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Exchange Rate Transmission through Multinational Firms: Evidence from Japan*

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August 2026

Abstract

We study an income-account channel of exchange-rate transmission using matched data on Japanese multinational parents and their foreign affiliates. During the sharp yen depreciation of 2021–22, we find that (i) foreign affiliates with greater exchange-rate exposure expanded their activity and generated more profits, with larger payments to their Japanese parents, and (ii) more exposed parents increased their average wages and shifted employment toward commercial branches and offices involved in sales, purchasing, and related business functions, with offsetting declines in other employment. A multinational firm model in which scarce parent-side support inputs are allocated between domestic operations and foreign affiliates rationalizes these findings. To study the aggregate implications, we embed this mechanism in a two-country general-equilibrium model with trade and multinational production. The model shows that moving foreign-market activity from exports to affiliate production reduces the domestic real GDP response to depreciation and shifts more of the external adjustment from trade and toward income earned abroad. Depreciation therefore need not generate a large expansion in domestic production.

JEL Codes: F31, F23, F32, F41.
Keywords: Exchange rates; Multinational firms; Current account; Japan

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1 Introduction

Understanding how exchange-rate dynamics affect domestic activity and the current account is a central question in international macroeconomics. Standard open-economy models emphasize a trade-based transmission in which depreciation induces expenditure switching toward home goods. This raises domestic production and improves the trade balance, so current-account adjustment occurs primarily through trade. But the current account also includes cross-border income flows, notably direct investment income generated by multinational firms. As multinational production has become increasingly important, exchange-rate transmission may depend not only on where goods are produced and traded, but also on where the income generated by production accrues.

Japan's experience during the 2021–22 yen depreciation looks quite different from the standard trade-based transmission. Despite the sharp depreciation, the trade balance deteriorated, while direct investment income increased and helped sustain the current-account surplus. This raises the question we study in this paper: how does depreciation affect the home economy when firms earn a substantial part of their income through production abroad?

This paper studies an income-account channel of exchange-rate transmission operating through multinational firms (MNEs). Using matched parent-affiliate data for Japanese MNEs, we examine how yen depreciation affects foreign affiliate activity and how these changes spill back to parent firms in Japan. Our empirical strategy combines bilateral exchange-rate movements with firms' pre-existing foreign affiliate networks. Parents whose pre-period networks were concentrated in currencies that appreciated more against the yen experienced greater revenue-side exchange-rate exposure. The identifying variation thus comes from cross-parent differences in predetermined affiliate networks interacted with bilateral exchange-rate movements that individual affiliates and parents take as given.

Our main empirical finding is that greater exposure to yen depreciation raises foreign affiliate activity and employment at parent commercial branches and offices, without generating a corresponding expansion of domestic production. Greater exposure is associated with higher affiliate profits, higher average wages at the parent, and employment growth at commercial branches and offices involved in sales, purchasing, and related business functions, while total parent employment remains broadly flat. The expansion occurs primarily abroad: affiliate employment, dispatched workers, and investment rise, while domestic adjustment is concentrated in wages and employment composition rather than production. This pattern contrasts with the standard view of depreciation as a broad stimulus to domestic activity.

To interpret this evidence, we develop a stylized model of a multinational firm that represents the relevant parent-side activity as a support input. Both domestic production and foreign affiliate activity rely on this input, which is productive but scarce. A yen depreciation raises the home-currency value of affiliate activity and therefore the marginal return to directing parent support toward foreign affiliates. The firm responds by expanding support activity and shifting its use toward its affiliates, leaving less support available for domestic production. The model thereby rationalizes the joint rise in affiliate profitability, payments to the parent, commercial employment, and parent wages, alongside the absence of domestic production growth.

We then embed this mechanism into a two-country general-equilibrium model with trade, multinational production, and affiliate-to-parent income flows. Japanese aggregate data discipline the steady-state scale and organization of foreign activity, including exports and direct-investment-income credits relative to GDP, while the firm-level estimates discipline the support-allocation mechanism within multinational firms. The model then quantifies how this mechanism interacts with standard expenditure switching to shape domestic production and the external accounts.

The quantitative model delivers two main results. First, under the baseline uncovered interest parity (UIP) shock, endogenous affiliate expansion amplifies the direct-investment-income response beyond mechanical currency translation. A shock normalized to generate a 10% real depreciation raises the direct-investment-income balance by 0.51 percentage points of GDP on impact, approximately twice the mechanical currency-translation response obtained when affiliate operating surpluses are held fixed. As a magnitude check, proportionally scaling the model response to Japan's 25–30% real effective depreciation over 2020–22 brings it materially closer to the observed increase in Japan's direct-investment-income surplus than does mechanical currency translation alone.

Second, exchange-rate transmission depends on how firms organize their foreign-market activity. In a counterfactual that holds fixed the impact depreciation and total foreign-facing sales relative to GDP, shifting foreign sales from exports to affiliate production increases the direct-investment-income response but weakens the domestic real-GDP and overall current-account responses, because the reduction in trade-balance adjustment exceeds the increase in foreign income. Multinational production therefore weakens the domestic production response and shifts the composition of external adjustment away from trade and toward income generated abroad.

Finally, we ask whether the separation between foreign income and domestic production that emerges from the firm-level evidence and the quantitative model is also visible across countries. Following the same exposure-based logic, we construct a country-level measure that weights bilateral depreciations by predetermined outward foreign direct investment (FDI) positions relative to GDP. Across 70 economies over 2014–2024, and conditional on conventional trade-weighted exchange-rate exposure and the overall scale of outward FDI, greater depreciation exposure through a country's multinational network is followed by higher direct-investment-income credits and weaker real GDP growth. Although suggestive, these estimates provide broader aggregate evidence consistent with the paper's central mechanism: exchange-rate exposure transmitted through foreign affiliate networks is associated with stronger income receipts without a commensurate expansion of domestic production.

Related Literature. Our paper contributes primarily to the international macro literature on exchange-rate transmission. Standard open-economy models emphasize expenditure switching, import-price pass-through, and financial frictions as key channels through which exchange-rate movements affect domestic activity and the external accounts (Galí and Monacelli, 2005, Devereux and Engel, 2003, Gopinath, Boz, Casas, Díez, Gourinchas and Plagborg-Møller, 2020, Gabaix and Maggiori, 2015, Itskhoki and Mukhin, 2021). A recent literature has questioned how strong expenditure switching is once pricing and invoicing patterns are taken seriously, and how much exchange-rate movements ultimately show up in trade and net exports. These responses can be weaker or more delayed than in standard models and can depend on the shock that moves the exchange rate (McLeay and Tenreyro, 2026, Miyamoto, Nguyen and Oh, 2025, Mac Mullen and Woo, 2025, Fukui, Nakamura and Steinsson, 2025, Bodenstein, Cuba-Borda, Gornemann and Presno, 2024, Camara, Christiano and Dalgic, 2025).

We focus on a different margin that arises when domestic firms produce abroad through foreign affiliates. In this case, exchange-rate movements affect the home economy not only through trade and import prices, but also through the income generated by foreign production and the resources that parent firms allocate to support it. This matters for both domestic production and the way external adjustment takes place. Following a depreciation, part of the improvement in the current account can come from income earned abroad rather than from a larger trade surplus, while domestic output may respond less.

Our paper is also related to research incorporating multinational production into quantitative macroeconomics and international transmission. McGrattan and Prescott (2010) show that multinational production and technology capital are central for interpreting external positions and the current account, while Ramondo and Rodriguez-Clare (2013) develop a general-equilibrium framework in which trade and multinational production are alternative modes of serving foreign markets. Cravino and Levchenko (2017) show that multinational firms transmit shocks internationally through parent-affiliate linkages and thereby contribute to international comovement. Relative to this literature, we emphasize how exchange-rate movements alter parent activity and the allocation of scarce support inputs across domestic operations and foreign affiliates. Our empirical contribution is to show that yen depreciation expands foreign affiliate activity and employment at parent commercial branches and offices without generating a broad expansion of domestic production. Our quantitative contribution is to show that this organizational margin weakens the domestic output response and shifts the composition of external adjustment away from trade and toward direct investment income.

The organizational mechanism also relates to work on shock transmission and within-firm resource allocation. Multi-unit firms reallocate capital and labor across establishments in response to local shocks, propagating those shocks across regions and markets (Giroud and Mueller, 2015, Hyun and Kim, 2026), while parent-country disruptions transmit to foreign affiliates through intra-firm input linkages (Boehm, Flaaen and Pandalai-Nayar, 2019). Within multinationals, parent-provided intangible inputs raise affiliate performance (Bilir and Morales, 2020), and parent-affiliate linkages contribute substantially to international comovement (di Giovanni, Levchenko and Méjean, 2018, Kleinert, Martin and Toubal, 2015). More broadly, managerial talent and organizational capacity are productive inputs deployed across activities and locations (Burstein and Monge-Naranjo, 2009, Bloom, Sadun and Van Reenen, 2012). Closest to our parent-side evidence, Alviarez, Chen, Pandalai-Nayar, Varela, Yi and Zhang (2026) use Japanese multinational microdata to show that host-country FDI liberalization shifts parent employment from manufacturing toward services and R&D. We apply the central insight of this literature—that shocks propagate through firms' internal organization—to exchange-rate transmission.

Finally, our income-account channel connects to the international macro literature on valuation effects and external adjustment. That literature studies how changes in exchange rates, asset prices, and relative returns revalue countries' gross foreign asset and liability positions, thereby changing net foreign wealth through capital gains and losses that are not recorded in the current account (Gourinchas and Rey, 2007, Tille, 2008, Lane and Milesi-Ferretti, 2007, 2018). We study a distinct but complementary flow channel involving direct investment income recorded in the current account. A depreciation mechanically raises the home-currency value of a given flow of foreign-currency affiliate earnings, but it can also change affiliate activity and operating surplus. Our analysis separates this mechanical translation component from the endogenous income response and traces the resulting real spillbacks to parent firms.

The rest of the paper proceeds as follows. Section 2 presents the macroeconomic motivation and documents the role of direct investment income in Japan's external adjustment. Section 3 describes the data, empirical strategy, and firm-level evidence. Section 4 develops a stylized multinational-firm model to interpret the empirical patterns. Section 5 embeds the mechanism into a two-country general-equilibrium framework, and Section 6 calibrates the model and studies its quantitative implications. Section 7 concludes.

2 Direct Investment Income and External Adjustment

Before turning to the firm-level analysis, we document the aggregate patterns that motivate our focus on direct investment income. Figure 1 highlights two facts. First, the 2021–22 yen depreciation coincided with a deterioration in Japan's trade balance and an increase in its

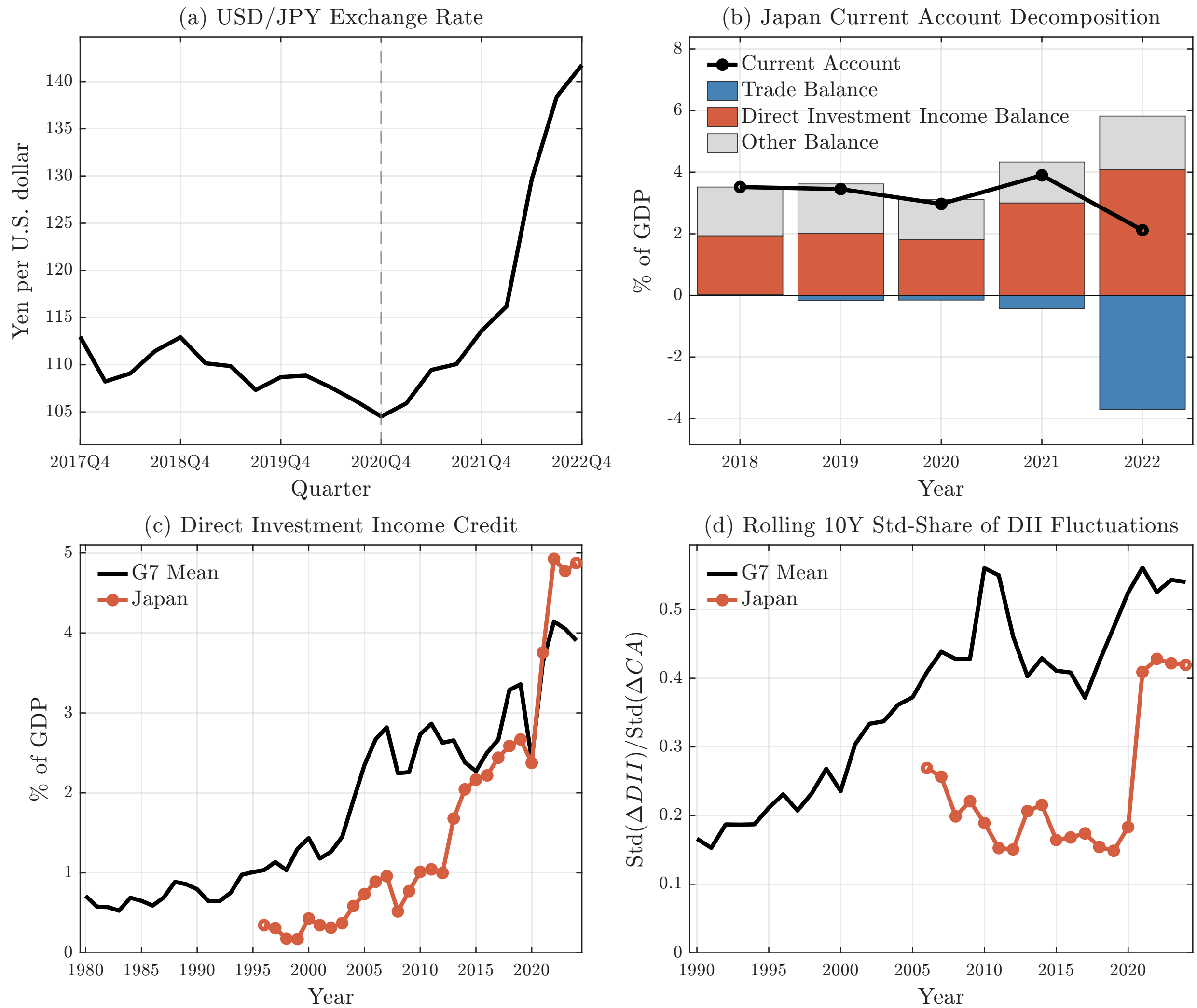

Figure 1: Yen Depreciation, Direct Investment Income, and Current Account Dynamics

Notes: Exchange-rate data are from the International Monetary Fund's (IMF) *International Financial Statistics*. GDP data are from the IMF *World Economic Outlook*, and balance-of-payments data are from the IMF *Balance of Payments Statistics* (BPM6). The top-left panel plots yen per U.S. dollar, so an increase denotes a yen depreciation. In the top-right panel, the current account is decomposed into the trade balance, the direct investment income balance, and other balance-of-payments components, all expressed as ratios to GDP. The direct investment income balance is equal to direct investment income credits minus debits. The bottom-left panel plots direct investment income credits as a share of GDP. The bottom-right panel plots the rolling 10-year ratio of the standard deviation of changes in the direct investment income balance to the standard deviation of changes in the current account. Direct investment income credit for the United Kingdom is unavailable for 2014–15 and 2017, while the direct investment income balance is unavailable for 2014–17. Balance-of-payments data for Japan are available from 1996 onward, whereas data for other G7 countries are available from at least 1980. Missing UK and Japan observations are excluded when computing the G7 average in the bottom-left panel. In the bottom-right panel, missing UK direct investment income balance observations are linearly interpolated solely for constructing the G7 average. All variables are expressed as ratios to GDP prior to aggregation, and the G7 average is computed as the cross-country mean. Rolling 10-year statistics use trailing windows.

direct investment income surplus. Second, direct investment income has become quantitatively important in the external accounts of Japan and other G7 economies. To interpret the current-account decomposition in the figure, we write

$$CA_t = TB_t + DII_t + Other_t,$$

where CA_t denotes the current account balance, TB_t the trade balance, DII_t the direct investment income balance, and $Other_t$ the balance of all remaining current-account components, including primary income other than direct investment income, such as portfolio income, as well as secondary income flows.

The top-left panel shows the sharp yen depreciation against the U.S. dollar during 2021–22. The top-right panel shows that external adjustment during this episode was not trade-led. Japan's trade balance deteriorated sharply, while its direct investment income surplus increased from about 2 percent of GDP in 2020 to about 4 percent in 2022. The increase in direct investment income partly offset the trade-balance deterioration and thereby limited the decline in the current account. This pattern motivates our focus on direct investment income as a non-trade component of exchange-rate transmission.

In the longer sample, the bottom panels show that direct investment income has become an important component of the external accounts of G7 economies. The bottom-left panel plots direct investment income credits as a share of GDP. These credits record income accruing to residents through outward direct-investment relationships, including distributed earnings, reinvested earnings, and interest on intercompany debt. They are therefore broader than cash payments remitted by foreign affiliates, but constitute the aggregate balance-of-payments counterpart most closely related to foreign affiliate income. Direct investment income credits have risen substantially over time, especially for Japan, where they approach 5 percent of GDP. The long-run rise in these income flows is naturally connected to the expansion of external balance sheets documented by Lane and Milesi-Ferretti (2007, 2018), who emphasize the growing role of equity-type positions, including FDI, in advanced economies. This expansion makes direct investment income a quantitatively important margin of external adjustment, but our focus is different: we study the cyclical response of these income flows to exchange-rate movements and the associated spillbacks to parent firms.

We next ask whether direct investment income is quantitatively relevant not only in levels, but also for current account fluctuations. The bottom-right panel plots the rolling ten-year ratio

$$\frac{\text{Std}(\Delta DII_t)}{\text{Std}(\Delta CA_t)}.$$

This statistic compares the volatility of changes in the direct investment income balance with that of changes in the current account. The ratio reaches roughly one-half for the G7 average and 0.4

for Japan in recent years, suggesting that direct investment income is not merely a slow-moving trend component, but also fluctuates on a scale that is meaningful relative to overall current account movements.

These aggregate patterns motivate a broader question: when direct investment income rises following a depreciation, how much reflects the mechanical currency translation of a given foreign-currency earnings flow, and how much reflects endogenous changes in multinational activity? The distinction matters because foreign affiliate activity may depend on parent-side organizational and commercial inputs. Changes in affiliate activity may therefore be accompanied by parent-level adjustments in wages, employment composition, and domestic production. Whether such spillbacks occur, and what form they take, is an empirical question.

We therefore turn to matched parent-affiliate microdata for Japan. While aggregate balance-of-payments data establish the quantitative importance of direct investment income, the firm-level data allow us to examine whether firms with greater exchange-rate exposure experience both stronger affiliate outcomes and corresponding adjustments at the Japanese parent.

3 Firm-Level Evidence on the Multinational Spillback Channel

This section studies whether greater exposure to yen depreciation generates gains at foreign affiliates and corresponding adjustments at their Japanese parent firms. We first describe the linked parent-affiliate data and the parent-side outcomes used to measure domestic adjustment. We then construct revenue- and purchase-side exchange-rate exposure measures from affiliates' pre-period transaction geography and bilateral yen movements. Finally, we use event-study and long-difference specifications to assess pre-trends, trace the timing of adjustment, and quantify affiliate-side gains and parent-side responses during the 2021–22 depreciation.

3.1. Data and Sample Construction

Japan provides a natural setting for studying multinational spillbacks. Japanese firms have substantially expanded their overseas production networks over recent decades (Hogen, Ito, Kanai and Kishi, 2024), and Japan now holds one of the world's largest outward FDI positions.[1] More importantly for our purposes, Japan's Ministry of Economy, Trade and Industry (METI) conducts surveys of Japanese multinational firms that link individual foreign affiliates to their Japanese parent firms. These linked surveys allow us to study affiliate and parent outcomes within the same multinational firm.

