_n = \frac{L_n + \sum_i E_{in}\widehat{E}_{in}}{L_n + \sum_i E_{in}}.$$

Counterfactual payment shares are evaluated at the new knowledge allocations and wages.

Let Δ_n denote the counterfactual change in log output per worker. Holding baseline reference productivities and country weights fixed,

$$\Delta_n = \ln\left(\frac{\widehat{Y}_n}{\widehat{\mathcal{L}}_n}\right) = \sum_j \frac{\theta_n^j}{\rho-1} \ln\left(\widehat{\phi}_n^j\right) + \ln\left(\frac{\widehat{R}_n}{\widehat{w}_n \widehat{\mathcal{L}}_n}\right).$$

We attribute the following share of baseline cross-country variation in output per worker to differences in communication costs:

$$C_h = -\frac{\mathrm{Cov}_n\left[\ln\left(Y_n/\mathcal{L}_n\right), \Delta_n\right]}{\mathrm{Var}_n\left[\ln\left(Y_n/\mathcal{L}_n\right)\right]}.$$

We separately report the proportional reduction in cross-country variance:

$$D_h = 1 - \frac{\mathrm{Var}_n\left[\ln\left(Y_n/\mathcal{L}_n\right) + \Delta_n\right]}{\mathrm{Var}_n\left[\ln\left(Y_n/\mathcal{L}_n\right)\right]}.$$

Positive C_h indicates larger counterfactual gains in initially less productive countries; positive D_h indicates a reduction in cross-country dispersion.

6 Quantification

This section adjusts the model to one source country, Korea, indexed by K, and describes how we will calibrate it and compute its counterfactual. The quantitative benchmark allows Korean firms to adjust knowledge, employment, and entry. Non-Korean firms are modeled as one group with fixed production technologies and a fixed set of incumbents. They use host-country labor, and their prices, sales, and employment respond to equilibrium changes. Their baseline employment is divided between variable production and fixed overhead.

Baseline data and calibration We will construct one baseline from annual aggregates over 2006–11. Within each year, affiliates will be aggregated to parent–host–sector operations before calculating revenues, employment, and operating counts. We will then average these annual aggregates and construct shares from the averaged totals. We will combine the survey with the OECD Analytical Activities of Multinational Enterprises (AMNE) database (Cadestin, De Backer, Desnoyers-James, Miroudot, Rigo, and Ye, 2018), which reports gross output by host country, industry, and country of the controlling parent. We will map three-digit KSIC industries to AMNE industries and harmonize currency and price base. AMNE output of Korean-controlled affiliates will be used to assess and reconcile the survey's coverage.

Host-sector production revenue determines R_n^j, Korean operations' share of that revenue determines S_{Kn}^j, and sectoral revenue shares determine $\theta_n^j = R_n^j / \sum_s R_n^s$. Because AMNE measures gross output, calibrated wages and output per worker are measured in terms of gross output. Active parent–host–sector counts in the survey determine M_{Kn}^j. The survey supplies Korean managerial, executive, and local employment; AMNE supplies output of domestic Korean operations and of non-Korean operations. Non-Korean employment in each host is total host-sector employment from the OECD Trade in Employment database less employment in Korean operations, and the Korean Census on Establishments supplies the number of domestic Korean firms.

At home, managers are Korean nationals and form the upper layer. For Korean domestic operations, we measure this layer using the Survey on Labor Conditions by Employment Type of the Ministry of Employment and Labor, which reports employment by occupation

and industry. Within each sector, define:

$$r_K^j = \frac{\text{Managers}_K^j}{\text{Other}_K^j},$$

where both counts cover the baseline period. Let T_K^j denote employment in Korean-owned domestic operations, measured as employment in Korea less employment in foreign affiliates in Korea from the OECD AMNE inward statistics. We assign domestic managerial and operating employment as:

$$E_{KK}^j = \frac{r_K^j}{1 + r_K^j} T_K^j, \qquad L_K^{K,j} = \frac{1}{1 + r_K^j} T_K^j.$$

This assignment supplies the domestic staffing target used to calibrate h_{KK}^j, accounting for optimal knowledge acquisition and fixed local overhead.