Our affiliate-level data come from METI's *Basic Survey of Overseas Business Activities*, an annual survey of Japanese firms' foreign affiliates. The survey reports affiliate sales, purchases,

[1]According to UN Trade and Development's *World Investment Report 2025*, Japan's outward FDI stock reached about $2.15 trillion in 2024, equivalent to just over half of GDP.

employment, balance-sheet information, and the geographic composition of revenues and purchases across host-country markets, Japan, and third countries. It also reports financial flows between affiliates and their Japanese parents, including dividends, royalties, and related transfers. We refer to these flows collectively as affiliate-to-parent payments and examine whether greater exchange-rate exposure is associated with larger financial flows to the parent.

We merge the affiliate data with parent-level data from METI's *Basic Survey of Japanese Business Structure and Activities*. The parent survey reports wages, employment, employment composition, fixed assets, and other balance-sheet variables. The two surveys share a common parent identifier, allowing us to link each foreign affiliate to its Japanese parent. Workers employed by legally separate foreign affiliates are recorded in the affiliate survey rather than as parent employees. Changes in parent employment therefore capture adjustment within the Japanese parent organization rather than employment growth at its foreign affiliates.

Parent employment composition. A key advantage of the parent survey is that it reports employment separately for the parent firm's head office and for establishments outside the head office.[2] We use this information to construct three mutually exclusive parent employment categories: head-office employment, non-production support employment, and other parent employment. Total parent employment is the sum of the three plus workers the parent dispatches to other firms, whom the survey records separately. First, *head-office employment* is total employment at the parent firm's head office. Second, we define *non-production support employment* as employment at domestic commercial establishments outside the head office, including commercial branches, offices, sales establishments, and related business establishments. Because our sample consists predominantly of manufacturing firms, we use this label to distinguish commercial and business functions, such as sales and purchasing, from direct manufacturing production. The label is organizational and establishment-based: it does not imply that these employees do not contribute to firm output or value added, particularly for parents in wholesale, retail, and other nonmanufacturing industries. The relevant activities may serve either domestic operations or overseas subsidiaries and affiliated companies, but the survey does not identify how individual employees allocate their work across these uses.[3] Third, *other parent employment*

[2] The survey separately reports employment in head-office departments and in non-head-office establishments, including manufacturing and mining establishments, commercial establishments, service establishments, laboratories, warehouses, overseas branches and offices, and other units. Within the head office, the survey further distinguishes departments such as planning, information processing, R&D, international operations, and other administrative functions.

[3] In correspondence with METI, we asked whether the relevant survey category, item 0216, which covers employment in commercial establishments such as retail stores, branches, offices, and sales offices outside the head office, includes personnel engaged in purchasing or sales transactions with overseas subsidiaries or affiliated companies. METI clarified that item 0216 does not restrict purchasing or sales activities by counterparty. Thus, personnel engaged in such transactions with overseas subsidiaries or affiliated companies are conceptually included, although the survey does not separately identify whether individual workers support domestic or overseas operations.

consists primarily of workers at domestic manufacturing establishments and therefore largely captures production employment in our sample. The category also includes employment at mining establishments, warehouses, laboratories, service establishments, overseas branches and offices, and other units.[4]

Summary statistics. Our baseline sample covers 2015–2022, and summary statistics for the matched parent-affiliate data are reported in the Appendix. Three features are especially relevant. First, affiliate revenue is earned overwhelmingly abroad: the local host market accounts for about two-thirds of affiliate revenue on average, while sales to Japan account for less than 20 percent. Affiliate activity is therefore primarily oriented toward serving foreign markets rather than selling back to the home country. Second, affiliate-to-parent payments are quantitatively large relative to affiliate current income: the mean ratio is about 74 percent. Because these payments include several types of intrafirm transfers, we interpret the ratio as a measure of the strength of the affiliate-to-parent financial linkage rather than as an exact payout rate or accrual-based measure of direct investment income. Third, non-production support workers, as defined above, account for around 23 percent of parent employment, making this a quantitatively important margin of parent-side adjustment. The Appendix details the survey coverage and cleaning steps and traces the sample from the raw affiliate panel to the estimation samples.

Exchange rates. We obtain bilateral yen exchange rates from the International Monetary Fund's *International Financial Statistics*. Exchange rates are measured as yen per unit of foreign currency, so an increase denotes a yen depreciation. We measure each currency's depreciation against the yen by the percentage change in the bilateral exchange rate between October 2020 and October 2022.

3.2. A Nested Shift-Share Exposure Design

The empirical design asks which Japanese parent firms were more exposed to the 2021–22 yen depreciation through their foreign affiliate networks. We construct separate revenue- and purchase-side exposure measures using two layers of predetermined shares. At the affiliate level, pre-period transaction shares describe how revenues and purchases are distributed across the host country, Japan, and third countries. These shares map bilateral yen movements into the exchange-rate exposure implied by each affiliate's transaction geography. At the parent level, pre-period network shares aggregate these affiliate-level exposures according to each affiliate's importance in the parent's foreign operations. The resulting measures are larger for parents whose pre-period affiliate activity was more heavily exposed to currencies that appreciated against the yen. The design is in the spirit of Amiti, Itskhoki and Konings (2014), but applies

[4] Production workers account for roughly three quarters of this category in the parent data. The category is not exclusively domestic, but the overseas component is tiny: employment at overseas branches and offices is 0.3 percent of this category in aggregate and zero for the median parent, since most parents report none.

shift-share exposure to multinational affiliate networks rather than to the parent firm's own export and import flows.

For parent firm f, the revenue- and purchase-side exposure measures are

$$\Delta \ln E_f^x = \sum_{a \in A_f} w_{f,a}^x \Delta \ln E_a^x, \qquad x \in \{S, P\},$$

where A_f denotes the set of foreign affiliates owned by parent f, $w_{f,a}^x$ is affiliate a's pre-period share in parent f's foreign affiliate network on side x, and $\Delta \ln E_a^x$ is affiliate a's exchange-rate exposure on side x. Here $x = S$ denotes the revenue side and $x = P$ the purchase side. The network weights are side-specific: revenue exposure uses each affiliate's share of the parent's total foreign affiliate revenue, whereas purchase exposure uses its share of total foreign affiliate purchases. The weights sum to one across affiliates within each parent and side.

Affiliate-level exposure is constructed as

$$\Delta \ln E_a^x = \sum_d s_{a,d}^x \Delta \ln E_d, \qquad x \in \{S, P\},$$

where $s_{a,d}^x$ is affiliate a's pre-period transaction share mapped to currency d, and $\Delta \ln E_d$ is the change in the log yen exchange rate against currency d between 2020 and 2022. For $x = S$, $s_{a,d}^S$ denotes revenue shares; for $x = P$, $s_{a,d}^P$ denotes purchase shares. The currency shares sum to one within each affiliate and side, and the exchange-rate change assigned to yen transactions is zero.

We average the transaction shares over 2016–2020 to smooth year-to-year noise and ensure that they are predetermined with respect to the depreciation episode. The parent-network weights are fixed at their 2020 values, the last pre-depreciation year, so that they capture each parent's affiliate network as it stood going into the episode.

We do not observe invoicing currencies in the affiliate survey and therefore map transaction geography into currencies using a baseline assignment. Revenues and purchases involving the host-country market are assigned to the host-country currency, transactions with Japan are assigned to the yen, and third-country transactions are assigned to the U.S. dollar, except those involving European counterparties, which are assigned to the euro. These conventions are consistent with broad invoicing patterns among Japanese overseas subsidiaries: local currencies are generally used for local-market sales and procurement, the yen and U.S. dollar account for most transactions with Japan, and the U.S. dollar is used extensively in Asian subsidiaries' transactions with third countries (Ito, Koibuchi, Sato and Shimizu, 2015). More generally, Boz, Casas, Georgiadis, Gopinath, Le Mezo, Mehl and Nguyen (2022) document the U.S. dollar's role as the dominant global vehicle currency and the euro's regional importance in trade invoicing. Because these assignments approximate rather than directly observe currency denomination, the Appendix reports robustness to alternative currency mappings.

We construct separate exposures because yen depreciation affects affiliate operations through both revenues and costs. Revenue-side exposure, $\Delta \ln E_f^S$, is larger when affiliates with greater weight in the parent network have more revenue assigned to currencies that appreciated against the yen, increasing the yen-denominated value of affiliate revenues and profits. Purchase-side exposure, $\Delta \ln E_f^P$, is larger when affiliates with greater network weight have more purchases assigned to currencies that appreciated against the yen, increasing yen-denominated input costs. Our mechanism centers on revenue-side exposure, while purchase-side exposure is included throughout as a control for cost-side exchange-rate exposure.

The parent-level measure is the main exposure used in the parent-firm regressions. We also estimate affiliate-level regressions using $\Delta \ln E_a^x$. These regressions allow us to examine whether the exposure measure predicts affiliate outcomes and allow us to assess whether nominal gains are accompanied by quantity adjustments rather than reflecting currency translation alone. Because our question concerns the value of foreign affiliate activity from the perspective of Japanese parent firms, nominal affiliate and parent outcomes are measured in yen, as reported in the surveys. Quantity outcomes, including employment and dispatched workers, are unaffected by currency conversion and therefore allow us to assess affiliate expansion beyond mechanical currency translation.

Figure 2 illustrates the exchange-rate shifters underlying the nested shift-share design. After 2020Q4, the yen depreciated sharply against the major currencies relevant for Japanese foreign affiliates, generating a broad increase in the yen value of foreign affiliate activity. The magnitude of the depreciation nevertheless differed substantially across currencies. Combined with predetermined differences in affiliate transaction geography, this cross-currency dispersion generates the firm-level exposure variation used in the analysis. The pre-2021 paths also show that the episode represented a departure from the preceding pattern rather than the continuation of an existing broad depreciation trend.

The Taiwan dollar and the Korean won provide an intuitive illustration. Taiwan and Korea are both important East Asian hosts for Japanese multinationals, with substantial affiliate activity in electronics and machinery. Their Japanese affiliates also have similar revenue geography in our data: approximately 70 percent of affiliate revenue is earned in the local market in both countries, while less than 10 percent comes from sales to Japan. Accordingly, under our baseline currency mapping, most of these affiliates' revenue exposure is assigned to the respective host-country currency. Through 2020, the yen followed nearly identical paths against the two currencies, with the series crossing repeatedly and remaining within a few log points of each other. Beginning in 2021, however, the paths diverged. By the end of 2022, the cumulative yen depreciation was approximately 22 log points against the Taiwan dollar and 11 log points against the won. All else equal, a parent whose network was weighted toward Taiwan therefore experienced substantially greater revenue-side exposure than one weighted toward Korea. The comparison illustrates

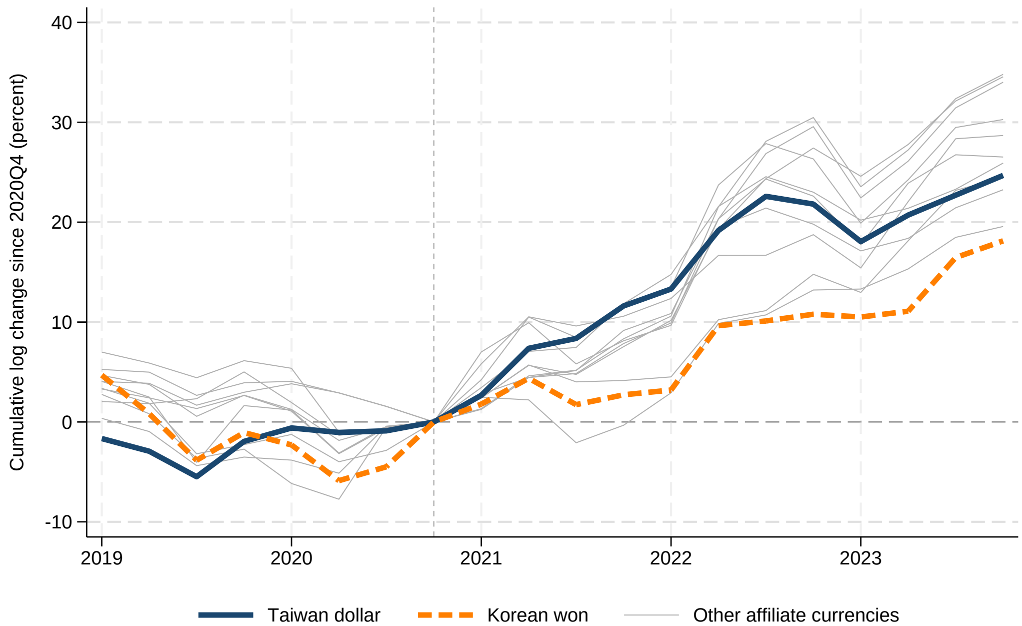

Figure 2: Yen Depreciation against Major Affiliate Currencies around 2021–22

Notes: This figure plots 100 times the cumulative log change in the yen exchange rate against each of the twelve currencies with the largest aggregate weights in the baseline revenue-side exposure measure, with each series normalized to zero in 2020Q4. Bilateral exchange rates are measured as yen per unit of foreign currency using quarterly data from the IMF's *International Financial Statistics*, so an increase denotes a yen depreciation. The Taiwan dollar and the Korean won are highlighted to illustrate the identifying variation: affiliates in Taiwan and Korea have similar revenue geography in our data, while the yen moved similarly against the two currencies through 2020 before the paths diverged beginning in 2021. The gray lines represent the remaining ten currencies: the U.S. dollar (USD), Chinese yuan (CNY), euro (EUR), Thai baht (THB), Singapore dollar (SGD), Indonesian rupiah (IDR), British pound (GBP), Hong Kong dollar (HKD), Australian dollar (AUD), and Canadian dollar (CAD).

how similar affiliate transaction structures generate different exposure when the currencies associated with local-market revenue move differently against the yen.

The exposure measures place the greatest weight on the U.S. dollar, the Chinese yuan, and other major Asian currencies. The United States and China account for approximately 30 and 17 percent of aggregate affiliate revenue, respectively, with other major Asian hosts accounting for much of the remainder. The underlying exposure components are also highly persistent. In the affiliate-year panel over 2015–2020, affiliate fixed effects account for approximately 97 percent of the variation in within-parent network weights and between 85 and 92 percent of the variation in transaction shares, whereas year fixed effects account for essentially none. The predetermined shares and weights therefore capture persistent features of firms' affiliate networks rather than short-run adjustments around the depreciation. Recomputing the exposure using the pre-pandemic 2015–2019 window produces similar results, as shown in the Appendix.

Identification. The identifying variation comes from the interaction of macro-level exchange-rate movements with predetermined affiliate transaction patterns and parent networks. At the affiliate level, exposure differs because affiliates differ in their pre-period transaction geography. At the parent level, exposure additionally reflects the composition of the affiliate network and each affiliate's importance within it. Bilateral yen movements are common to all Japanese firms exposed to a given currency and are taken as given by individual affiliates and parents. Identification requires that, conditional on the controls and fixed effects used below, these predetermined transaction patterns and network weights not proxy for other factors that differentially affect outcomes during the depreciation episode. In particular, more- and less-exposed units should not have been on different outcome trends before the depreciation or simultaneously affected by other shocks correlated with their currency exposure. The event-study specification below assesses whether more- and less-exposed units followed differential pre-trends and traces the timing of any subsequent differential adjustment.

3.3. Empirical Specifications

We estimate two complementary specifications for the affiliate- and parent-level outcomes examined in the empirical results that follow. Affiliate outcomes include operating performance, payments to the parent, and employment; parent outcomes include average wages, employment by category, and fixed assets. For notational compactness, let u index the unit of observation—an affiliate a in affiliate-level regressions and a parent firm f in parent-level regressions—and let $\Delta \ln E_u^x$, $x \in \{S, P\}$, denote the corresponding affiliate- or parent-level exposure measure.

The first specification is an event-study design. Its main purpose is diagnostic: it allows us to test for differential pre-trends and to trace the timing of adjustment around the 2021–22 depreciation. For outcome Y_{ut}, we estimate

$$Y_{ut} = \sum_{\tau \neq 2020} \beta_\tau \left(\Delta \ln E_u^S \times \mathbf{1}\{t=\tau\}\right) + \sum_{\tau \neq 2020} \gamma_\tau \left(\Delta \ln E_u^P \times \mathbf{1}\{t=\tau\}\right) + \alpha_u + \delta_t + \Lambda' X_{ut} + \varepsilon_{ut}. \quad (3.1)$$

Here τ indexes calendar years in the event-study window, with 2020 omitted as the base year. The exposure measures $\Delta \ln E_u^S$ and $\Delta \ln E_u^P$ are fixed unit-level measures constructed from the 2020–2022 exchange-rate changes. The coefficients β_τ trace whether units with greater revenue-side exposure experience differential changes relative to 2020, conditional on purchase-side exposure, fixed effects, and any additional controls included in the specification. Pre-2020 coefficients provide a test for differential pre-trends, while post-2020 coefficients trace the relative adjustment of more exposed units during the depreciation episode. The unit fixed effect α_u absorbs time-invariant differences across affiliates in affiliate-level regressions and across parent firms in parent-level regressions, while the year fixed effect δ_t absorbs shocks common to all units in a given year. The vector X_{ut} denotes any additional specification-specific controls, and ε_{ut} is an error term. When additional controls are included, they are reported in the corresponding figure notes.

The second specification is a long-difference regression over the depreciation episode:

$$\Delta Y_u^{2020\text{–}2022} = \beta \Delta \ln E_u^S + \gamma \Delta \ln E_u^P + \mu_{g(u)} + \Gamma' X_u + \varepsilon_u.$$

Here $\Delta Y_u^{2020\text{–}2022}$ denotes the change in the outcome between 2020 and 2022. The coefficient of interest is β, which captures the effect of revenue-side exposure. The purchase-side exposure, $\Delta \ln E_u^P$, is included throughout as a control for cost-side exchange-rate exposure. The fixed effect $\mu_{g(u)}$ absorbs group-specific shocks, X_u contains additional pre-period controls when included, and ε_u is an error term. For affiliate-level specifications, $\mu_{g(u)}$ denotes host-country-by-sector fixed effects; for parent-level specifications, it denotes parent-industry fixed effects. The long-difference estimates provide our main quantitative magnitudes for the 2021–22 depreciation episode, using 2020 as the pre-depreciation base year. For log outcomes, β measures how the 2020–22 log change in the outcome varies with revenue-side log exchange-rate exposure.

3.4. Empirical Results

We present the results in two steps. We first analyze affiliate-side outcomes, asking whether revenue-side exposure raises yen-denominated affiliate gains and whether the response includes real affiliate expansion beyond valuation alone. We then turn to parent-side outcomes to assess whether those gains are associated with changes in wages, employment composition, and domestic production activity at the Japanese parent.

3.4.1. Affiliate-Side Effects. Figure 3 presents event-study estimates for affiliate value added and total payments to the parent. Affiliate value added, defined as total sales minus intermediate input purchases, captures the net operating margin through which revenue- and purchase-side exchange-rate exposure affect affiliate activity. Total payments to the parent, which include dividends, royalties, and other transfers, measure the extent to which affiliate gains are transmitted financially to the Japanese parent.

The event-study estimates serve two purposes. First, they provide a pre-trend check: before the depreciation episode, affiliates with greater revenue-side exposure do not exhibit systematically different changes in value added or payments to the parent. Second, they show the timing of the response. Both outcomes rise only after 2020, when the yen depreciation begins, indicating that revenue-side exposure translated into higher yen-denominated affiliate gains and larger affiliate-to-parent payments during the depreciation episode.

Table 1 reports long-difference estimates for a broader set of affiliate outcomes. The 2021–22 depreciation episode coincided with substantial global disruptions, including pandemic-related restrictions, sector-specific demand shifts, and supply-chain bottlenecks. To separate exchange-rate exposure from these broader shocks, all specifications include host-country-by-sector fixed effects. These fixed effects absorb average changes common to affiliates operating in the same

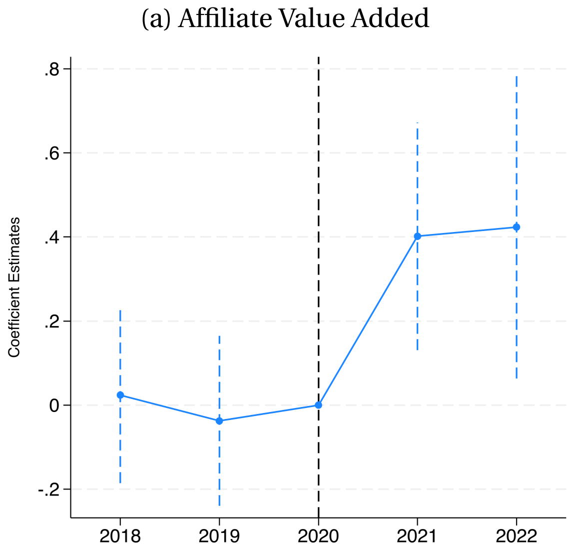

Figure 3: Event Study: Affiliate Value Added and Affiliate-to-Parent Payments

Notes: This figure reports the revenue-side coefficients β_τ from Equation (3.1), with 90% confidence intervals. The dependent variables are the log of affiliate value added and the log of total affiliate-to-parent payments. Affiliate value added is total affiliate sales minus purchases of intermediate inputs. All specifications include affiliate and year fixed effects, as well as the purchase-side shock interacted with year indicators. No additional controls are included. Standard errors are two-way clustered by host country and parent firm.

host country and sector, such as local COVID restrictions, destination-sector demand shifts, or supply disruptions affecting a particular market-sector cell. The estimates therefore compare affiliates operating in the same host country and sector that differ in their pre-period transaction geography and hence in their revenue- and purchase-side currency exposure.

Panel A shows broad increases in reported affiliate performance and financial flows. Revenue-side exposure is associated with higher value added, current profit, payments to the parent, and retained earnings, while the royalty response is not statistically significant. The magnitudes are economically meaningful: moving an affiliate from the 10th to the 90th percentile of the revenue-exposure distribution is associated with an approximately 19 percent increase in reported current profit. Current profit and payments to the parent also have similar point estimates, consistent with affiliate income gains being accompanied by larger payments to the parent.

Because these outcomes are reported in yen, their responses may combine changes in underlying affiliate performance with currency conversion. The survey reports neither the currencies in which the underlying transactions are denominated nor the conventions used to translate foreign accounts, so we do not attempt to decompose the estimates. This also cautions against expecting every payment component to respond uniformly. Royalties constitute a small share of total payments and may differ from dividends in their currency denomination or contractual adjustment, neither of which we observe. The insignificant royalty estimate is

Table 1: Impact of Exchange Rate Shocks on Affiliate Outcomes

Panel A: Profitability and Financial Flows					
	Value Added	Profit	Total Pay	Royalty	Ret. Earn
	(1)	(2)	(3)	(4)	(5)
$\Delta \ln E_a^S$	0.497**	0.754***	0.622***	0.064	0.832***
	(0.213)	(0.230)	(0.160)	(0.261)	(0.289)
$\Delta \ln E_a^P$	-0.272**	0.020	-0.364	-0.005	0.161
	(0.107)	(0.178)	(0.225)	(0.210)	(0.220)
Sector×Country FE	✓	✓	✓	✓	✓
p90–p10 effect (E^S)	0.129	0.193	0.147	0.015	0.219
N	8384	5601	4194	2365	4096
R-squared	0.100	0.096	0.085	0.132	0.093

Panel B: Real Activity					
	Emp	Disp. Emp	Rent Cost	R&D Cost	Cap. Invest.
	(1)	(2)	(3)	(4)	(5)
$\Delta \ln E_a^S$	0.149**	0.184**	-0.187	0.428	0.211
	(0.057)	(0.088)	(0.129)	(0.397)	(0.329)
$\Delta \ln E_a^P$	-0.216***	-0.177***	-0.083	-0.448	-0.186
	(0.044)	(0.057)	(0.128)	(0.452)	(0.324)
Sector×Country FE	✓	✓	✓	✓	✓
p90–p10 effect (E^S)	0.040	0.048	-0.048	0.102	0.054
N	9240	6379	6317	828	4642
R-squared	0.073	0.068	0.075	0.164	0.089

Notes: The dependent variables are the log changes in the indicated affiliate outcomes between 2020 and 2022. A log change requires a strictly positive value in both years, so each column is estimated on the affiliates positive for that outcome in 2020 and 2022, and the estimates describe the intensive margin rather than entry into or exit from profitability or from paying. Panel A reports profitability and financial flow outcomes and Panel B reports real activity outcomes. Value Added is defined as total affiliate sales minus total purchases of intermediate inputs. Profit is current profit. Total Pay is total payments to the parent company, including dividends, royalties, and related transfers; dividends account for nearly all of these payments for the typical affiliate. Royalty is royalty payments to the parent. Ret Earn is current retained earnings. Total Emp is total affiliate employment (headcount), including workers dispatched from the parent. Disp Emp is the number of workers dispatched from the parent to the affiliate. Rent Cost is rental expenditure, R&D Cost is research and development expenditure, and Cap Invest is capital investment expenditure excluding land. $\Delta \ln E_a^S$ is the revenue-side exchange-rate shock and $\Delta \ln E_a^P$ is the purchase-side shock. The "p90–p10 effect" row reports the predicted effect of moving an affiliate from the 10th to 90th percentile of the revenue shock distribution. All specifications include host-country × sector fixed effects. Standard errors are two-way clustered by host country and parent firm. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

therefore not inconsistent with the broader increase in affiliate-to-parent payments. We interpret Panel A as showing that revenue-side exposure raises reported affiliate income and payments to the parent, without assigning the response entirely to valuation or real activity.

Panel B provides more direct evidence of real affiliate expansion. Revenue-side exposure increases both affiliate employment and the number of workers dispatched from the Japanese parent. Total affiliate employment includes dispatched workers, but excluding them leaves the result essentially unchanged. The response is therefore visible in affiliate labor use as well as in reported yen-denominated outcomes.

None of the remaining revenue-side expenditure estimates is statistically significant. The point estimates are positive for capital investment and R&D and negative for rental costs, but none is precisely estimated.

The increase in dispatched workers is particularly informative because it provides an observable, albeit narrow, measure of labor supplied directly by the parent to foreign affiliates. In the Appendix, we test whether this response is stronger among sales- and services-oriented affiliates, where parent-supplied commercial and coordination functions may be especially important, than among manufacturing affiliates. The dispatched-worker response is significantly stronger among sales- and services-oriented affiliates, while total affiliate employment shows no comparable differential, whether measured before or after subtracting dispatched workers. Although we do not observe the specific tasks performed by dispatched workers, this pattern points to a parent-supplied support component beyond the broader increase in affiliate labor demand.

Finally, although purchase-side exposure is not the focus of the paper, its estimates provide a useful internal check on the exposure design. Greater purchase-side exposure reduces value added in Panel A and both affiliate employment and dispatched workers in Panel B, while its remaining coefficients are imprecisely estimated. This contrasting pattern supports the interpretation that the two exposure measures distinguish revenue and cost channels rather than capturing a generic response to foreign-currency movements. Including purchase-side exposure throughout also means that the revenue-side estimates are conditional on affiliates' cost exposure.

Overall, the affiliate evidence documents the first link in the spillback channel: greater revenue-side exposure is associated with higher reported affiliate income and larger payments to the parent, alongside employment-based evidence of real affiliate expansion. We next turn to whether these affiliate-side gains are associated with adjustments in wages, employment composition, and domestic activity at the Japanese parent.

3.4.2. Parent-Side Effects. We now turn to parent-side outcomes in Japan. Figure 4 presents event-study estimates for parent wages and employment composition. To distinguish exposure through foreign affiliates from conventional trade exposure and other pre-existing firm differences, these specifications interact a set of predetermined parent characteristics with year indicators.

Panel (a) shows no differential pre-trend in average wages, followed by an increase after 2020 among parents with greater revenue-side affiliate exposure. Panel (b) shows that the employment adjustment is concentrated in composition rather than total employment. Non-production

Figure 4: Event Study: Parent Wage and Employment Composition

Notes: This figure reports the revenue-side coefficients β_τ from Equation (3.1), with 90% confidence intervals. Panel (a) uses log average parent wages as the dependent variable. Panel (b) uses log non-production support employment, log other parent employment, and log total parent employment, defined as in Section 3.1. Non-production support and other parent employment do not exhaust total parent employment, which also includes head-office employees and workers dispatched by the parent. The omitted year is 2020. All specifications include parent-firm and year fixed effects, the purchase-side shock interacted with year indicators, and pre-period parent controls interacted with year indicators. Exposure-related controls—affiliate revenue and purchase coverage and parent export and import shares—are measured in 2020, the baseline year for the depreciation episode, whereas the total wage bill, total parent employment, and R&D expenditure are measured in 2018 to capture broader firm characteristics before the pandemic. Standard errors are clustered by industry.

support employment rises after 2020, while other parent employment declines and total employment stays approximately flat. The divergence emerges only with the depreciation episode, consistent with a shift in the composition of parent-side activity toward support functions rather than a broad expansion of domestic employment.

Table 2 reports long-difference estimates for parent-firm outcomes. The results reinforce the event-study evidence. Revenue-side affiliate exposure raises average parent wages, while total parent employment remains broadly unchanged. The employment response instead appears in composition: non-production support employment increases, while other establishment employment declines. Head-office employment, which the table reports separately, does not respond.

The magnitudes are economically meaningful. Moving a parent firm from the 10th to the 90th percentile of the revenue-exposure distribution raises non-production support employment by approximately 9 percent and reduces other employment by approximately 7 percent. Domestic fixed assets also decline by about 5 percent. The parent-side response is therefore concentrated in wages and employment composition rather than in total employment or domestic capital expansion.

Table 2: Impact of Affiliate Exchange Rate Shock on Parent Outcomes

	Avg Wage	Total Emp	Head Emp	NP Support Emp	Other Emp	Fix Asset
$\Delta \ln E_f^S$	0.169**	-0.014	-0.160	0.384**	-0.297*	-0.201***
	(0.098)	(0.054)	(0.174)	(0.200)	(0.186)	(0.062)
	[0.080]	[0.038]	[0.129]	[0.152]	[0.173]	[0.064]
$\Delta \ln E_f^P$	-0.038	-0.033	-0.036	0.111	-0.007	-0.033
	(0.080)	(0.060)	(0.120)	(0.183)	(0.205)	(0.047)
	[0.071]	[0.048]	[0.101]	[0.198]	[0.164]	[0.059]
p90–p10 effect (E^S)	0.042	-0.004	-0.039	0.093	-0.070	-0.049
Industry FE	✓	✓	✓	✓	✓	✓
N	1,811	1,811	1,811	1,125	1,446	1,811
R^2	0.136	0.072	0.057	0.084	0.092	0.063

Notes: This table reports long-difference estimates of the effect of affiliate exchange-rate shocks on parent-firm outcomes. The dependent variables are log changes in the indicated outcomes between 2020 and 2022. $\Delta \ln E_f^S$ is the revenue-side parent-level exchange-rate shock, constructed as the pre-period affiliate-revenue-share-weighted average of affiliate-specific shocks. $\Delta \ln E_f^P$ is the corresponding purchase-side shock. Ave Wage is average wage. Total Emp is total parent employment. Head Emp, Support Emp, and Other Emp are head-office employment, non-production support employment, and other parent employment. Fix Asset is parent fixed assets. Controls include affiliate revenue and purchase coverage, parent export and import shares, R&D expenditure, the total wage bill, and total employment, all measured in 2020. All specifications include industry fixed effects. The "p90–p10 effect" row reports the predicted effect of moving a parent firm from the 10th to the 90th percentile of the revenue-shock distribution. Parentheses report industry-clustered standard errors. Brackets report shift-share robust standard errors following Borusyak et al. (2022). Significance levels are based on shift-share robust standard errors. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Because the parent survey reports average wages only at the firm level, we cannot determine whether the wage response reflects wage increases within employment categories, changes in workforce composition, or both. We therefore interpret the result as an increase in average wages at the parent without assigning it to a particular worker-level margin.

To assess whether the employment response is connected to foreign operations, the Appendix examines how it varies with the scale of the parent's foreign affiliate workforce. The response is concentrated among parents with larger affiliate workforces, with little response below the median. Although the survey cannot identify the activities supported by individual employees, this heterogeneity provides indirect evidence linking the parent-side employment response to foreign affiliate operations.

Purchase-side exposure does not generate a comparable parent-side response. Its coefficients are small and generally statistically insignificant across wages, employment categories, and fixed assets. This pattern accords with the affiliate-level evidence: cost-side exposure affects some affiliate outcomes but is not associated with comparable parent-facing income gains. The parent-side results therefore point to the revenue-side affiliate-income channel as the primary source of spillbacks to Japanese parents.

The results are qualitatively similar across alternative fixed-effect structures, controls, samples, and exposure constructions, as reported in the Appendix.

3.5. Empirical Takeaways

The empirical evidence reveals a common pattern across foreign affiliates and their Japanese parents. Greater revenue-side exposure raises reported affiliate value added, profits, retained earnings, and payments to the parent. Affiliate employment and dispatched workers also increase, showing that the response includes real affiliate expansion. At the parent, average wages and non-production support employment at domestic commercial establishments rise, while total employment remains broadly unchanged and domestic fixed assets decline. Foreign affiliate gains are therefore accompanied by a shift in the composition of parent-side activity rather than a broad domestic expansion.

Taken together, these findings point to a parent-support margin in multinational adjustment. The increase in dispatched workers directly captures a narrow form of labor supplied by parents to foreign affiliates. The rise in non-production support employment indicates a broader parent-side adjustment. Although the survey cannot determine whether individual support employees serve domestic operations or foreign affiliates, the response is concentrated among parents with larger foreign affiliate workforces. Additional tests reported in the Appendix find no evidence that the response is amplified by affiliates' sourcing from Japan or varies systematically with pre-period parent leverage.

These findings motivate the firm-level model developed next. We subsequently embed the mechanism in a general-equilibrium framework to study its implications for exchange-rate transmission.

4 A Model of Exchange-Rate Transmission within MNEs

We develop a stylized model in which parent-side support services are productive, scarce, and allocated between domestic operations and foreign affiliates. The model formalizes the allocation margin suggested by the empirical evidence: a depreciation raises the parent-currency value of foreign affiliate activity and therefore raises the relative return to allocating parent-side support services to foreign affiliates. This framework rationalizes the expansion of support functions without a broad expansion of domestic production. It also generates higher support wages, one possible contributor to the increase in average parent wages observed in the data.

The model builds on the idea that multinational production uses parent-side organizational inputs that are not freely scalable across locations. This idea goes back to the span-of-control logic of Lucas (1978), in which managerial or organizational capacity is a scarce factor that limits the scale of production. It is also closely related to Burstein and Monge-Naranjo (2009), who model managerial know-how as requiring direct involvement and therefore entailing an opportunity cost across tasks and locations. The organizational input in our model is broader than managerial know-how narrowly defined. We interpret it as an operational support margin encompassing coordination, logistics, procurement, sales support, engineering, and other business functions. Our employment measure captures one observable component of this broader margin—employment at domestic commercial establishments—and does not require support activity to be located in formal headquarters units.

Other aspects of the model are intentionally parsimonious. We abstract from vertical input sourcing, global value-chain linkages, transfer pricing, endogenous affiliate location or ownership, and capital accumulation. This lets us isolate a revenue-side exchange-rate shock and focus on the internal allocation margin directly connected to the empirical patterns in Section 3.

4.1. Multinational Firm

Consider a multinational firm composed of a domestic parent and a foreign affiliate. The parent produces domestic output using production labor and parent-side support services:

$$Y = F(S_d, L),$$

where Y is domestic output, L is domestic production labor, and S_d denotes support services allocated to domestic operations. We assume that F is twice continuously differentiable and increasing in both inputs:

$$\frac{\partial F(S_d, L)}{\partial S_d} > 0, \qquad \frac{\partial F(S_d, L)}{\partial L} > 0.$$

The parent also produces support services using non-production support labor:

$$S = N,$$

where N is support labor. These support services are allocated between domestic operations and the foreign affiliate:

$$S = S_d + S_a,$$

where S_a denotes support services allocated to the foreign affiliate. This allocation constraint captures the idea that managerial, sales, logistics, coordination, and administrative inputs are scarce within the firm.

The foreign affiliate produces output using local production labor and support services from the parent:

$$Y^* = F(S_a, L^*),$$

where Y^* is affiliate output and L^* is foreign production labor. Affiliate operating surplus is

$$\widetilde{\Pi}^* = P^* Y^* - W_L^* L^*.$$

Let $\mathscr{E}$ denote the nominal exchange rate, measured as units of domestic currency per unit of foreign currency. Thus, for a Japanese parent, an increase in $\mathscr{E}$ denotes a yen depreciation. An effective fraction $\xi \in [0,1]$ of affiliate operating surplus is internalized by the Home parent in its income and resource-allocation decisions.[5] The Home-currency value of affiliate income entering the parent's problem is therefore $\xi \mathscr{E} \widetilde{\Pi}^*$.

To define the operating value of domestic and affiliate production, let domestic and foreign inverse demands be summarized by revenue functions

$$R(Y) \equiv P(Y)Y, \qquad R^*(Y^*) \equiv P^*(Y^*)Y^*.$$

The price choice is therefore implicit in the inverse demand curve: conditional on output, domestic and affiliate operations charge the prices that clear demand.

Given support services S_d, the domestic parent operation chooses production labor to maximize operating profit:

$$V(S_d) \equiv \max_L \{R(F(S_d, L)) - W_L L\}. \tag{4.1}$$

Similarly, given support services S_a, the affiliate chooses local production labor to maximize operating profit:

$$V^*(S_a) \equiv \max_{L^*} \left\{R^*\left(F(S_a, L^*)\right) - W_L^* L^*\right\}. \tag{4.2}$$

The parent chooses total support labor and the internal allocation of support services. It hires support labor from an upward-sloping firm-specific labor supply curve:

$$W_N(N) = \overline{W}_N \left(\frac{N}{\overline{N}}\right)^{1/\varepsilon_N}, \qquad \varepsilon_N > 1.$$

The total cost of support labor is therefore

$$C(N) = W_N(N)N,$$

with marginal cost $C'(N)$. For the isoelastic labor supply schedule above,

$$C'(N) = W_N(N)\left(1 + \frac{1}{\varepsilon_N}\right),$$

and $C''(N) > 0$.

[5]We interpret ξ as a reduced-form affiliate-income pass-through parameter, rather than as the Home parent's legal equity share or the affiliate's statutory dividend payout rate. In the quantitative model, ξ is disciplined using affiliate-to-parent payments relative to affiliate current income, which we use as a proxy for the strength of the income linkage between the affiliate and the parent. The model abstracts from the accounting distinction between distributed and reinvested earnings and from the associated financial-account entry. The remaining share does not enter the Home parent's reduced-form objective.