We normalize $\lambda = 1$ and set $c/\lambda = 0.225$ and $\rho = 3.8$, following Caliendo and Rossi-Hansberg (2012). Because a single baseline does not identify the destination-choice elasticity, we set $\eta = 1$. We set γ to the Pareto tail index of affiliate sales in the foreign affiliate survey.

We will jointly calibrate communication costs h_{Kn}^j, local fixed requirements f^j, and foreign executive requirements f_{Kn}^j. Observed Korean-manager employment targets the headcount of variable managers, e_{Kn}; executive employment targets fixed managerial labor; and local-manager plus field-worker employment targets the headcount of variable local workers, l_{Kn}, plus fixed overhead. For domestic operations, the preceding assignment supplies managerial and local employment targets, and $f_{KK}^j = 0$. For any candidate parameters, we will solve the constrained knowledge-choice problem, including boundary solutions, and obtain the managerial variable-payment share u_{Kn}^j. Predicted cell employment is:

$$\begin{aligned}
L_n^{K,j,\text{model}} &= \frac{\rho - 1}{\rho} \frac{\left(1 - u_{Kn}^j\right) R_n^j S_{Kn}^j}{w_n \left(1 + c\psi_{Kn}^{0,j*}\right)} + M_{Kn}^j f^j \theta_n^j L_n, \\
KM_{Kn}^{j,\text{model}} &= \frac{\rho - 1}{\rho} \frac{u_{Kn}^j R_n^j S_{Kn}^j}{v_{Kn} \left(1 + c\psi_{Kn}^{1,j*}\right)}, \\
KB_{Kn}^{j,\text{model}} &= M_{Kn}^j f_{Kn}^j.
\end{aligned}$$

We will minimize the sum of squared differences between predicted and observed

cell employment, dividing each employment difference by the cell's observed total employment. Aggregate local and Korean upper-layer labor in Korean operations in each destination, measured in efficiency units, will match their observed baseline levels exactly. These conditions determine local and Korean managerial wages. Because efficiency units depend on knowledge choices, wages are solved jointly with the parameters that fit cell-level staffing. The Pareto fixed-payment restriction will also hold:

$$M_{Kn}^{j}\left(w_n f^j \theta_n^j L_n + v_{Kn} f_{Kn}^{j}\right) = \frac{\gamma - 1}{\gamma \rho} R_n^j S_{Kn}^j.$$

Destination managerial supplies are $E_{Kn} = \sum_j \left(\left(1 + c\psi_{Kn}^{1,j*}\right) KM_{Kn}^j + KB_{Kn}^j\right)$ for foreign operations and the assigned domestic managerial total, converted in the same way, for $n = K$; their sum determines E_K. Local supplies combine Korean-operation local employment and non-Korean employment, with variable local employment converted to efficiency units using $1 + c\psi^{0*}$. Conditional on the staffing calibration, we recover hierarchy efficiency g_{Kn}^j from communication costs, relative wages, and optimal knowledge choices.

Adjusted development accounting For the development accounting, we estimate aggregate firm-embedded productivity with AMNE, which reports output shares by source country in every host country and sector, including domestic firms. The survey alone cannot identify it, because with Korea as the only source country a host effect is not separated from bilateral costs with Korea. Substituting the entry cutoff and the payment shares into the aggregation in Section 5 gives, within each sector:

$$\ln S_{in}^j = \delta_i^j + \mu_n^j + G_{in}^{\top} \zeta^j + \varepsilon_{in}^j,$$

where the source effect absorbs the mass and quality of source-country firms, and the bilateral terms in quality, hierarchy efficiency, and executive overhead are captured by the bilateral analogs (log distance, colonial ties, and RTA status) of the variables in Section 4.2, a domestic indicator, and a residual. The host effect is:

$$\mu_n^j = -\gamma \ln \phi_n^j - (\gamma - 1) \ln\left(1 - s_n^E\right) + \bar{\mu}^j,$$

where the second term depends on the upper-layer share of labor payments in the host country and the last term is a sector constant. We estimate this equation by regressing log source-country output shares on source-country fixed effects, host-country fixed effects, and the bilateral variables. We assume that these bilateral terms have no host-specific

component beyond the host effect. We measure the upper-layer payment share with the managers' share of labor earnings from ILOSTAT, so that $-\left[\mu_n^j + (\gamma-1)\ln\left(1-s_n^E\right)\right]/\gamma$ identifies $\ln\phi_n^j$ up to a sector constant. We normalize the Korean host effect to zero, so that Korea is the reference country.

Adjusted exact hat algebra The exact hat calculations will use baseline revenues, market shares, operating counts, labor supplies, calibrated relative wages, communication costs, payment shares, and internally consistent fitted employment shares. These calculations do not require individual quality and efficiency draws or their separate levels. We apply the counterfactual to Korean foreign operations.

Because h_{Kn}^j is chosen to fit staffing, it also absorbs other cell-specific staffing determinants, such as differences in local learning costs. The counterfactual therefore equalizes only the part explained by G_{Kn}, which contains the bilateral variables in Section 4.2: log distance from Korea, the indicator for Korea's historical link with Japan, and RTA status. We exclude GDP per capita and population, which operate through wages and market size in the model. The projection uses active foreign operations. Operations with high communication costs are less likely to be active, so the projection corrects for selection. In the model, host-sector revenue R_n^j shifts the entry cutoff but not communication costs, so we estimate the probability that a Korea–host–sector cell is active on G_{Kn} and $\ln R_n^j$, and include the implied selection term in the projection.

Let $\phi_n^{O,j}$ denote the aggregate productivity contribution of non-Korean firms. Holding their technologies and incumbent set fixed implies $\phi_n^{O,j\prime} = \phi_n^{O,j}$. The aggregate-productivity equation therefore becomes:

$$\widehat{\phi}_n^j = 1 - S_{Kn}^j + S_{Kn}^j \left(\widehat{R}_n\right)^{\gamma-1} \left(\widehat{\phi}_n^j\right)^{1-\gamma} \left(d_{Kn}^j\right)^{\gamma} \left(\widehat{\mathcal{F}}_{Kn}^j\right)^{1-\gamma}.$$

The counterfactual Korean revenue share is:

$$S_{Kn}^{j\prime} = 1 - \frac{1 - S_{Kn}^j}{\widehat{\phi}_n^j}.$$

Thus, the market share of non-Korean firms can change even though their technologies and entry are fixed.

Let $L_n^{K,j}$ and $L_n^{O,j}$ denote baseline local employment in Korean and non-Korean operations, respectively, and let $L_n = \sum_j \left(L_n^{K,j} + L_n^{O,j}\right)$. Define their shares in host local employment as $\chi_n^{K,j} = L_n^{K,j}/L_n$ and $\chi_n^{O,j} = L_n^{O,j}/L_n$. The baseline variable employment

share of non-Korean operations is:

$$\nu_n^j = \frac{\rho - 1}{\rho} \frac{R_n^j \left(1 - S_{Kn}^j\right)}{w_n L_n^{O,j}}.$$

We require $0 \leq \nu_n^j \leq 1$. We will recover ν_n^j from non-Korean baseline revenues, employment, and calibrated local wages. The remaining employment is fixed overhead.

Local labor market clearing in the counterfactual is:

$$1 = \sum_j \chi_n^{K,j} \frac{\widehat{R}_n S_{Kn}^{j\prime}}{\widehat{w}_n S_{Kn}^j} \frac{b_{Kn}^{L,j\prime}}{b_{Kn}^{L,j}} + \sum_j \chi_n^{O,j} \left[1 - \nu_n^j + \nu_n^j \frac{\widehat{R}_n}{\widehat{w}_n \widehat{\phi}_n^j}\right].$$

In this benchmark, the managerial labor market and destination-choice equations apply to Korean upper-layer labor, and total host employment is $\mathcal{L}_n = L_n + E_{Kn}$.

We will report percentage changes in aggregate firm-embedded productivity by host country and sector and in output per worker by host country:

$$100 \left(\widehat{\phi}_n^j - 1\right), \qquad 100 \left(\frac{\widehat{Y}_n}{\widehat{\mathcal{L}}_n} - 1\right).$$

Because the experiment changes only Korean operations, C_h measures the contribution of communication costs faced by Korean multinationals.