Given the above operating value functions, the parent chooses total support labor and its allocation across domestic and affiliate operations to solve

$$\max_{S_d,S_a,N} V(S_d)+\mathscr{E}\xi V^*(S_a)-C(N),$$

subject to

$$N=S_d+S_a.$$

Under this formulation, support allocated to the affiliate is an unpriced internal input rather than a service sold separately to the affiliate. The parent bears the support-labor cost $C(N)$, while its return from affiliate operations enters through $\mathscr{E}\xi V^*(S_a)$.

4.2. Optimal Allocation of Support

Substituting the support-resource constraint $N=S_d+S_a$ into the parent's problem, the parent solves

$$\max_{S_d,S_a} \; V(S_d)+\mathscr{E}\xi V^*(S_a)-C(S_d+S_a). \tag{4.3}$$

For an interior allocation, the first-order conditions are

$$V'(S_d)=C'(N),$$
$$\mathscr{E}\xi V^{*\prime}(S_a)=C'(N).$$

Combining these conditions gives the central allocation equation:

$$V'(S_d)=\mathscr{E}\xi V^{*\prime}(S_a). \tag{4.4}$$

Equation (4.4) shows how exchange rates affect the internal allocation of support services. A depreciation raises $\mathscr{E}$, and therefore raises the parent-currency marginal value of affiliate operating profits. At the initial allocation, the marginal value of support allocated to the foreign affiliate rises relative to the marginal value of support allocated to domestic operations. The parent therefore has an incentive to shift support toward the affiliate.

The first-order conditions also discipline the scale of support employment. Total support N is chosen so that the marginal cost of support labor equals the marginal value of support in each operation. Hence, the response to depreciation has both an allocation margin and a scale margin: the parent can reallocate support across operations, but can also expand total support employment at increasing marginal cost. The following proposition characterizes these two margins jointly.

Proposition 4.1 (Depreciation and support reallocation)**.** *Consider the parent support-allocation problem in Equation* (4.3)*. Suppose the optimum is interior, $\mathscr{E}>0$, and the pass-through parameter ξ is fixed and strictly positive. Suppose $V(S_d)$ and $V^*(S_a)$ are increasing and strictly* *concave. Suppose also that support labor costs are convex,* $C''(N) > 0$*, and that the support wage is increasing in support employment,* $W'_N(N) > 0$*. Then, locally, a depreciation,* $d\mathcal{E} > 0$*, reallocates support services toward the foreign affiliate and away from domestic operations, while raising total support employment and the support wage:*

$$dS_a > 0, \qquad dS_d < 0, \qquad dN > 0, \qquad dW_N > 0.$$

Proof. See the Appendix. ■

Proposition 4.1 characterizes the model's internal allocation margin. It shows that a depreciation shifts parent-side support services toward affiliate operations and away from domestic operations, while increasing total support employment and the support wage. In the data, however, the allocation of support services across domestic and affiliate operations is not directly observable. We therefore ask how this unobserved reallocation should be reflected in observed production outcomes.

Let

$$L = \ell(S_d), \qquad L^* = \ell^*(S_a)$$

denote the optimal production-labor choices from Equation (4.1) and Equation (4.2). In general, the sign of the production-labor response depends on whether allocated support raises the marginal profitability of production labor. If

$$\ell'(S_d) > 0, \qquad \ell^{*\prime}(S_a) > 0, \tag{4.5}$$

then the support reallocation in Proposition 4.1 maps into observed production labor responses:

$$dL^* > 0, \qquad dL < 0.$$

Thus the model links a latent internal resource-allocation margin to observable outcomes: affiliate production employment rises, while domestic production employment faces downward pressure.[6] The following corollary shows that this mapping from unobserved support reallocation to observed production labor obtains under standard demand and production assumptions.

Corollary 4.1 (Isoelastic demand and Cobb-Douglas production)**.** *Suppose domestic and affiliate revenue functions are isoelastic:*

$$R(Y) = AY^{\rho}, \qquad R^*(Y^*) = A^*(Y^*)^{\rho}, \qquad 0 < \rho < 1,$$

and the production function is Cobb-Douglas:

$$F(S, L) = S^{\alpha_S} L^{\alpha_L}, \qquad \alpha_S > 0, \quad \alpha_L > 0,$$

[6] The Appendix provides primitive conditions under which Equation (4.5) holds.

with

$$\rho(\alpha_S + \alpha_L) < 1.$$

Then optimized production-labor demand is increasing in allocated support:

$$\ell'(S_d) > 0, \qquad \ell^{*\prime}(S_a) > 0.$$

Therefore, if support is reallocated toward the affiliate, $dS_a > 0$ and $dS_d < 0$, then

$$dL^* > 0, \qquad dL < 0,$$

which implies

$$dY^* > 0, \qquad dY < 0.$$

Proof. See the Appendix. ■

The partial-equilibrium result should not be read as predicting an outright decline in aggregate domestic output. Expenditure switching, domestic demand, and aggregate shocks may offset the crowding-out force identified here. The implication is instead that support reallocation places downward pressure on domestic multinational production, so a depreciation need not generate a broad domestic production boom.

4.3. Discussion of the Mechanism

The model highlights a transmission channel distinct from standard expenditure switching. In the textbook channel, a depreciation stimulates domestic production by making Home goods cheaper relative to Foreign goods. Here, depreciation also operates through the multinational firm's internal organization: it raises the parent-currency value of foreign affiliate activity and thereby increases the return to parent-side support used in affiliate operations.

The key step is that the exchange-rate valuation gain need not be purely passive. The parent-currency value of affiliate operating surplus internalized by the parent is

$$\mathcal{E}\xi V^*(S_a).$$

Holding the foreign revenue function $R^*(\cdot)$, the foreign production wage W_L^*, and the pass-through parameter ξ fixed, a depreciation affects this object through two margins:

$$d\big(\mathcal{E}\xi V^*(S_a)\big) = \underbrace{\xi V^*(S_a)\,d\mathcal{E}}_{\text{valuation effect}} + \underbrace{\mathcal{E}\xi V^{*\prime}(S_a)\,dS_a}_{\text{support response}}.$$

The first term is the mechanical valuation effect: holding affiliate support fixed, a depreciation raises the parent-currency value of existing affiliate profits. The second term captures the endogenous production response of the multinational firm. If the higher parent-currency return to affiliate activity raises affiliate support, $dS_a > 0$, then depreciation increases affiliate surplus itself, not only its currency value.

This distinction separates the mechanism from a pure valuation benchmark. A pure valuation channel can raise measured affiliate income, but by itself it has no direct implication for affiliate employment, parent-side support employment, support wages, or domestic production. The support response adds this missing margin: depreciation changes the parent firm's demand for support services and the allocation of those services across domestic and foreign operations.

Other mechanisms may also explain parts of the evidence. For example, a wealth or financial-relaxation channel could raise parent resources and activity broadly, while readily scalable support services could allow affiliate activity to expand without crowding out domestic operations. The scarce-support interpretation emphasized here is motivated by the joint pattern that affiliate activity expands, parent-side support employment and average parent wages rise, and domestic production responds weakly.[7]

5 Exchange-Rate Transmission in General Equilibrium

Section 4 characterizes how an individual multinational firm responds to a depreciation when parent-side support services are scarce and allocated across domestic and foreign operations. We now embed that multinational mechanism in a two-country New Keynesian environment. The general-equilibrium extension is needed to determine how this firm-level response interacts with expenditure switching, equilibrium wages and prices, monetary policy, and the external accounts. Unless otherwise noted, we retain the notation of Section 4, adding time subscripts to variables that now vary over time and sector or location subscripts where needed.

The model allows Home firms to serve Foreign demand in two distinct ways. Tradable firms produce at Home and export to Foreign households, generating domestic value added and trade-balance receipts. Multinational parents can instead serve Foreign customers through affiliates producing abroad. Affiliate production does not contribute to Home GDP or the Home trade balance, but the affiliate-income flow internalized by the Home parent is mapped into direct investment income.

Figure 5 summarizes the goods, parent-support, and affiliate-income flows. The tradable block generates the conventional expenditure-switching channel. The multinational block generates an income-account channel through the valuation and endogenous response of foreign affiliate operating surplus, together with the parent-support mechanism documented in the firm-level evidence. The Foreign economy is defined symmetrically.

The full equilibrium system is reported in the Appendix. In brief, households consume

[7] In the Appendix, we assess the financial-relaxation interpretation by interacting the revenue-side shock with the parent's initial leverage. More financially constrained parents do not respond more strongly, providing little support for a financial-relaxation mechanism.

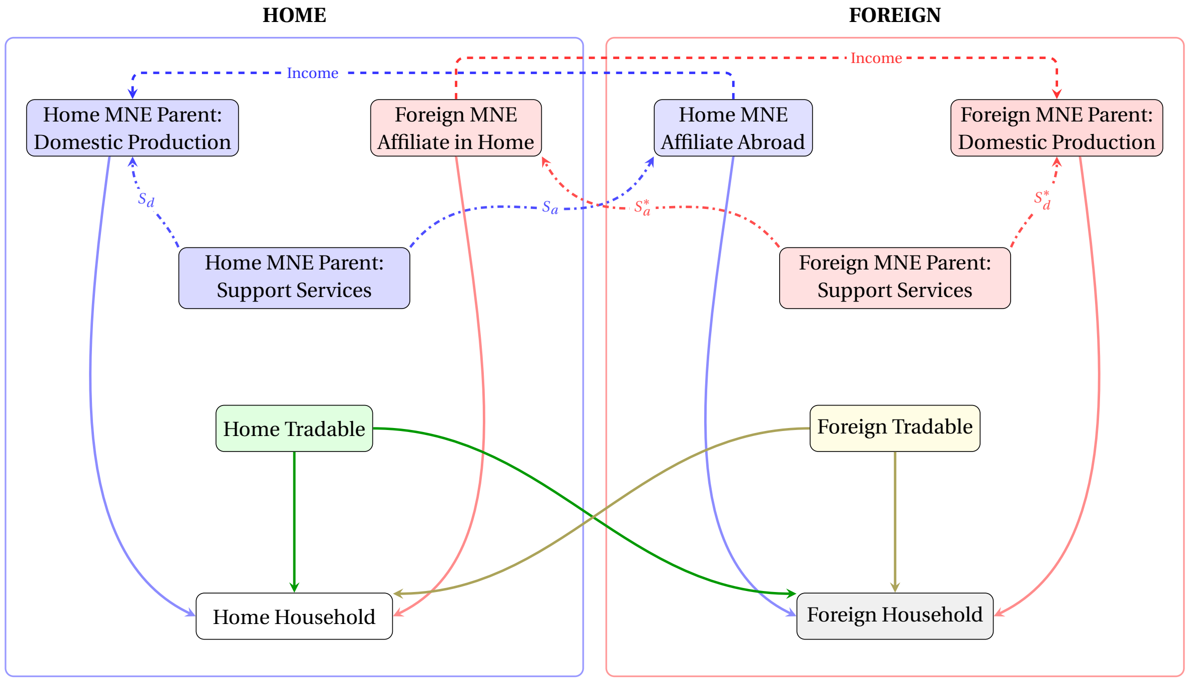

Figure 5: Goods, Support, and Affiliate-Income Flows in the Model

Notes: The figure is a partial flow diagram highlighting the goods, parent-support, and affiliate-income flows that enter the external-account decomposition. Household payments for goods, wage and profit payments, bond trade, and monetary policy are omitted. The support boxes are part of the parent firms and are drawn separately only to display the allocation of parent support between domestic production, S_d, and foreign affiliate activity, S_a. Solid arrows denote goods flows, dash-dotted arrows denote parent-support allocations, and dashed arrows denote flows entering the parent firm's income.

tradable and multinational goods, supply production and non-production support labor, and trade a one-period foreign-currency bond. Tradable and multinational producers set local-currency prices subject to Rotemberg adjustment costs. Monetary policy follows a Taylor rule, and the international bond position is stabilized by a debt-elastic interest-rate premium as in Schmitt-Grohé and Uribe (2003).

The rest of this section presents the four elements needed for the quantitative exercises. First, the demand system determines the relative scale of trade and multinational production. Second, the parent-support allocation condition carries the firm-level mechanism into general equilibrium. Third, the international financial-market block governs international asset pricing and introduces the disturbance used to generate the depreciation experiment. Fourth, the national-accounting structure distinguishes production located at Home from income generated abroad but accruing to Home residents.

5.1. Foreign-Market Organization

Because our focus is short-run exchange-rate transmission, we take each economy's existing organization of foreign-market activity between exports and multinational production as given.

Quantitative trade models have treated exports and multinational production as alternative ways of serving foreign markets (Ramondo and Rodriguez-Clare, 2013). Consistent with our empirical design, which measures exchange-rate exposure using firms' pre-existing affiliate networks, we treat this organization as predetermined over the horizon of interest and ask how it shapes exchange-rate transmission.[8]

Final consumption is a constant-elasticity-of-substitution (CES) aggregate of a multinational-goods composite, $C_{M,t}$, and a tradable-goods composite, $C_{T,t}$:

$$C_t = \left[\omega^{\frac{1}{\eta}} C_{M,t}^{\frac{\eta-1}{\eta}} + (1-\omega)^{\frac{1}{\eta}} C_{T,t}^{\frac{\eta-1}{\eta}}\right]^{\frac{\eta}{\eta-1}},$$

where ω governs the expenditure weight on multinational goods and η is the elasticity of substitution between multinational and tradable goods.

Each sectoral composite $C_{\ell,t}$, for $\ell \in \{M, T\}$, combines a Home and a Foreign component:

$$C_{\ell,t} = \left[\omega_\ell^{\frac{1}{\eta_\ell}} C_{\ell H,t}^{\frac{\eta_\ell-1}{\eta_\ell}} + (1-\omega_\ell)^{\frac{1}{\eta_\ell}} C_{\ell F,t}^{\frac{\eta_\ell-1}{\eta_\ell}}\right]^{\frac{\eta_\ell}{\eta_\ell-1}}, \qquad \ell \in \{M, T\}.$$

Within the tradable composite, $C_{TH,t}$ is consumption of Home-produced tradable goods and $C_{TF,t}$ is consumption of imported Foreign tradable goods. Thus, ω_T governs the Home share of tradable demand and disciplines the scale of the export channel.

Within the multinational composite, $C_{MH,t}$ is consumption of goods produced in Home by Home multinational parents, while $C_{MF,t}$ is consumption of goods produced in Home by affiliates of Foreign multinational parents. Thus, ω_M governs the parent-country composition of multinational goods consumed in Home. By symmetry, it also disciplines the scale of production abroad by affiliates of Home multinational parents. The top-level weight ω determines the aggregate importance of the multinational block.

To summarize how Home firms serve Foreign markets, let $\mathscr{X}$ denote steady-state Home exports and let $\mathscr{A}$ denote steady-state sales abroad by affiliates of Home multinational parents. We define the affiliate share of Home foreign-facing sales as

$$\vartheta_A \equiv \frac{\mathscr{A}}{\mathscr{X} + \mathscr{A}}. \tag{5.1}$$

A higher value of ϑ_A means that a larger share of sales to Foreign customers is supplied through affiliate production abroad rather than through exports produced at Home.

In the counterfactual exercises, we compare economies with different values of ϑ_A. For each target value, we jointly recalibrate the tradable and multinational home-bias weights, ω_T and ω_M, together with their Foreign counterparts under symmetry, so that the model matches the

[8] Endogenizing firms' choice between exporting and affiliate production would be important for studying FDI entry, plant location, and the long-run organization of production.

corresponding affiliate share while maintaining the baseline ratio of total foreign-facing sales to GDP. Equivalently, the two demand weights are chosen to match the implied export-to-GDP and affiliate-sales-to-GDP ratios. The top-level multinational expenditure weight ω and the remaining structural parameters are held fixed.

5.2. Multinational Production and Parent Support

The multinational block carries the parent-support mechanism from Section 4 into the general-equilibrium model. A Home parent hires support labor N_t, transforms it one-for-one into support services S_t, and allocates those services between domestic operations and its foreign affiliate:

$$S_t = N_t = S_{d,t} + S_{a,t}.$$

Domestic parent production and foreign affiliate production are

$$Y_{MH,t} = F(S_{d,t}, L_{MH,t}),$$
$$Y^*_{MH,t} = F(S_{a,t}, L^*_{MH,t}),$$

where $L_{MH,t}$ is production labor employed by the Home parent and $L^*_{MH,t}$ is production labor hired locally by the affiliate abroad. In the quantitative exercises,

$$F(S,L) = S^{\alpha_S} L^{1-\alpha_S}.$$

Parent support allocated abroad is not separately priced in the benchmark and therefore does not generate a service-export receipt; Section 5.4 states the corresponding national-accounting convention.

Let $\widetilde{\Pi}^*_{MH,t}$ denote the operating surplus of the affiliate of a Home multinational parent located abroad, measured in Foreign currency. As in Section 4, the Home parent internalizes an effective fraction (ξ) of this surplus. Its Home-currency value is

$$\mathscr{E}_t \xi \widetilde{\Pi}^*_{MH,t}.$$

Let $Q_{MH,t}$ be the Home-currency shadow value of relaxing the domestic MNE production constraint, and let $Q^*_{MH,t}$ be the Foreign-currency shadow value of relaxing the affiliate production constraint. The optimal allocation of parent support satisfies

$$Q_{MH,t} F_S(S_{d,t}, L_{MH,t}) = \mathscr{E}_t \xi Q^*_{MH,t} F_S(S_{a,t}, L^*_{MH,t}) = MC^N_t, \tag{5.2}$$

where MC^N_t is the marginal cost of a unit of parent support.

Equation (5.2) is the general-equilibrium counterpart of the allocation condition in Section 4. The underlying firm-level force is unchanged: a depreciation raises the Home-currency marginal value of support allocated to the foreign affiliate. The general-equilibrium environment makes the shadow values $Q_{MH,t}$ and $Q^*_{MH,t}$, as well as the marginal cost MC^N_t, endogenous to product demand, wages, prices, and monetary policy. The parent-support decision can therefore affect both the location of multinational production and aggregate equilibrium outcomes. We do not repeat the comparative statics from Section 4; Section 6 evaluates their quantitative importance in general equilibrium.

5.3. International Financial Markets

Home households trade a one-period bond denominated in Foreign currency. Define the real exchange rate and the Home-currency real value of Foreign bond holdings as

$$q_t \equiv \frac{\mathcal{E}_t P_t^*}{P_t}, \qquad b_t \equiv \frac{\mathcal{E}_t B_{F,t}}{P_t}.$$

An increase in q_t denotes a Home real depreciation.

Let λ_t denote the Home household's marginal utility of consumption. The Euler equation for the Foreign-currency bond is

$$1 = \beta \mathbb{E}_t \left[\frac{\lambda_{t+1}}{\lambda_t} \frac{R_t^*}{\pi_{t+1}^*} \frac{q_{t+1}}{q_t} \frac{\exp(\psi_{rp,t})}{1 + \psi_b (b_t - \overline{b})} \right], \tag{5.3}$$

where $\psi_b > 0$ is the debt-elastic premium parameter and $\psi_{rp,t}$ is an exogenous risk-premium disturbance. The quantitative experiment uses an innovation to this disturbance to generate a Home depreciation. The risk-premium disturbance generates deviations from uncovered interest parity.

5.4. Production Location and the External Accounts

The model distinguishes where production occurs from where the resulting income accrues. Production within Home contributes to Home GDP irrespective of the parent country of the producer. Production abroad by an affiliate of a Home multinational parent does not contribute to Home GDP, but the model counterpart of affiliate income internalized by the Home parent enters direct investment income.[9]

To close the national accounts, the benchmark normalizes the transfer price of parent support to zero rather than imposing an unobserved intrafirm service charge. Support allocated abroad is therefore not recorded as a service export. Its wage cost is borne by the Home parent and reduces the parent's resident operating surplus; the resulting labor compensation and reduction in operating surplus offset in Home GDP, so the activity does not constitute a separate addition to Home GDP. The effective fraction ξ of affiliate operating surplus accruing to the Home parent is recorded as direct investment income and therefore enters Home gross national income and the current account, but not Home GDP. The treatment is symmetric: support supplied by a

[9] Parent-country labels identify the multinational group with which the affiliate is associated. The parent determines the allocation of parent-side support, while ξ governs the effective fraction of affiliate operating surplus that enters the Home parent's income and allocation problem.

Foreign parent to an affiliate producing in Home is not recorded as a Home service import, while the affiliate's local production enters Home GDP and the income accruing to its Foreign parent is recorded as a direct-investment-income debit.[10]

All external-account flows are expressed in nominal Home-currency units. Let TB_t denote the Home trade balance, defined as export receipts from Home-produced tradable goods net of expenditure on imported tradable goods. Multinational goods, by contrast, are produced and consumed locally. Foreign affiliate activity therefore enters the external accounts through direct investment income rather than through the trade balance. The model counterpart of the Home direct investment income balance is

$$DII_t = \underbrace{\mathscr{E}_t \xi \widetilde{\Pi}^*_{MH,t}}_{\text{affiliate income of Home parents}} - \underbrace{\xi^* \widetilde{\Pi}_{MF,t}}_{\text{affiliate income of Foreign parents}}, \tag{5.4}$$

where $\widetilde{\Pi}_{MF,t}$ is the operating surplus of affiliates of Foreign multinational parents located in Home, and ξ^* is the corresponding effective affiliate-income pass-through parameter for Foreign parents.

A depreciation affects the first term in Equation (5.4) through two conceptually distinct margins. Holding affiliate operating surplus fixed, it raises the Home-currency value of Foreign-currency affiliate income. It may also change affiliate operating surplus through equilibrium demand and the reallocation of parent support.[11]

This distinction also broadens the transmission of exchange-rate movements to the current account. In standard open-economy models without multinational production, the production-side component of current-account adjustment is captured by cross-border trade flows, TB_t. With multinational production, foreign affiliate activity also generates a direct investment income balance, DII_t, so the Home current account in the model is

$$CA_t = TB_t + DII_t + PI_t,$$

where PI_t denotes net portfolio income on international bond holdings.

These relationships clarify the role of the general-equilibrium extension. The firm-level model in Section 4 determines how a depreciation reallocates activity within the multinational

[10] In practice, some parent activities are priced as management or technical services or as charges for the use of intellectual property. Our data identify neither destination-specific parent support nor the associated intrafirm transfer prices. Assigning a positive price—even one imputed at labor cost—would therefore require additional assumptions about cost allocation, markups, contracting, and tax treatment, introducing a distinct transfer-pricing mechanism that is not disciplined by our data. We use the zero-price normalization to isolate the real support-allocation channel, while disciplining aggregate affiliate income with measured direct-investment-income credits.

[11] The model abstracts from the balance-of-payments decomposition of direct investment income into distributed earnings, reinvested earnings, and intercompany interest. The parameters ξ and ξ^* provide a reduced-form mapping from affiliate operating surplus to the affiliate-income flows entering the parent countries' external accounts. Affiliate-to-parent payments are used to discipline the strength of this mapping, but are not interpreted as an exact accounting measure of accrual-based direct investment income.

firm, while the general-equilibrium model determines how that reallocation affects domestic production, direct investment income, and the overall current-account response.

6 Quantitative Implications

We use the general-equilibrium model to quantify how multinational production shapes exchange-rate transmission. The calibration combines aggregate and firm-level evidence. Japanese aggregate data discipline the steady-state scale and composition of foreign-market activity, including the relative roles of exports and affiliate production, while the parent-level estimates in Section 3 discipline the allocation of support within multinational firms.

The quantitative analysis proceeds in three steps. First, we decompose the direct investment income response to a depreciation into a mechanical currency-translation component and an endogenous component arising from changes in foreign affiliate activity. Second, holding total foreign-facing sales relative to GDP fixed, we examine how the transmission of a given depreciation varies with the division of foreign-market activity between exports and affiliate production. Third, we provide complementary cross-country evidence on whether greater depreciation exposure through existing outward FDI networks is associated with higher direct investment income receipts and weaker domestic production, after accounting for conventional trade exposure and the overall scale of outward FDI positions.

6.1. Calibration

The model is calibrated at quarterly frequency as a symmetric two-country benchmark.[12] The aggregate calibration combines Japan's 2019 external-account data, which provide a pre-COVID benchmark, with 2020 multinational-activity data on domestic and foreign-affiliate sales. The parent-level targets use cross-sectional responses to exchange-rate exposure over 2020–22. Because the micro identification exploits differences in pre-existing exchange-rate exposure through parents' affiliate networks, these estimates discipline the model's firm-level response elasticities rather than the magnitude or structural source of the aggregate depreciation. Table 3 reports the baseline parameterization.

The aggregate calibration determines how Home firms serve foreign markets and the scale of the resulting affiliate-income flows. The tradable home-bias weight, $\omega_T = 0.750$, matches Japan's 2019 export-to-GDP ratio of 17.7%. The multinational home-bias weight, $\omega_M = 0.723$, matches the scale of foreign-affiliate sales relative to domestic MNE sales, which was approximately 38% in the aggregate MNE data. The effective affiliate-income pass-through parameter is set to $\xi = 0.743$, using affiliate-to-parent payments relative to affiliate current income in the matched data as a proxy for the strength of the income linkage between affiliates and their parents. Conditional on

[12] Section 6.5 considers an asymmetric calibration matching Japan's outward and inward multinational exposure.

Table 3: Baseline Calibration

Symbol	Description	Value	Source / Target
Preferences and policy			
β	Discount factor	0.99	4% annual real rate
σ	Relative risk aversion	2	Standard
φ	Inverse Frisch elasticity	1	Unit Frisch elasticity
ρ_R	Taylor rule persistence	0.8	Standard
ϕ_π	Inflation feedback	1.5	Standard
ϕ_y	Output feedback	0.125	Standard
Trade and multinational exposure			
ω_T	Home share in tradables	0.750	17.7% Japan exports/GDP
ω_M	MNE home share	0.723	Domestic vs affiliate sales
ω	MNE expenditure share	0.292	2.7% DII credits/GDP
ξ	Effective affiliate-income pass-through	0.743	Payments/income
η, η_M, η_T	Demand substitution elasticities	1.5	Common across CES nests
MNE technology and market structure			
α_S	Support-input share	0.361	Parent employment slopes
ε_N	Support-labor supply elasticity	2.34	Parent employment slopes
$\varepsilon_M, \varepsilon_T$	Goods elasticities	6	20% markup
ψ_p	Rotemberg price-adjustment cost	58.25	75% Calvo non-adjustment prob.
External block			
ψ_b	Debt-elastic premium	0.001	Schmitt-Grohé and Uribe (2003)
ρ_ψ	UIP risk-premium persistence	0.9	Standard

Notes: The baseline imposes symmetry across countries. Hence gross direct-investment-income receipts and payments are equal in steady state, the net direct-investment-income balance is zero, and the current account is balanced. The two parent-level regression slopes—0.384 for support employment and −0.297 for other parent employment—jointly identify α_S and ε_N.

these parameters, the top-level multinational expenditure weight, $\omega = 0.292$, is chosen so that the model's steady-state affiliate-income credits match Japan's measured direct-investment-income credits of 2.7% of GDP. Together, these targets determine the baseline division of foreign-facing activity between exports and affiliate production and imply an affiliate share, as defined in Equation (5.1), of $\vartheta_A = 0.305$.

The parent-side parameters are disciplined by the firm-level evidence. Holding aggregate conditions fixed, we expose otherwise identical parent blocks to the empirical distribution of revenue-side exchange-rate exposure, solve the model firm by firm, and estimate the same cross-sectional regressions in the simulated data as in the actual data. The simulated coefficients thus capture relative responses across parents, evaluated in the same exchange-rate environment in which the empirical slopes were estimated. The support-input share, α_S, and the support-labor supply elasticity, ε_N, are jointly chosen to match the estimated responses of support employment, 0.384, and other parent employment, −0.297, from Table 2.

Two further parent-level moments determine measurement constants rather than structural model parameters. The support-employment share within support plus other employment, 0.396, maps model support services into the observed support-employment category, while the average parent-wage slope, 0.169, maps the model support-service price into the observed average parent wage. Both mappings leave the firm block and the aggregate equilibrium unchanged; their role is to express model outcomes in survey units.[13] Under these mappings, the model reproduces the flat total-employment response in the data and is close to the p90–p10 effects of exposure on support employment, other employment, and the average wage.

The remaining preference, nominal-rigidity, monetary-policy, and international-financial-market parameters take conventional values. Goods varieties have elasticity $\varepsilon_M = \varepsilon_T = 6$, implying a gross markup of 1.2, or a 20% markup. The elasticities of substitution across the CES demand nests are set to $\eta = \eta_M = \eta_T = 1.5$. Rotemberg adjustment costs correspond to a Calvo non-adjustment probability of 0.75, monetary policy follows a standard Taylor rule, and international bond holdings are stabilized by a small debt-elastic premium following Schmitt-Grohé and Uribe (2003).

6.2. Exchange-Rate Experiment

The baseline experiment uses the risk-premium disturbance introduced in Equation (5.3):

$$\psi_{rp,t} = \rho_\psi \psi_{rp,t-1} + e_{\psi,t}, \qquad \rho_\psi = 0.9.$$

A positive innovation raises the effective return on Foreign-currency assets and generates a Home depreciation. For each model economy, we scale the innovation so that the Home real exchange rate depreciates by 10% on impact. This common normalization allows the responses to be compared across the baseline and foreign-market-organization counterfactuals.

The UIP disturbance serves as a controlled device for generating a persistent exchange-rate movement without introducing an independent productivity or foreign-demand disturbance. It is not intended to identify the structural source of any particular historical depreciation. The Appendix repeats the exercise using Foreign monetary-policy and Foreign discount-factor disturbances, each normalized to generate the same impact depreciation. These alternatives allow the endogenous response of affiliate profits to vary with the macroeconomic forces accompanying the depreciation.

6.3. Direct Investment Income Beyond Currency Translation

Figure 6 reports the baseline response to the exchange-rate experiment. Panel (a) shows the normalization: the Home real exchange rate depreciates by 10% on impact and then gradually

[13] Further details on the firm-level calibration and measurement mapping are provided in the Appendix.

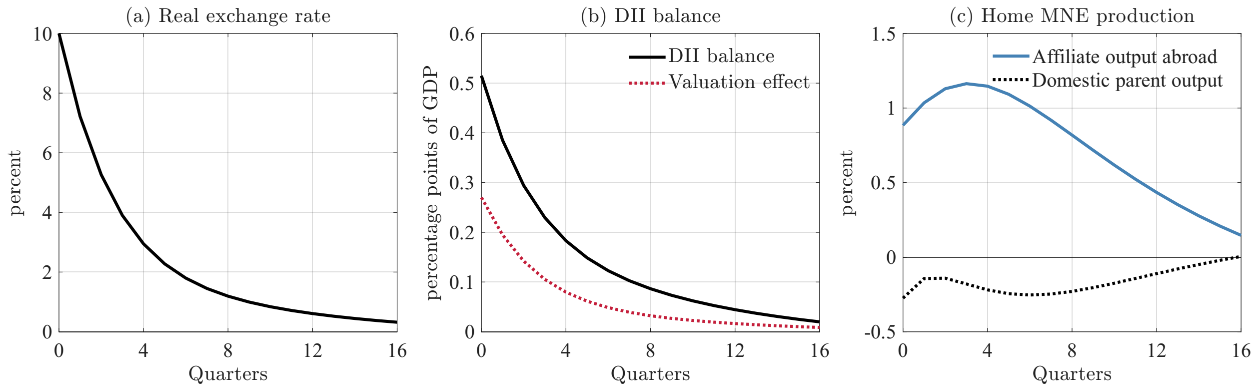

Figure 6: Direct Investment Income and MNE Production after a Home Depreciation

Notes: Impulse responses to a UIP risk-premium shock, normalized to a 10% real depreciation on impact. Panels (a) and (c) are in percent deviations from steady state; panel (b) is in percentage points of steady-state GDP. Panel (b) compares the model-implied direct investment income balance with the impulse response of the fixed-surplus benchmark, $\xi q_t \overline{\widetilde{\Pi}^*_{MH}/P^*} - \xi^* \overline{\widetilde{\Pi}_{MF}/P}$, labeled "valuation effect" in the figure. This benchmark allows the real exchange rate to follow its dynamic path while holding affiliate operating surpluses, expressed in local real units, at their steady-state levels. The gap between the two lines is the component arising from endogenous changes in operating surplus. Panel (c) reports output produced abroad by affiliates of Home multinational parents and domestic output produced by Home multinational parents.

returns to steady state.

Panel (b) separates the direct investment income response into a mechanical currency-translation effect (labeled as "valuation effect") and a component arising from endogenous changes in affiliate operating surplus. The currency-translation effect captures the increase in the Home real value of foreign affiliate income when the real exchange rate depreciates, holding affiliate operating surpluses fixed. Because the calibration matches Japan's direct investment income credits of 2.7% of GDP, a 10% real depreciation produces a mechanical increase of approximately 0.27 percentage points of GDP. The total direct investment income balance improves by 0.51 percentage points of GDP on impact. Thus, approximately half of the impact response reflects currency translation, while the remainder arises from endogenous changes in multinational activity.

Panel (c) shows the production response associated with this endogenous component. The depreciation raises the Home-currency marginal return to support allocated to the foreign affiliate, inducing the parent to shift support toward activity abroad. Affiliate output rises by approximately 0.9% on impact and peaks near 1.2%, while domestic parent output falls and remains below steady state over the first year. Direct investment income therefore rises not only because foreign affiliate earnings are worth more in Home real terms, but also because foreign affiliate operating surplus expands.

The magnitude provides a useful benchmark for the Japanese episode. Between 2020 and 2022, Japan experienced a real depreciation of roughly 25–30%, while its direct investment income balance increased by about 2 percentage points of GDP.[14] To make this comparison, we express the model's cumulative first-year response relative to annual GDP. A fully persistent depreciation of this size would raise the Home real value of steady-state credits by 0.7–0.8 percentage points of GDP. Because the model's real exchange rate mean-reverts, its first-year currency-translation component is smaller, at 0.45–0.53 percentage points. Proportionally scaling the model's cumulative first-year response gives an increase of approximately 0.9–1.1 percentage points of annual GDP—roughly twice the currency-translation component and about half of the observed change.[15] These comparisons are illustrative, since the endogenous contribution depends on the persistence of the depreciation and the foreign profitability conditions accompanying it.

To assess how the source of depreciation matters, the Appendix considers a Foreign monetary policy shock and a Foreign discount-factor shock, each normalized to generate the same 10% impact real depreciation. Under the monetary policy tightening, weaker Foreign demand offsets the incentive created by the depreciation to expand affiliate activity, leaving the direct investment income response close to the currency-translation benchmark. Under the discount-factor shock, stronger Foreign demand raises affiliate profitability and induces a larger reallocation of parent support toward foreign affiliates. The extent to which affiliate expansion amplifies direct investment income beyond currency translation therefore depends on whether the forces generating the depreciation reinforce or offset profitability in the markets served by foreign affiliates. Conditional on initial affiliate earnings, the exchange rate determines the currency-translation component but not the endogenous direct investment income response.

6.4. Foreign-Market Organization and Domestic Adjustment

We next ask how exchange-rate transmission depends on the way Home firms serve foreign markets. The trade-intensive economy has an affiliate share of foreign-facing sales of $\vartheta_A = 0.10$, while the MNE-intensive economy has $\vartheta_A = 0.50$. The Japan baseline lies between these cases, with $\vartheta_A = 0.305$. Across the counterfactuals, we vary ϑ_A by jointly recalibrating ω_T and ω_M while holding steady-state total foreign-facing sales relative to GDP fixed. The exercise therefore changes the composition and location of foreign-market production rather than its steady-state scale.

Panel (a) shows that the direct investment income response rises sharply with the affiliate share. When more foreign demand is served through affiliate production, a depreciation raises the Home real value of a larger foreign income flow and induces a stronger expansion of affiliate

[14] Using annual averages of the Bank for International Settlements' broad real effective exchange-rate index, the 2020–22 change corresponds to approximately a 26% real depreciation.

[15] Under the asymmetric calibration matching Japan's debit-to-credit ratio, the corresponding increase is 0.7–0.9 percentage points of annual GDP, or about 40% of the observed change and 1.6 times the currency-translation component.

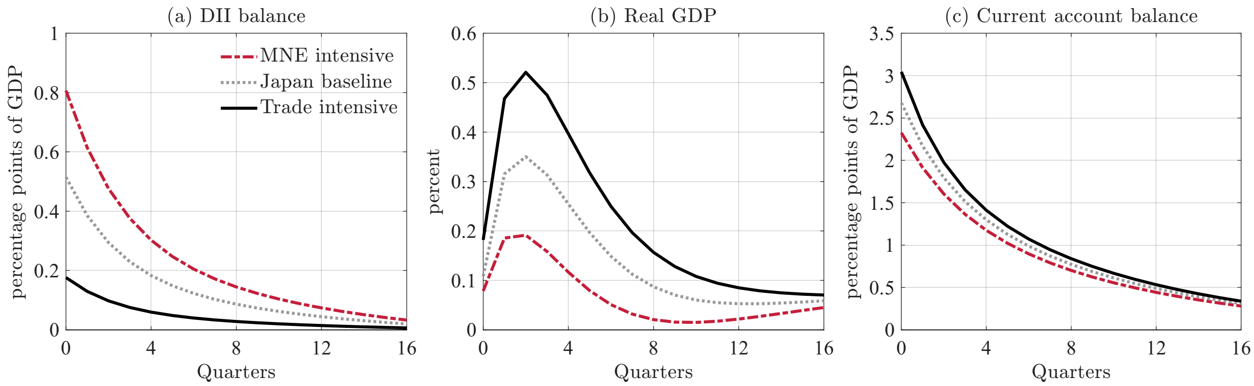

Figure 7: Foreign-Market Organization and Exchange-Rate Transmission

Notes: Impulse responses to a UIP risk-premium shock, each normalized to a 10% real depreciation on impact. The counterfactuals vary the affiliate share of foreign-facing sales, ϑ_A, by jointly recalibrating ω_T and ω_M, while holding steady-state total foreign-facing sales relative to GDP fixed. Solid black: trade-intensive economy ($\vartheta_A = 0.10$); dotted gray: Japan baseline ($\vartheta_A = 0.305$); dash-dotted red: MNE-intensive economy ($\vartheta_A = 0.50$). Panels (a) and (c) are in percentage points of steady-state GDP; panel (b) is in percent deviations from steady state. Real GDP aggregates production located in Home using each economy's steady-state value-added weights. At first order, this fixed-weight quantity index corresponds to the local approximation of a chain-weighted real GDP measure.

activity. The impact improvement in the direct investment income balance is therefore small in the trade-intensive economy, larger in the Japan baseline, and largest in the MNE-intensive economy.

The domestic production response moves in the opposite direction. Panel (b) reports real GDP, aggregating production located in Home using steady-state value-added weights. The peak response is largest in the trade-intensive economy, where expenditure switching toward Home goods translates more directly into production located at Home. As affiliate production becomes more important, more of the foreign-market response occurs abroad and therefore does not enter Home GDP. Parents also reallocate scarce support toward their foreign affiliates, crowding out domestic MNE activity. The peak and subsequent real GDP responses are consequently smaller in the Japan baseline and weakest in the MNE-intensive economy.