7 Conclusion

This paper asks what carries a multinational firm's ideas to its foreign affiliates: goods shipped from the parent, or people from the home country. Surveys of Korean foreign affiliates point to people. Affiliates have expat executives or managers more often than they trade with their parents or make capital payments to them. These expats hold executive and managerial jobs and typically stay as local management expands. A knowledge hierarchy links this staffing to communication costs and local knowledge. The ratio of these expats to local managers is higher in richer and more distant host countries, and the ratio of expat managers to local managers is higher in industries with greater management and administration requirements. The model provides a framework for quantifying how expats contribute to cross-country productivity differences through communication costs and the allocation of knowledge. These results bear on whether policies that seek foreign production should target the entry of skilled people or imports of inputs.

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A Data Construction

A.1 Other data

For the country regressions, bilateral distance, historical links, and regional trade agreement status come from the Centre d'Études Prospectives et d'Informations Internationales (CEPII) Gravity database (Conte, Cotterlaz, and Mayer, 2022); population and GDP per capita come from the World Development Indicators. For industry task measures, we use the Korean Network for Occupations and Workers (KNOW) occupation requirements. We construct a management and administration requirement and a client and training requirement. The former is the occupation-level requirement in management and administration. For the latter, we construct the client and training index by separately standardizing the industry-level customer-service and education-and-training scores, averaging the two standardized scores, and standardizing the resulting average.

We average four-digit Korean Employment Classification of Occupations (KECO) scores within two-digit KECO occupations and aggregate them to three-digit industries using industry–occupation job-placement counts from the Employment and Labor Data Analysis System (ELDS) of the Korea Employment Information Service, then match them to the first three digits of affiliate industry. Both measures are standardized across industries before merging with the affiliate data. Median matched placement-weight coverage is 96.0%.

B Supplementary Facts

B.1 Concentration of multinational production

Korean affiliates are geographically concentrated. Following Tintelnot (2017), we count each host country once per parent and include the home country as one location. In 2010, the average number of locations is 2.5, with a median of two. Affiliates also sell outside their host countries. Table B.1 reports the share of aggregate affiliate sales sold outside the host country for the five leading hosts and for all hosts in 2010.

B.2 All links to Korea

Table B.2 reports all links to Korea, unweighted and sales-weighted.

Table B.1: Affiliate sales outside host country, 2010

Host country	China	United States	Vietnam	Japan	Indonesia	All hosts
Share of sales outside host country (%)	40.8	13.3	50.5	41.8	53.5	39.5

Notes: Each entry is the ratio of aggregate affiliate sales outside the host country to aggregate affiliate sales. The final column pools affiliates across all host countries.

Table B.2: Links to Korea in Korean affiliates

Link	Affiliate-year share	Sales-weighted share
Expat executives or managers	79.5%	89.0%
Direct-parent capital payments	18.8%	31.6%
Exports to parent	36.5%	48.4%
Exports to other Korean firms	8.5%	16.1%
Imports from parent	42.7%	78.8%
Imports from other Korean firms	13.1%	26.8%

Notes: Direct-parent transactions are with the Korean investor; other-Korean transactions are with other Korean counterparties. Direct-parent capital payments include dividends, interest, and other payments.

B.3 Layer presence and employment

We examine whether each of the four layers has positive employment and how large employment is when positive. The layers are expat executives, expat managers, local managers, and local field workers. Panel A estimates the probability of positive employment using:

$$1_{at}^{g} = \alpha_{p(a)t} + \alpha_{c(a)j(a)t} + \beta_g \ln \text{Sales}_{at} + \sum_b \delta_{gb} 1\{\text{AgeBin}_{at} = b\} + \varepsilon_{at}^{g}.$$

Here, 1_{at}^{g} indicates positive employment in layer g. Standard errors are clustered by affiliate. Conditional on positive employment in the stated layer, Panel B estimates:

$$\ln \text{Labor}_{at}^{g} = \alpha_{p(a)t} + \alpha_{c(a)j(a)t} + \beta_g \ln \text{Sales}_{at} + \sum_b \delta_{gb} 1\{\text{AgeBin}_{at} = b\} + \varepsilon_{at}^{g}.$$

Standard errors are clustered by affiliate.