Panel (c) shows the resulting current account response. The current account improves in all three economies, but by less as foreign-market activity shifts toward affiliate production. When foreign demand is served through exports, the resulting receipts enter the Home trade balance. Affiliate sales, by contrast, are generated by production located abroad; only the income accruing to the Home parent enters the Home current account. The larger direct investment income response therefore only partly replaces the weaker trade balance response. On impact, direct investment income accounts for approximately 6% of the current account improvement in the trade-intensive economy, 19% in the Japan baseline, and 35% in the MNE-intensive economy.

Figure 7 therefore shows that multinational production changes the form of exchange-rate adjustment rather than simply adding an income response to the conventional trade channel.

Greater reliance on affiliate production shifts adjustment away from domestic production and trade and toward income generated abroad. It also widens the distinction between production located in Home and income accruing to Home residents. Affiliate output does not enter Home GDP, whereas income accruing to the Home parent enters Home gross national income (GNI) through direct investment income. Abstracting from the small portfolio-income response, greater affiliate intensity therefore widens the gap between the responses of GNI and GDP following a depreciation: foreign affiliate earnings support national income even as domestic production responds less.

6.5. Robustness

We consider three robustness exercises, detailed in the Appendix, covering the calibration of affiliate-income pass-through, the accounting treatment of parent support, and asymmetry between inward and outward MNE positions.

Affiliate-income pass-through. The pass-through parameter ξ is calibrated to the mean affiliate-to-parent payment ratio, whose distribution is highly skewed. We re-solve the model at $\xi = 0.5$ and at the median ratio, $\xi = 0.315$, recalibrating (ω, ω_T) to the same gross-flow targets. Holding measured credits fixed, a lower ξ requires a substantially larger affiliate sector: at the median, steady-state affiliate sales rise from 7.8% to 18.3% of GDP. Nevertheless, the aggregate responses change little. The net direct investment income response rises from 0.515 to 0.532 percentage points of GDP, and the component attributable to support reallocation rises from 0.19 to 0.23 percentage points of GDP.

Parent-support accounting. The baseline treats parent support deployed abroad as an internal, nontraded intrafirm input, so its contribution to affiliate output enters Foreign GDP and reaches Home through direct investment income. We alternatively treat this support as a service exported to the affiliate at the support wage. The real allocation is unchanged: the alternative convention reclassifies part of the associated cross-border flow from direct investment income to services trade and changes the corresponding GDP–GNI decomposition. Treating support as an exported service raises measured Home GDP, particularly at short horizons and in affiliate-intensive economies. It does not, however, eliminate the distinction between goods produced for export at Home and goods produced by foreign affiliates. Greater reliance on affiliate production still weakens the domestic goods-production response and shifts external adjustment toward flows associated with production abroad.

Asymmetric inward and outward MNE positions. As a final check, we relax symmetry only between gross inward and outward MNE positions, while retaining a balanced-current-account steady state and otherwise leaving the benchmark structure unchanged. This matters for net direct investment income because Japan's debits are only about one quarter of its credits. We adjust the inward MNE position to reproduce this debit-to-credit ratio while holding the credit and export targets fixed. The gross credit and current-account responses are essentially unchanged, as is the share of the endogenous response attributable to support reallocation. The net direct investment income response is about one-sixth smaller because the symmetric benchmark overstates the offsetting decline in payments to foreign parents.

6.6. Cross-Country Macro Patterns

This subsection asks whether the aggregate pattern highlighted by the model also appears across countries: whether depreciation exposure through outward FDI networks is associated with higher foreign income receipts and weaker domestic production. The firm-level estimates exploit differences across firms within Japan and therefore absorb the aggregate adjustments at the center of the model counterfactual. Country-level outcomes incorporate these adjustments, including the domestic general-equilibrium response. We construct a country-level analogue of the firm-level exposure variable by weighting realized bilateral depreciations by predetermined bilateral outward FDI positions relative to GDP. In both measures, predetermined multinational-network weights are interacted with realized bilateral exchange-rate movements.

Using this exposure, we estimate panel local projections for 70 economies over 2014–2024, tracing direct-investment-income credits relative to GDP and real GDP growth at horizons of up to two years. Because the bilateral weights sum to the outward-FDI position relative to GDP rather than to one, the specification includes this share sum as a control. This accounts for outcome differences associated with the overall scale of outward FDI while preserving the fact that a given network-weighted depreciation generates greater exposure in economies with larger outward-FDI positions. The specification also controls for conventional trade-weighted exchange-rate exposure, country and year fixed effects, and the lagged outcome. The remaining variation comes from whether a country's currency depreciates relatively more against currencies receiving larger predetermined weights in its outward FDI network, conditional on its trade-weighted depreciation and the overall scale of its outward FDI position.

Figure 8 reports the estimates. Greater depreciation against the destinations in a country's outward-FDI network is followed by higher direct-investment-income credits relative to GDP and weaker real GDP growth. The credit response is concentrated at the one- and two-year horizons, while the GDP response is already visible on impact and strengthens over time. The magnitudes are moderate: a one-standard-deviation increase in exposure is associated with direct-investment-income credits that are 0.13 percentage points of GDP higher at the one-year horizon and cumulative real GDP growth that is 0.8 percentage points lower at the two-year horizon.

The Appendix shows that the corresponding debit response is small and imprecisely estimated, indicating that the income response is concentrated in gross credits, the component

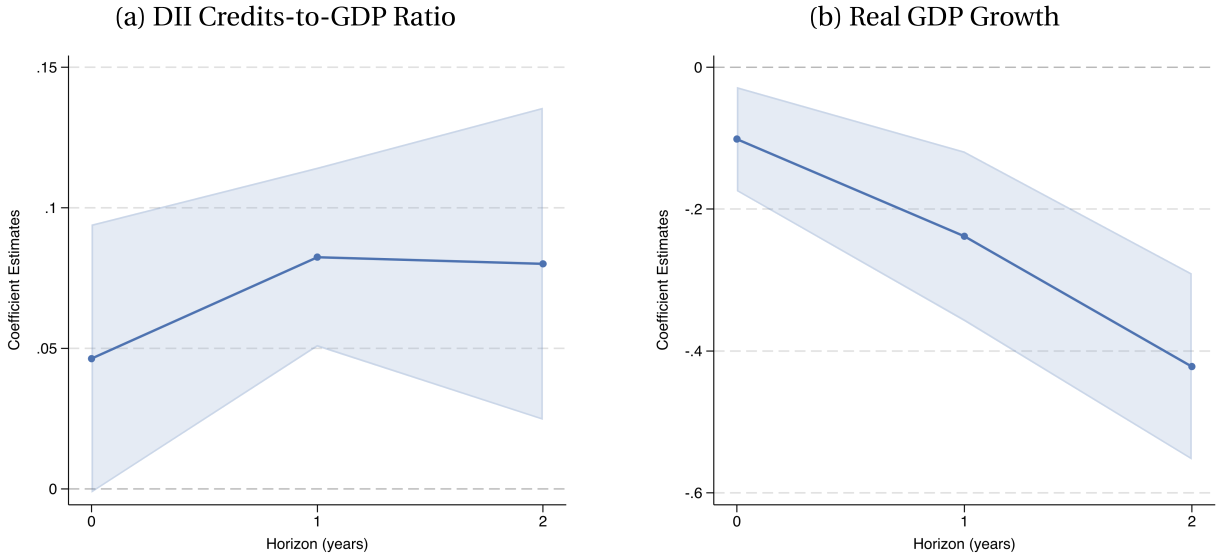

Figure 8: Cross-Country Panel Local Projections: FDI-Network Depreciation

Notes: This figure reports the coefficients β_h on the FDI-network depreciation exposure from panel local projections at horizons $h = 0, 1, 2$, with 90% confidence intervals based on standard errors clustered by country. The sample covers 70 economies with shock years 2014–2024. In panel (a), the dependent variable is the change in the ratio of direct investment income credits to GDP from $t-1$ to $t+h$, in percentage points. In panel (b), the dependent variable is cumulative real GDP growth from $t-1$ to $t+h$, in percent. The exposure is measured in percent, so a unit increase corresponds to one percentage point of FDI/GDP-weighted network depreciation; one standard deviation of the exposure is 1.6 percentage points in the credit sample and 1.9 in the real GDP sample. All specifications control for trade-weighted effective depreciation (nominal in panel (a) and CPI-deflated in panel (b)), the outward-FDI share equal to the sum of the bilateral FDI weights, and the lagged dependent variable, and include country and year fixed effects. The Appendix describes the data and specifications and reports robustness results.

associated with outward affiliate activity. The real-activity response is also present in manufacturing value added and is robust to alternative specifications and samples, including a specification adapting the local-projection difference-in-differences approach of Dube, Girardi, Jordà and Taylor (2023). The results also persist when we exclude the United States and dollar-pegged destinations, separate network geography from the scale of outward FDI, and control for demand conditions in destination markets.

We interpret these estimates as suggestive rather than causal. The geography of outward FDI is not randomly assigned, and bilateral exchange rates are equilibrium outcomes that may respond to some of the same forces driving income and output. Nevertheless, the joint pattern mirrors the model's central implication: depreciation exposure through foreign affiliate networks is associated with stronger foreign income receipts but weaker domestic activity.

7 Conclusion

This paper studies an income-account channel of exchange-rate transmission through multinational firms. Using matched data on Japanese parents and their foreign affiliates, we show that greater exposure to the 2021–22 yen depreciation raised affiliate activity, profits, and payments to parents. At home, exposed parents increased wages and shifted employment toward support functions, but did not broadly expand domestic production. This pattern points to a targeted spillback from foreign affiliate gains to parent-side commercial and support activity.

We interpret these findings through a model in which domestic and foreign operations compete for scarce parent-side support. A depreciation raises the home-currency value of affiliate activity and induces parents to shift support toward foreign affiliates. This reallocation expands affiliate production, crowds out domestic multinational production, and can amplify the direct investment income response beyond what would arise from currency translation alone. Holding fixed the impact depreciation and steady-state total foreign-facing sales, model economies that rely more heavily on affiliate production consequently exhibit a larger direct investment income response but smaller domestic real GDP and current account responses than economies that rely more heavily on exports.

Suggestive cross-country evidence is consistent with this mechanism: greater depreciation exposure through a country's outward FDI network is followed by higher direct investment income credits and weaker domestic real GDP growth. More broadly, the results show that external adjustment can occur through income generated by production located abroad. Current account improvements therefore need not be accompanied by a commensurate expansion of domestic production.

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Online Appendix

Exchange-Rate Transmission through Multinational Firms: Evidence from Japan

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A Firm-Level Data and Empirics

A.1. Summary Statistics

Table A.1 reports summary statistics for the matched parent-affiliate data on Japanese multinational firms in 2020. The sample consists of parent firms that own at least one foreign affiliate, appear in the parent-firm panel with a branch employment decomposition, and have a constructed exchange-rate shock.

Table A.1: Summary Statistics: Affiliate Networks and Parent Workforce

	Mean	SD	p10	p25	p50	p75	p90
Panel A: Foreign affiliate networks							
Number of affiliates per parent	4.9	10.1	1.0	1.0	2.0	5.0	10.0
Number of host countries per parent	3.4	4.5	1.0	1.0	2.0	4.0	8.0
Affiliate employment	270	1,244	2	8	40	164	522
Affiliate sales (million yen)	9,888	57,729	72	305	1,279	5,079	18,043
Ownership share of affiliates (%)	90.2	20.0	51.0	97.9	100.0	100.0	100.0
Share of current income paid to parent (%)	74.2	160.4	0.0	5.1	31.5	75.0	153.3
Revenue share: local host market (%)	67.4	38.8	0.0	30.8	90.1	100.0	100.0
Revenue share: Japan (%)	17.0	31.2	0.0	0.0	0.1	15.6	80.8
Revenue share: third countries (%)	15.6	28.8	0.0	0.0	0.0	15.3	67.3
Panel B: Parent workforce							
Parent employment	1,099	3,267	88	148	316	793	2,055
Employment composition shares (% of own parent employment)							
Head-office share	43.2	28.4	9.4	18.0	37.0	67.2	87.1
Non-production support share	22.5	23.4	1.8	5.0	13.5	32.7	61.2
Other employment share	34.3	30.4	0.0	4.0	28.6	61.7	79.2
of which production worker	25.1	28.8	0.0	0.0	10.7	48.8	71.3

Notes: All statistics are for 2020, the pre-depreciation baseline year. The common parent sample consists of firms that own at least one foreign affiliate, appear in the parent-firm panel with a branch employment decomposition, and have a constructed exchange-rate shock. Panels A and B describe the same 2,210 parent firms, covering 10,776 affiliates in 102 host countries. The first two rows of Panel A, affiliates per parent and host countries per parent, are computed at the parent-firm level, with one observation per parent ($N = 2,210$). All other Panel A statistics are computed at the affiliate level, with one observation per affiliate ($N = 10,776$). Ownership share is the parent's equity stake in the affiliate. Share of current income paid to parent is affiliate payments to the parent as a fraction of affiliate current profit. Because this ratio is unstable for affiliates with near-zero profits, it is winsorized at the 99th percentile; the median is unaffected. Revenue shares from the local host market, Japan, and third countries sum to 100 percent. Panel B describes the same parent firms on the workforce side; 62 percent are in manufacturing, defined as JSIC 091–329. Composition rows report, across firms, the distribution of each category's share of its own parent's employment.

A.2. Data Construction

Survey coverage and linkage. The parent survey (BSJBSA) covers firms with at least 50 employees and at least 30 million yen in capital, spanning mining, manufacturing, electricity and gas, wholesale, retail, and selected service industries; roughly 25,000–30,000 firms respond each year, with a response rate above 80 percent. The affiliate survey (BSOBA) covers all Japanese firms operating at least one foreign affiliate, excluding parents in finance, insurance, and real estate.[5] A foreign affiliate is a foreign entity in which Japanese investors hold at least 10 percent of equity; majority-owned affiliates of majority-owned subsidiaries are also covered. When several Japanese firms invest in the same affiliate, the questionnaire is filed by the largest Japanese investor. The two surveys share a permanent firm identifier, which we use to link each affiliate to its parent.

Cleaning. We drop affiliate-year observations in which total sales and total purchases are both unreported or both zero; this effectively removes affiliates that are not in operation. The geographic decomposition of revenues and purchases is built only from affiliates that report the corresponding components: when a total is unreported, its components are treated as unreported, and we verify that recovered totals track reported totals closely (correlations above 0.95 for every component). For parent firms that switch industries over time, we fix the industry at its final-year classification, since the survey classifies firms by their largest-revenue product in the previous year. Parent total employment is the sum of head-office employment, employment at establishments outside the head office, and employees dispatched to other firms; parent wages include bonuses and exclude retirement benefits. Bilateral exchange rates are from the IMF International Financial Statistics, measured as yen per unit of foreign currency. Transaction shares are measured over 2016–2020 and exposure weights are fixed at their 2020 values; outcomes are 2020–2022 log changes. Table A.2 traces the path from the cleaned affiliate panel to the baseline estimation samples.

Where the exposure comes from. Table A.3 reports the thirteen largest host countries by affiliate revenue, their currencies, and the geographic decomposition of revenues and purchases.

Persistence of exposure shares. Table A.4 reports, for each exposure share, the R^2 from regressing the share on affiliate fixed effects only and on year fixed effects only, in the affiliate-year panel for 2015–2020.

A.3. Additional Evidence on the Reallocation Mechanism

In the model, parent non-production support labor is an input into foreign affiliate production, and a depreciation that raises the value of affiliate operations pulls this labor toward affiliate-related activity. The evidence matches this reallocation: total parent employment is roughly flat

[5] The sector composition table nonetheless shows seven parents in the broad finance and real-estate grouping, 0.4 percent of the estimation sample. The industry code there is the parent's own classification in the parent survey, which is assigned by main line of business and need not coincide with the frame the affiliate survey screens on, and the broad grouping also covers adjacent industries such as leasing. Dropping these parents leaves the parent-level estimates unchanged, for example the average-wage coefficient moves from 0.169 to 0.168 and the support-employment coefficient from 0.384 to 0.387.

Table A.2: Sample Construction

	Count
Affiliate side	
Affiliates in cleaned panel, 2016–2020	34,094
with non-missing, non-zero sales or purchases	28,904
with constructed exchange-rate shocks (2020 base)	13,939
in the baseline employment regression	9,240
Parent side	
Parents matched to the parent survey	38,747
with parent-level shocks	3,416
in the baseline wage regression	1,811

Notes: Counts of affiliates (affiliate side) and parent firms (parent side) at each step of the sample construction. The affiliate rows count distinct affiliates in the cleaned 2016–2020 panel, those surviving the reporting screen, those with constructed 2020-base exchange-rate shocks, and those in the baseline affiliate employment regression of Table 1. The parent rows count firms matched to the parent survey, those with constructed parent-level shocks, and those in the baseline wage regression of Table 2. The summary-statistics sample of Table A.1 lies between the last two parent rows; it additionally requires the branch employment decomposition.

Table A.3: Composition of Affiliate Exposure by Host Country

		Revenue				Purchases			
Host country	Currency	Share	Local	Japan	Third	Share	Local	Japan	Third
USA	USD	0.30	0.64	0.03	0.33	0.29	0.54	0.37	0.09
CHN	CNY	0.17	0.64	0.14	0.23	0.17	0.68	0.24	0.08
THA	THB	0.08	0.56	0.13	0.31	0.08	0.72	0.18	0.11
SGP	SGD	0.05	0.32	0.21	0.47	0.05	0.35	0.25	0.40
IDN	IDR	0.03	0.56	0.12	0.32	0.03	0.66	0.19	0.15
GBR	GBP	0.03	0.46	0.08	0.46	0.03	0.30	0.23	0.46
HKG	HKD	0.03	0.42	0.16	0.42	0.04	0.28	0.45	0.28
BEL	EUR	0.02	0.27	0.02	0.71	0.02	0.07	0.85	0.08
DEU	EUR	0.02	0.61	0.03	0.36	0.02	0.23	0.51	0.25
AUS	AUD	0.02	0.72	0.11	0.17	0.02	0.45	0.48	0.06
CAN	CAD	0.02	0.45	0.02	0.54	0.02	0.33	0.34	0.33
KOR	KRW	0.02	0.68	0.09	0.23	0.02	0.57	0.35	0.08
TWN	TWD	0.02	0.68	0.09	0.23	0.02	0.41	0.44	0.15

Notes: Thirteen largest host countries by aggregate affiliate revenue, averaged over 2016–2020, which together span the twelve currencies in Figure 2. Share is the country's share of aggregate affiliate revenue (purchases). Local, Japan, and Third decompose the country's affiliate revenue (purchases) by counterpart market and sum to one within each block.

while non-production support employment rises, and affiliate employment, dispatched workers, and investment expand.

This appendix adds two further tests of the mechanism and examines two alternative channels. First, the reallocation in the model sends parent labor toward affiliate operations, and

Table A.4: Persistence of Exposure Shares

	R^2: Affiliate FE	R^2: Year FE
Network weights		
Affiliate share of parent revenue	0.975	0.000
Affiliate share of parent purchases	0.969	0.000
Transaction-geography shares		
Revenue share: local market	0.907	0.000
Revenue share: Japan	0.924	0.000
Revenue share: third countries	0.875	0.000
Purchase share: local market	0.878	0.000
Purchase share: Japan	0.887	0.000
Purchase share: third countries	0.845	0.000
Third-country regional shares		
Third-country revenue: North America	0.832	0.000
Third-country revenue: Asia	0.893	0.000
Third-country revenue: Europe	0.886	0.000
Third-country revenue: other regions	0.801	0.000
Third-country purchases: North America	0.847	0.000
Third-country purchases: Asia	0.870	0.000
Third-country purchases: Europe	0.877	0.000
Third-country purchases: other regions	0.716	0.000

Notes: Each row reports the R^2 from regressing the indicated share on affiliate fixed effects only (first column) and on year fixed effects only (second column), in the affiliate-year panel for 2015–2020. Network weights are each affiliate's share of its parent's total affiliate revenue and purchases, the outer weights used in the nested shift-share. Transaction-geography shares decompose each affiliate's revenue and purchases across the local host market, Japan, and third countries, and the third-country regional shares split third-country revenue and purchases across North America, Asia, Europe, and other regions.

dispatched workers, parent employees posted to foreign affiliates, are where this flow is directly recorded. Table A.5 shows that the dispatched-worker response to the revenue-side shock is roughly three times larger for sales- and services-oriented affiliates (wholesale and retail trade, and business services), the same commercial functions counted as non-production support employment at the parent. The differential is specific to parent-provided labor: the dispatched-worker increase is much smaller for manufacturing affiliates, and affiliate employment shows no differential for either affiliate type, whether measured as the survey total, which includes dispatched workers, or net of them. What moves is parent-supplied support component.

Second, if the rise in non-production support employment serves foreign operations, it should be concentrated among parents whose foreign operations are largest. Table A.6 splits parents at the median of their total foreign affiliate employment in 2020. Columns 1 and 2 estimate the parent regression separately on each group, and column 3 pools them and interacts both shocks with an above-median indicator. Parents below the median show no support response, while their counterparts above the median do. The pooled differential is significant

Table A.5: Affiliate-Side Response by Affiliate Type: Sales/Services vs. All Other Affiliates

	Disp Emp	Aff Emp	Local Emp
	(1)	(2)	(3)
$\Delta \ln E_a^S$	0.113*	0.207***	0.210***
	(0.064)	(0.071)	(0.072)
$\Delta \ln E_a^S \times$ Sales/Serv	0.254**	-0.095	-0.123
	(0.107)	(0.129)	(0.126)
Implied effect, Sales/Serv	0.367	0.112	0.087
Host-country FE	✓	✓	✓
N	6,542	9,448	9,326

Notes: Affiliate-level long-difference (2020–2022) regressions of the indicated outcome on the revenue-side shock $\Delta \ln E_a^S$ and its interaction with an indicator for *sales/services* affiliates (wholesale and retail trade and business services; affiliate industry codes 230, 280, 290), with manufacturing and other affiliates as the omitted group. The first row reports the effect for manufacturing and other affiliates, the second the additional effect for sales/services affiliates, and the "implied effect" row their sum. Column (1), Disp Emp, is the number of workers dispatched from the parent to the affiliate (parent-provided labor); column (2), Aff Emp, is total affiliate employment as reported in the survey, which includes dispatched workers. Column (3), Local Emp, nets dispatched workers out of the total; we treat the survey total as the primary measure since the net measure differences two reported series. All specifications include host-country fixed effects and the purchase-side shock $\Delta \ln E_a^P$, also interacted with the type indicator. Standard errors, two-way clustered by host country and parent firm, are in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

at the ten percent level, and the purchase-side interaction is not significant, so the pattern is specific to the revenue side. We read the split as suggestive.

An alternative channel for the parent-side response is financial rather than organizational: more exposed parents repatriate affiliate income and spend the windfall on domestic hiring. If so, the response should be stronger for initially more financially constrained firms. Table A.7 interacts the revenue-side shock with the parent's standardized initial leverage (total liabilities over total assets), a standard firm-level measure of financial constraint (Giroud and Mueller, 2017). The interaction is insignificant for every outcome: more leveraged parents do not respond more strongly.

A second alternative is a vertical intermediate-input channel. A depreciation lowers the foreign-currency cost of Japanese inputs, so affiliates that source more from the parent country could expand for a standard trade-cost reason rather than through parent-side support. The purchase-side shock absorbs average cost-side exposure as a level control, but the saving on Japanese inputs grows with the same local depreciation that drives the revenue-side shock, so the two could move together across affiliates. To test this channel, Table A.8 interacts the revenue-side shock with the affiliate's Japan-sourcing intensity, its purchases from Japan relative to total purchases. The vertical channel predicts a positive interaction, and we find none: across the same seven outcomes as the affiliate baseline, the interaction is insignificant everywhere

Table A.6: Parent Support Employment and Foreign Affiliate Employment

	NP support employment		
	(1)	(2)	(3)
	Below median	Above median	All parents
$\Delta \ln E_f^S$	0.060	0.574**	0.088
	(0.241)	(0.253)	(0.223)
$\Delta \ln E_f^S \times$ Above median			0.629*
			(0.318)
$\Delta \ln E_f^P$	0.017	0.199	-0.022
	(0.233)	(0.309)	(0.215)
$\Delta \ln E_f^P \times$ Above median			0.101
			(0.388)
Industry FE	✓	✓	✓
N	449	659	1,123

Notes: The dependent variable is the long-difference (2020–2022) in log non-production support employment at the Japanese parent. Parents are split at the median of total foreign affiliate employment in 2020, the summed employment of their affiliates. Columns (1) and (2) estimate the regression separately on the below- and above-median groups, so the controls and industry fixed effects are free to differ across groups; column (3) pools the two and interacts both the revenue- and purchase-side shocks with an above-median indicator. All columns match the specification of the main parent regressions in Table 2, with the baseline parent controls (purchase-side shock, affiliate revenue and purchase coverage, export/import shares, R&D, revenue, employment) and industry fixed effects; standard errors clustered by industry are in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table A.7: Parent-Side Spillback and Initial Financial Position

	(1)	(2)	(3)	(4)	(5)	(6)
	Avg Wage	Total Emp	Head Emp	NP Support	Other Emp	Fix Asset
$\Delta \ln E_f^S$	0.139	-0.041	-0.162	0.501*	-0.313	-0.229***
	(0.124)	(0.071)	(0.140)	(0.291)	(0.214)	(0.074)
$\Delta \ln E_f^S \times Z$	-0.134	-0.122	-0.277	0.460	0.077	-0.051
	(0.230)	(0.155)	(0.442)	(0.628)	(0.375)	(0.162)
N	1,776	1,776	1,776	1,104	1,425	1,776

Notes: Long-difference (2020–2022) parent-level regressions of the indicated outcome on the revenue-side shock $\Delta \ln E_f^S$ and its interaction with the parent's standardized 2020 leverage Z, total liabilities over total assets, with mean 0 and s.d. 1. β_S is the shock effect at the mean of Z and $\beta_{S\times Z}$ the differential per one-standard-deviation increase in Z. The main effect of Z is included throughout the specifications. All specifications include the baseline parent controls (purchase-side shock, affiliate revenue and purchase coverage, export/import shares, R&D, revenue, employment) and industry fixed effects; standard errors clustered by industry are in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

except profit, where it is negative, so the baseline estimates do not reflect cheaper Japanese inputs.

Table A.8: Affiliate Response and Intra-firm Import Intensity from Japan

	(1) Value Added	(2) Profit	(3) Total Pay	(4) Ret. Earn	(5) Emp	(6) Disp. Emp	(7) Cap. Invest.
$\Delta \ln E_a^S$	0.491**	0.760***	0.632***	0.847***	0.145**	0.185**	0.242
	(0.219)	(0.241)	(0.165)	(0.298)	(0.058)	(0.091)	(0.319)
$\Delta \ln E_a^S \times$ Japan-input share	-0.181	-0.324***	-0.076	-0.151	-0.068	0.029	-0.379
	(0.141)	(0.121)	(0.201)	(0.213)	(0.046)	(0.047)	(0.256)
N	8,384	5,601	4,194	4,096	9,240	6,379	4,642

Notes: Affiliate-level long-difference (2020–2022) regressions of the indicated outcome on the revenue-side shock $\Delta \ln E_a^S$ and its interaction with the affiliate's Japan-input share, purchases from Japan over total purchases averaged over 2016–2020 and standardized to mean 0 and s.d. 1. All specifications include the purchase-side shock and host-country×sector fixed effects. Standard errors two-way clustered by host country and parent firm are in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

A.4. Robustness

At the affiliate level we vary the fixed-effect structure. Table A.9 removes the fixed effects entirely, and Table A.10 replaces the host-country-by-sector fixed effects with host-country fixed effects, which absorb host-country-level shocks such as local pandemic restrictions while retaining cross-sector variation within countries. The baseline pattern is stable in both, as value added, profit, payments to the parent, and employment respond to the revenue-side shock, and royalties and rental costs remain null.

Varying the fixed effects also changes where the identifying variation comes from, and the two sources face different confounders. Under host-country-by-sector fixed effects, the bilateral exchange-rate change is common within a host country, so exposure varies only through pre-period transaction geography, and identification requires those shares to be unrelated to other 2020–22 shocks. Without fixed effects, the currency movements themselves contribute variation, and identification instead requires host-country conditions to be unrelated to how far each currency moved. The estimates are similar across the two, so unobserved characteristics common to affiliates in the same host country and sector are not what generated them, including the pandemic-era demand and supply disruptions that dominate 2020–22.

At the parent level, the estimation sample is concentrated in manufacturing, and within manufacturing in metal, machinery, and electronics, as Table A.11 shows. Restricting to manufacturing parents (Table A.12) gives the same picture as the pooled baseline, somewhat more strongly: wages rise, total employment holds steady, non-production support employment grows while other employment shrinks, and fixed assets decline.

Removing the industry fixed effects (Table A.13) changes little: wages rise, non-production support employment increases, fixed assets fall, and total and head-office employment stay flat. The decline in other employment is similar in size.

Table A.9: Affiliate Outcomes: No Fixed Effects

Panel A: Profitability and Financial Flows					
	Value Added	Profit	Total Pay	Royalty	Ret. Earn
	(1)	(2)	(3)	(4)	(5)
$\Delta \ln E_a^S$	0.465**	0.554**	0.816***	0.229	0.515**
	(0.230)	(0.237)	(0.197)	(0.188)	(0.235)
$\Delta \ln E_a^P$	-0.404**	-0.570**	-0.392*	0.023	-0.299
	(0.166)	(0.228)	(0.220)	(0.207)	(0.223)
Sector×Country FE					
N	8613	5787	4367	2509	4261
R-squared	0.005	0.004	0.005	0.001	0.002

Panel B: Real Activity					
	Emp	Disp. Emp	Rent Cost	R&D Cost	Cap. Invest.
	(1)	(2)	(3)	(4)	(5)
$\Delta \ln E_a^S$	0.155*	0.183**	-0.004	0.150	0.399
	(0.083)	(0.081)	(0.127)	(0.277)	(0.355)
$\Delta \ln E_a^P$	-0.220***	-0.202***	-0.160	0.088	-0.213
	(0.073)	(0.064)	(0.125)	(0.377)	(0.288)
Sector×Country FE					
N	9466	6556	6497	933	4830
R-squared	0.004	0.004	0.000	0.000	0.001

Notes: Long-difference estimates of the baseline affiliate specification with the host-country-by-sector fixed effects removed. Outcomes and variable definitions are as in Table 1. Standard errors are two-way clustered by host country and parent firm. *, **, *** denote significance at the 10%, 5%, and 1% levels.

Table A.14 measures R&D expenditure, the total wage bill, and total employment in 2018 rather than 2020, matching the event study of Figure 4. The baseline empirical pattern remains unchanged: support employment rises, other employment falls, fixed assets decline, and total and head-office employment do not respond.

Constructing the exposure. The baseline exposure averages the affiliate transaction shares over 2016–2020 and assigns third-country transactions with European destinations to the euro and the rest to the U.S. dollar. Tables A.15 and A.16 vary these two choices. Shifting the share window to 2015–2019 leaves the parent and affiliate results strong and, if anything, strengthens the support and wage responses. Assigning all third-country transactions to the U.S. dollar, or instead assigning third-country Europe to the euro and third-country Asia to the Renminbi, moves the estimates little, because third-country sales are a minority of affiliate revenue and the host-market and Japan components are unaffected. The last row of Table A.15 instead fixes the parent-network weights at their 2016–2020 average rather than their 2020 values, and the

Table A.10: Affiliate Outcomes: Host-Country Fixed Effects Only

Panel A: Profitability and Financial Flows					
	Value Added	Profit	Total Pay	Royalty	Ret. Earn
	(1)	(2)	(3)	(4)	(5)
$\Delta \ln E_a^S$	0.699**	0.767***	0.766***	0.198	0.869***
	(0.282)	(0.241)	(0.185)	(0.304)	(0.231)
$\Delta \ln E_a^P$	-0.281**	-0.310*	-0.446**	-0.018	0.036
	(0.125)	(0.169)	(0.194)	(0.184)	(0.174)
Country FE	✓	✓	✓	✓	✓
Sector×Country FE					
N	8597	5773	4347	2494	4247
R-squared	0.041	0.032	0.035	0.055	0.033

Panel B: Real Activity					
	Emp	Disp. Emp	Rent Cost	R&D Cost	Cap. Invest.
	(1)	(2)	(3)	(4)	(5)
$\Delta \ln E_a^S$	0.176***	0.209**	-0.056	0.411	0.189
	(0.059)	(0.082)	(0.128)	(0.304)	(0.199)
$\Delta \ln E_a^P$	-0.208***	-0.196***	-0.191	-0.232	-0.439
	(0.056)	(0.053)	(0.121)	(0.402)	(0.326)
Country FE	✓	✓	✓	✓	✓
Sector×Country FE					
N	9448	6542	6482	926	4820
R-squared	0.023	0.019	0.016	0.031	0.022

Notes: Long-difference estimates of the baseline affiliate specification with host-country fixed effects in place of the host-country-by-sector fixed effects. Outcomes and variable definitions are as in Table 1. Standard errors are two-way clustered by host country and parent firm. *, **, *** denote significance at the 10%, 5%, and 1% levels.

parent estimates are essentially unchanged, consistent with the near-perfect persistence of the within-parent weights documented above. The affiliate operating, payment, and headcount responses are significant under every variant, and the parent wage, support-employment, and fixed-asset responses are stable throughout.

Table A.11: Sector Composition of the Parent-level Sample

Sector	Firms	Share (%)
Manufacturing		
Food, Textile, Chemical, Oil, Plastics	464	25.6
Metal, Machinery, Electronics	770	42.5
Transport Equipment, Precision, Other Mfg.	270	14.9
Manufacturing, total	**1,504**	**83.0**
Non-manufacturing		
Agri/Mining/Construction	21	1.2
Wholesale and Retail	212	11.7
Finance and Real Estate	7	0.4
Utilities/Info/Services/Other	67	3.7
Non-manufacturing, total	**307**	**17.0**
All sectors	**1,811**	**100.0**

Notes: Sector composition of the parent-level estimation sample. Manufacturing follows JSIC Division E (codes 091–329). Shares are computed over the set of firms entering the parent-level first-difference specification.

Table A.12: Parent-level Outcomes: Manufacturing Firms Only

	Avg Wage	Total Emp	Head Emp	NP Support Emp	Other Emp	Fix Asset
$\Delta \ln E_f^S$	0.175*	0.002	-0.241	0.451**	-0.349**	-0.173**
	(0.115)	(0.061)	(0.201)	(0.240)	(0.186)	(0.065)
	[0.098]	[0.040]	[0.157]	[0.176]	[0.155]	[0.069]
$\Delta \ln E_f^P$	-0.017	-0.079	-0.050	0.106	-0.021	-0.050
	(0.093)	(0.063)	(0.146)	(0.207)	(0.205)	(0.045)
	[0.081]	[0.049]	[0.118]	[0.226]	[0.161]	[0.062]
p90–p10 effect (E^S)	0.041	0.000	-0.056	0.103	-0.077	-0.040
Industry FE	✓	✓	✓	✓	✓	✓
N	1,504	1,504	1,504	927	1,232	1,504
R^2	0.118	0.052	0.054	0.083	0.051	0.059

Notes: First-difference estimates for the manufacturing subsample (JSIC 091–329). Outcomes are as in Table 2. Standard errors clustered by industry are in parentheses; exposure-robust standard errors are in brackets. The p90–p10 effect scales the $\Delta \ln E^S$ coefficient by the p90–p10 range of the shock. *, **, *** denote significance at the 10%, 5%, and 1% levels.

Table A.13: Parent-level Outcomes: Robustness without Industry Fixed Effects

	Avg Wage	Total Emp	Head Emp	NP Support Emp	Other Emp	Fix Asset
$\Delta \ln E_f^S$	0.146*	-0.011	-0.129	0.554***	-0.270	-0.197***
	(0.090)	(0.054)	(0.174)	(0.194)	(0.198)	(0.063)
	[0.080]	[0.038]	[0.127]	[0.152]	[0.173]	[0.063]
$\Delta \ln E_f^P$	-0.022	-0.025	-0.058	0.075	0.059	-0.036
	(0.083)	(0.059)	(0.114)	(0.185)	(0.194)	(0.050)
	[0.070]	[0.047]	[0.100]	[0.198]	[0.164]	[0.059]
Industry FE						
N	1,834	1,834	1,834	1,144	1,466	1,834
R^2	0.082	0.016	0.013	0.014	0.007	0.016

Notes: First-difference estimates of the baseline parent-level specification with the industry fixed effects removed; controls are identical to the baseline. Outcomes are as in Table 2. Standard errors clustered by industry are in parentheses; exposure-robust standard errors are in brackets. *, **, *** denote significance at the 10%, 5%, and 1% levels.

Table A.14: Parent-level Outcomes: Controls Measured in 2018

	Avg Wage	Total Emp	Head Emp	NP Support Emp	Other Emp	Fix Asset
$\Delta \ln E_f^S$	0.153*	-0.012	-0.133	0.347**	-0.394**	-0.150**
	(0.108)	(0.052)	(0.183)	(0.188)	(0.227)	(0.060)
	[0.084]	[0.039]	[0.129]	[0.147]	[0.169]	[0.066]
$\Delta \ln E_f^P$	-0.030	-0.036	-0.000	0.165	-0.141	-0.074
	(0.112)	(0.055)	(0.121)	(0.190)	(0.231)	(0.051)
	[0.078]	[0.051]	[0.104]	[0.197]	[0.179]	[0.063]
p90–p10 effect (E^S)	0.037	-0.003	-0.033	0.083	-0.091	-0.037
Industry FE	✓	✓	✓	✓	✓	✓
N	1,726	1,726	1,726	1,086	1,373	1,726
R^2	0.046	0.068	0.055	0.085	0.076	0.067

Notes: First-difference estimates of the baseline parent-level specification, including industry fixed effects, with R&D expenditure, the total wage bill, and total parent employment measured in 2018 instead of 2020. The affiliate coverage and trade-share controls remain measured in 2020, as in the baseline. Outcomes and sample construction are as in Table 2. Standard errors clustered by industry are in parentheses; exposure-robust standard errors are in brackets. *, **, *** denote significance at the 10%, 5%, and 1% levels.