Table B.3 summarizes the results. Operating age has no systematic association with either outcome. By contrast, affiliate sales predict positive employment in every layer and higher employment where it is positive. In Panel B, the sales coefficient for expat executives is smaller than those for expat managers, local managers, and local field workers.

Table B.3: Scale, operating age, and labor layers

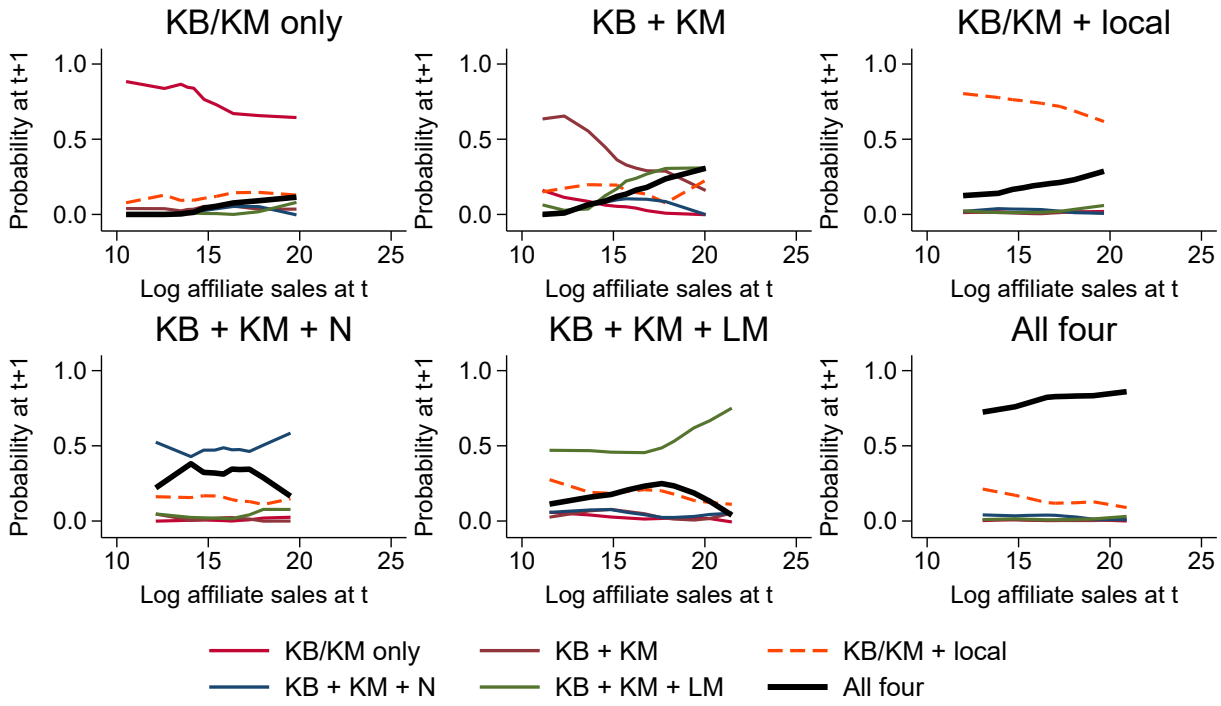
	Expat executives	Expat managers	Local managers	Local field workers
Panel A. Positive employment				
Log sales	0.052***	0.021***	0.021***	0.027***
	(0.008)	(0.006)	(0.006)	(0.007)
Age 3–5	0.010	0.006	−0.004	−0.033*
	(0.026)	(0.017)	(0.017)	(0.018)
Age 6–10	0.049	−0.023	0.022	−0.035
	(0.034)	(0.021)	(0.020)	(0.021)
Age 11+	−0.037	−0.032	−0.006	−0.029
	(0.037)	(0.025)	(0.022)	(0.027)
Observations	5,034	5,034	5,034	5,034
R^2	0.68	0.68	0.77	0.73
Panel B. Log employment, conditional on positive employment				
Log sales	0.084***	0.258***	0.347***	0.452***
	(0.018)	(0.023)	(0.021)	(0.026)
Age 3–5	−0.073*	−0.113*	−0.006	−0.130*
	(0.044)	(0.059)	(0.068)	(0.070)
Age 6–10	0.010	−0.058	0.073	−0.078
	(0.059)	(0.074)	(0.083)	(0.095)
Age 11+	0.051	−0.018	0.119	0.013
	(0.068)	(0.086)	(0.095)	(0.109)
Observations	3,243	4,078	4,051	4,153
R^2	0.69	0.76	0.85	0.90
Parent-year FE	Yes	Yes	Yes	Yes
Host-country-industry-year FE	Yes	Yes	Yes	Yes

Notes: Panel A reports linear-probability estimates for positive employment in the stated layer. Panel B reports log-employment estimates conditional on positive employment in the stated layer. All columns condition on the affiliate having expat executives or managers. The sample excludes affiliate-years with missing operating age and singletons within the fixed effects; with parent-year fixed effects, the estimates use parents with more than one affiliate in a given year. The omitted age category is 0–2 years. Age 11+ denotes mature operation. Standard errors clustered by affiliate are reported in parentheses. Significance: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$.

B.4 Layer and size

Figure B.1 shows how the following year's layer composition varies with initial sales. We group affiliates into ten initial-sales bins separately by their initial layer composition. The lines show the share in each layer composition in the following year.

Figure B.1: Next-year layer composition by initial sales



Notes: Each panel is an initial layer composition. The sample includes affiliates that keep expat executives or managers in the following year. Within each panel, observations are grouped into ten initial-sales bins. Lines show locally smoothed bin-level probabilities of each layer composition in the following year. Probabilities sum to one within each initial-sales bin. The figure reports raw probabilities, with no fixed effects or other controls.

B.5 How often each combination of layers occurs

Table B.4 reports how often each combination of the four layers occurs. Our main decomposition requires positive employment of expat executives or managers, local managers, and local field workers. This sample contains 10,173 of 17,058 affiliate-years (59.6%). Of the remaining 6,885 affiliate-years, 1,281 (7.5%) employ expat executives or managers and local field workers but no local managers; 1,239 (7.3%) employ expat executives or managers and local managers but no local field workers; 955 (5.6%) employ local managers and field workers without expat executives or managers; and 3,410 (20.0%) have positive employment in at most one of these three groups. Only the first of these cases allows us to compute $\ln(K^H/N)$, but it cannot be split into the two terms of the decomposition. These observations remain in the descriptive sample but are excluded from the main decomposition; some remain in Panel A of the regressions.

Table B.4: Combinations of the four layers

Combination	Expat executive	Expat manager	Local manager	Local field worker	Share
All four layers	Yes	Yes	Yes	Yes	38.9%
None of the four layers	No	No	No	No	10.8%
No expat executive	No	Yes	Yes	Yes	11.2%
No expat manager	Yes	No	Yes	Yes	9.6%
Local manager and field only	No	No	Yes	Yes	5.6%
Local manager only	No	No	Yes	No	3.2%
No local manager	Yes	Yes	No	Yes	4.5%
No local field worker	Yes	Yes	Yes	No	3.3%
Other eight combinations			—		12.9%
Affiliate-years			—		17,058

Notes: Expat field workers and local executives are excluded from the four layers because they are much less common. The table reports the eight most common combinations.

C Additional Tables

Table C.1: Transitions in layer composition

	Layer composition at $t+1$						
Layer composition at t	KB/KM only	KB + KM	KB/KM + local	KB + KM + N	KB + KM + LM	All four	Transitions
KB/KM only	77.4	4.1	11.1	2.1	1.2	4.1	243
KB + KM	6.0	39.8	17.3	6.8	17.3	12.8	133
KB/KM + local	1.3	1.0	73.5	2.7	2.1	19.4	2,536
KB + KM + N	0.7	1.7	15.1	48.8	3.3	30.4	418
KB + KM + LM	2.3	4.0	18.1	4.8	53.0	17.8	353
All four	0.4	0.6	13.6	3.2	1.3	80.9	4,139

Notes: KB/KM only denotes KB or KM, not both; KB/KM + local denotes KB or KM, not both, with local employees. The sample includes affiliates that keep expat executives or managers in the following year. *KB*, *KM*, *LM*, and *N* denote expat executives, expat managers, local managers, and local field workers. Entries are row percentages and rows sum to 100 percent.