Table A.15: Parent-level Outcomes: Robustness to Exposure Construction

	Ave Wage	Total Emp	Head Emp	NP Support	Other	Fix Asset
Baseline (2016–2020)	0.169**	-0.014	-0.160	0.384**	-0.297*	-0.201***
	[0.080]	[0.038]	[0.129]	[0.152]	[0.173]	[0.064]
2015–2019 window	0.215***	-0.024	-0.163	0.478***	-0.283	-0.190***
	[0.081]	[0.040]	[0.134]	[0.151]	[0.175]	[0.065]
Third-country → USD	0.189**	-0.047	-0.183	0.362**	-0.283	-0.223***
	[0.078]	[0.038]	[0.126]	[0.148]	[0.174]	[0.063]
Third-country EU→EUR, Asia→CNY	0.167**	-0.013	-0.149	0.412***	-0.321*	-0.196***
	[0.082]	[0.040]	[0.133]	[0.160]	[0.171]	[0.064]
2016–2020 average weights	0.166**	-0.015	-0.146	0.368***	-0.287*	-0.140**
	[0.071]	[0.035]	[0.110]	[0.141]	[0.147]	[0.056]

Notes: Long-difference (2020–2022) parent-level estimates under alternative constructions of the exposure measure; outcomes run across the columns and specifications down the rows. The rows vary the pre-period share window (baseline 2016–2020 versus 2015–2019), the third-country currency rule (baseline: Europe to the euro, rest to the U.S. dollar; "Third-country → USD": all third-country to the U.S. dollar; "Third-country EU→EUR, Asia→CNY": Europe to the euro and Asia to the renminbi), and, in the last row, the parent-network weights (baseline: fixed at 2020; "2016–2020 average weights": averaged over the pre-period window). Host-market and Japan transactions are assigned to the host and yen currencies throughout. All specifications include the baseline controls and industry fixed effects. Entries are the revenue-side coefficient with shift-share robust standard errors in brackets, as in Table 2. *, **, *** denote significance at the 10%, 5%, and 1% levels.

Table A.16: Affiliate Outcomes: Robustness to Exposure Construction

	Value Added	Profit	Total Pay	Ret. Earn	Emp	Disp. Emp	Cap. Invest.
Baseline (2016–2020)	0.497**	0.754***	0.622***	0.832***	0.149***	0.184**	0.211
	(0.213)	(0.230)	(0.160)	(0.289)	(0.057)	(0.088)	(0.329)
2015–2019 window	0.501**	0.828***	0.496***	0.926***	0.102**	0.174**	0.256
	(0.254)	(0.254)	(0.156)	(0.351)	(0.050)	(0.083)	(0.220)
Third-country → USD	0.470**	0.686***	0.647***	0.819***	0.132**	0.177**	0.384
	(0.202)	(0.219)	(0.165)	(0.303)	(0.057)	(0.086)	(0.298)
Third-country EU→EUR, Asia→CNY	0.569**	0.754***	0.643***	0.763**	0.178***	0.216**	0.317
	(0.264)	(0.276)	(0.164)	(0.348)	(0.060)	(0.092)	(0.355)

Notes: Long-difference (2020–2022) affiliate-level estimates under alternative constructions of the exposure measure; outcomes run across the columns and specifications down the rows, defined as in Table A.15 (the parent-network weight row does not apply at the affiliate level). All specifications include host-country×sector fixed effects. Entries are the revenue-side coefficient with standard errors two-way clustered by host country and parent firm in parentheses. *, **, *** denote significance at the 10%, 5%, and 1% levels.

B Cross-Country Evidence

This appendix describes the data and specification behind Figure 8 and reports robustness.

B.1. Data, Exposure, and Specification

Bilateral outward FDI positions are from the IMF Coordinated Direct Investment Survey, which reports positions in U.S. dollars and is available from 2009. Exchange rates are period-average rates against the U.S. dollar from the IMF International Financial Statistics, from which any bilateral rate follows as a cross rate; a rise is a depreciation. Because the exchange-rate file does not carry euro-area members as individual reporters, they are not in the sample. Direct investment income is from the IMF Balance of Payments Statistics (BPM6), real GDP growth is from the World Economic Outlook, and nominal GDP from the same source scales the income outcome. Conduit and special-purpose-entity hubs (Bermuda, the British Virgin Islands, the Cayman Islands, Curaçao, Cyprus, Guernsey, Hong Kong SAR, Ireland, the Isle of Man, Jersey, Liberia, Luxembourg, Malta, Mauritius, the Netherlands, Panama, and Singapore) and three small offshore financial centers of the same character (Barbados, Macao SAR, and Samoa) are excluded because their reported positions reflect where investment is booked rather than where affiliate activity takes place. Hyperinflation episodes, defined as annual depreciation above roughly 120 log points, are dropped, and outcomes are winsorized at the 2.5 and 97.5 percentiles. The estimation sample covers 70 economies with shock years 2014–2024.

For horizons $h = 0, 1, 2$, we estimate

$$\Delta_h y_{c,t} = \alpha_c + \lambda_t + \beta_h X_{c,t}^{FDI} + \gamma_h X_{c,t}^{Trade} + \delta_h Z_{c,t} + \rho_h y_{c,t-1} + \varepsilon_{c,t+h},$$

with country and year fixed effects and standard errors clustered by country. The exposure is the FDI-weighted network depreciation, $X_{c,t}^{FDI} = \sum_d (\text{FDI}_{cd,0}/\text{GDP}_{c,0})\, \Delta s_{cdt}$, where Δs_{cdt} is the bilateral depreciation of country c against destination d, measured in percent, and $\text{FDI}_{cd,0}$ is the predetermined outward position, averaged together with GDP over $[t-5,\ t-3]$. Because bilateral positions exist from 2009, 2014 is the earliest shock year with a full window. Because the weights sum to the outward-FDI position relative to GDP rather than to one, $Z_{c,t}$ controls for that sum, following the treatment of incomplete shares in Borusyak et al. (2022). The control $X_{c,t}^{Trade}$ is the trade-weighted effective depreciation, constructed by applying pre-period bilateral goods-trade shares to the same bilateral exchange-rate movements because the published IMF effective exchange rate covers only about half of the estimation sample; it enters nominal for the income outcome and CPI-deflated for real GDP. For the income outcome, the dependent variable is the change in the ratio of direct investment income credits to GDP from $t-1$ to $t+h$, in percentage points. Because numerator and denominator are converted at the same year's exchange rate, this ratio equals the local-currency ratio and is invariant to the reporting currency, so it retains

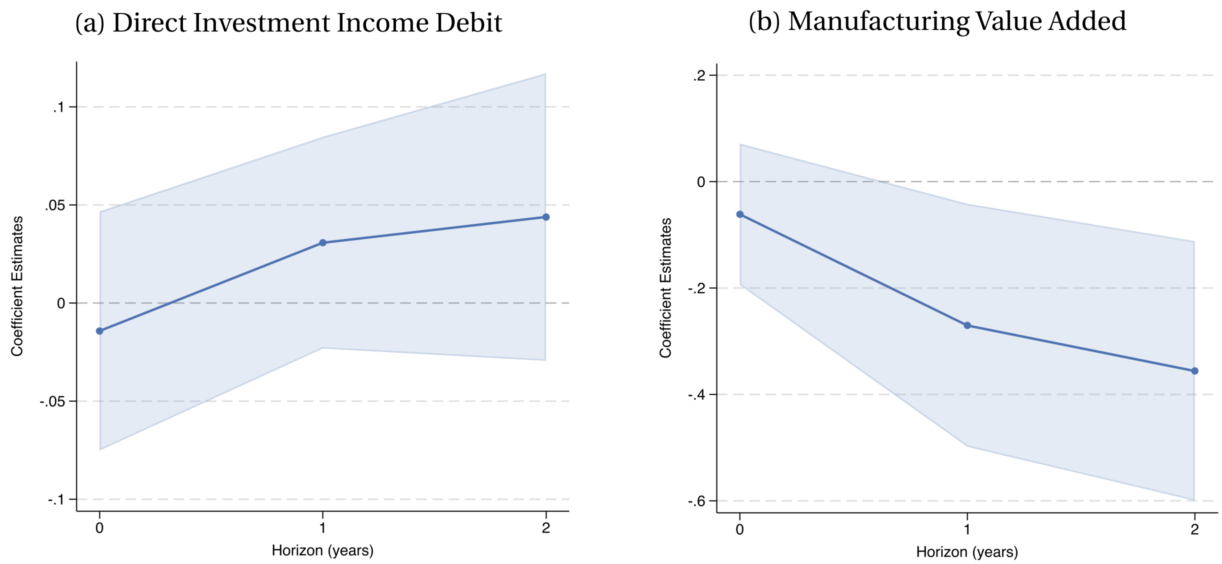


Figure B.1: Cross-Country Panel Local Projections: Additional Outcomes

Notes: This figure reports the coefficients β_h on the FDI-network depreciation exposure from the same panel local projections as Figure 8, with 90% confidence intervals based on standard errors clustered by country. In panel (a), the dependent variable is the change in the ratio of direct investment income debits to GDP from $t-1$ to $t+h$, in percentage points, with the nominal trade-weighted control; debit is income paid to nonresident direct investors. In panel (b), the dependent variable is cumulative manufacturing value added growth (World Bank WDI, constant prices) from $t-1$ to $t+h$, in percent, with the CPI-deflated trade-weighted control. All specifications include the sum of the FDI weights, the lagged dependent variable, and country and year fixed effects.

the home-currency valuation of foreign-currency income. For real GDP, the dependent variable is cumulative growth from $t-1$ to $t+h$, in percent.

A unit increase in exposure corresponds to one percentage point of GDP-share-weighted network depreciation. The standard deviation of exposure is 1.6 percentage points in the credit sample and 1.9 percentage points in the real GDP sample. Using these outcome-specific standard deviations, the estimates imply direct investment income credits 0.13 percentage points of GDP higher and cumulative real GDP growth 0.8 percentage points lower at the two-year horizon.

B.2. Additional Outcomes and Robustness

Figure B.1 reports the same projection for two additional outcomes. Panel (a) shows the gross debit, direct investment income paid to nonresident direct investors, with the same currency-invariant ratio construction as the credit. The response referenced in the main text is small and imprecisely estimated at every horizon; payments to inward direct investors are home-currency profits with no translation component, so a flat debit is what the mechanism implies. Panel (b) shows cumulative manufacturing value added growth, the tradable production the mechanism reallocates across borders; it falls at one to two years, in line with the real GDP response in Figure 8.

Table B.1 reports robustness of the two responses plotted in Figure 8. Controlling for one lag of both shocks leaves the responses intact. Converting income and GDP to local currency with the bilateral U.S. dollar rate before differencing, the other currency-invariant measurement, gives the same or stronger credit response. Both responses are as strong within shock years 2017–2024. The remaining rows adapt the local-projection difference-in-differences ingredients of Dube et al. (2023) to a continuous treatment. Controlling for the shocks dated between $t+1$ and $t+h$ isolates the response to a one-off shock and is close to the baseline. Additionally restricting the sample to observations whose two lagged absolute exposures lie below the sample median, their clean-control condition adapted to a continuous treatment, cuts the panel to roughly a third; the responses keep their sign, with magnitudes no longer well disciplined. Dropping the country fixed effects, which the long-differenced outcome makes largely redundant, gives smaller responses that remain significant at one to two years.

Table B.2 instead varies how the exposure itself is built, addressing three concerns: that it is driven entirely by the dollar, that it mixes the geography of a country's outward-FDI network with the size of that network, and that it reflects demand conditions in the destination markets. Dropping the United States as a destination, and then also dropping every currency that is pegged to the dollar, leaves both responses intact and, if anything, somewhat larger, so neither depends on the dollar leg of the exposure. The next row separates geography from size. Because the weights are bilateral positions over GDP, the exposure splits exactly into two additive terms: the outward-FDI-to-GDP ratio times the country's own depreciation against the dollar, and the position-weighted depreciation of the destination currencies. The first is large whenever a country with a big outward-FDI sector sees its currency fall against everything, which is the combination that could proxy for global episodes rather than for the multinational channel. Controlling for it holds both the size of the outward-FDI sector and the country's own depreciation fixed, so the exposure is identified from the destination-currency term alone, that is, from which destinations the country invested in. Both responses survive and are larger than in the baseline. Finally, controlling for the position-weighted real GDP growth of the destination countries leaves both responses essentially unchanged.

Table B.1: Cross-Country Robustness: Credit and Real GDP Responses

	$h=0$	$h=1$	$h=2$	$N_{h=0}$
Panel A: Direct investment income, gross credit				
Baseline	0.046	0.082***	0.080**	612
	(0.029)	(0.019)	(0.034)	
Lagged shocks controlled	0.048**	0.086***	0.084***	587
	(0.024)	(0.017)	(0.032)	
Local-currency outcome	0.053*	0.087***	0.103**	612
	(0.031)	(0.027)	(0.048)	
Shock years 2017–2024	0.069**	0.081***	0.091***	469
	(0.027)	(0.018)	(0.035)	
One-off: future shocks controlled	0.046	0.089***	0.080**	612
	(0.029)	(0.015)	(0.035)	
One-off, quasi-stayer sample	0.109	0.083	0.514***	237
	(0.084)	(0.087)	(0.138)	
Year fixed effects only	0.015	0.050***	0.052**	612
	(0.018)	(0.017)	(0.025)	
Panel B: Real GDP growth				
Baseline	-0.101**	-0.238***	-0.422***	632
	(0.045)	(0.073)	(0.080)	
Lagged shocks controlled	-0.099**	-0.237***	-0.391***	605
	(0.043)	(0.056)	(0.071)	
Shock years 2017–2024	-0.088**	-0.204***	-0.366***	478
	(0.040)	(0.073)	(0.070)	
One-off: future shocks controlled	-0.101**	-0.203***	-0.391***	632
	(0.045)	(0.067)	(0.064)	
One-off, quasi-stayer sample	-1.544*	-2.416	-3.556*	241
	(0.922)	(1.692)	(2.068)	
Year fixed effects only	-0.076	-0.175*	-0.276***	632
	(0.048)	(0.098)	(0.106)	

Notes: Each row re-estimates the baseline panel local projection for the gross-credit outcome (Panel A) or the real-GDP outcome (Panel B) of Figure 8 with the stated modification; entries are β_h with country-clustered standard errors in parentheses, and N at $h=0$ (N declines with the horizon as in the baseline). "Lagged shocks controlled" adds one lag of the FDI-network exposure and of the trade-weighted depreciation. "Local-currency outcome" converts income and GDP to local currency with the bilateral U.S. dollar rate before differencing and applies to the income outcome only. "One-off" controls for the shocks between $t+1$ and $t+h$, and the quasi-stayer sample additionally restricts to observations whose two lagged absolute exposures lie below the sample median; together these adapt the local-projection difference-in-differences logic of Dube et al. (2023). * $p<0.10$, ** $p<0.05$, *** $p<0.01$.

Table B.2: Cross-Country Robustness: Constructing the Exposure

	$h=0$	$h=1$	$h=2$	$N_{h=0}$
Panel A: Direct investment income, gross credit				
Baseline	0.046	0.082***	0.080**	612
	(0.029)	(0.019)	(0.034)	
Leave-U.S. exposure	0.067**	0.115***	0.101**	612
	(0.033)	(0.024)	(0.043)	
Leave-dollar exposure	0.075**	0.130***	0.104**	609
	(0.032)	(0.025)	(0.044)	
Scale × own depreciation controlled	0.121***	0.168***	0.138***	612
	(0.028)	(0.031)	(0.047)	
Destination-weighted growth controlled	0.046	0.082***	0.080**	612
	(0.029)	(0.019)	(0.034)	
Panel B: Real GDP growth				
Baseline	-0.101**	-0.238***	-0.422***	632
	(0.045)	(0.073)	(0.080)	
Leave-U.S. exposure	-0.133***	-0.290***	-0.509***	632
	(0.049)	(0.092)	(0.113)	
Leave-dollar exposure	-0.141***	-0.310***	-0.519***	629
	(0.051)	(0.097)	(0.117)	
Scale × own depreciation controlled	-0.168***	-0.291***	-0.455***	632
	(0.055)	(0.102)	(0.110)	
Destination-weighted growth controlled	-0.097**	-0.237***	-0.426***	632
	(0.044)	(0.071)	(0.077)	

Notes: Each row re-estimates the baseline panel local projection of Table B.1 with the exposure rebuilt or with an additional control, for the gross-credit outcome (Panel A) and the real-GDP outcome (Panel B); entries are β_h with country-clustered standard errors in parentheses. "Leave-U.S. exposure" rebuilds the exposure after dropping the United States as a destination, and "Leave-dollar exposure" additionally drops every destination whose currency is de facto pegged to the dollar, defined as a standard deviation of its annual depreciation against the dollar below 0.01 over the sample. "Scale × own depreciation controlled" adds the outward-FDI-to-GDP ratio interacted with the country's own depreciation against the dollar, which is the additive piece of the exposure that reflects the size of the outward-FDI sector rather than its geography, so that the exposure coefficient comes from the destination-currency piece alone. "Destination-weighted growth controlled" adds the position-weighted real GDP growth of the destination countries. * $p<0.10$, ** $p<0.05$, *** $p<0.01$.

C Proofs and Regularity Conditions for Section 4

C.1. Proof of Proposition 4.1

We prove the comparative static in Proposition 4.1. The parent solves

$$\max_{S_d,S_a} V(S_d) + \mathscr{E}\xi V^*(S_a) - C(S_d + S_a),$$

with $N = S_d + S_a$. The first-order conditions are

$$V'(S_d) = C'(N),$$
$$\mathscr{E}\xi V^{*\prime}(S_a) = C'(N).$$

Totally differentiating the first condition gives

$$V''(S_d)dS_d = C''(N)dN.$$

Using $dN = dS_d + dS_a$, this becomes

$$V''dS_d = C''(dS_d + dS_a).$$

Rearranging,

$$dS_d = -\frac{C''}{-V'' + C''}dS_a. \tag{C.1}$$

Because $V'' < 0$ and $C'' > 0$, Equation (C.1) implies that $dS_d < 0$ whenever $dS_a > 0$. Moreover,

$$dN = dS_d + dS_a = \frac{-V''}{-V'' + C''}dS_a. \tag{C.2}$$

Thus $dN > 0$ whenever $dS_a > 0$.

Now totally differentiate the second first-order condition:

$$\xi V^{*\prime}d\mathscr{E} + \mathscr{E}\xi V^{*\prime\prime}dS_a = C''dN.$$

Using Equation (C.2), we obtain

$$\xi V^{*\prime}d\mathscr{E} = \left[-\mathscr{E}\xi V^{*\prime\prime} + C''\frac{-V''}{-V'' + C''}\right]dS_a.$$

The term in brackets is strictly positive because $V^{*\prime\prime} < 0$, $V'' < 0$, $C'' > 0$, $\mathscr{E} > 0$, and $\xi > 0$. Since $\xi V^{*\prime} > 0$, an increase in $\mathscr{E}$ implies

$$dS_a > 0.$$

Equation (C.1) and Equation (C.2) then imply

$$dS_d < 0, \qquad dN > 0.$$

Finally, because $W_N'(N) > 0$, the increase in support employment raises the support wage:

$$dW_N = W_N'(N)dN > 0.$$

■

C.2. Production-Labor Regularity Conditions

The main text assumes that optimized production-labor demand is increasing in the support services allocated to that operation:

$$\ell'(S_d) > 0, \qquad \ell^{*\prime}(S_a) > 0.$$

The following proposition gives primitive conditions under which this property holds.

Proposition C.1 (Regularity conditions for production-labor responses)**.** *Suppose domestic production labor and affiliate production labor are chosen optimally from the value functions*

$$V(S_d) = \max_{L} \{R(F(S_d, L)) - W_L L\},$$
$$V^*(S_a) = \max_{L^*} \left\{R^*\left(F(S_a, L^*)\right) - W_L^* L^*\right\}.$$

Assume the domestic and affiliate production-labor choices are interior. Suppose the domestic labor choice satisfies the second-order condition

$$R''(F(S_d, L)) \left(\frac{\partial F(S_d, L)}{\partial L}\right)^2 + R'(F(S_d, L)) \frac{\partial^2 F(S_d, L)}{\partial L^2} < 0, \tag{C.3}$$

and suppose support services raise the marginal profitability of domestic production labor:

$$R''(F(S_d, L)) \frac{\partial F(S_d, L)}{\partial S_d} \frac{\partial F(S_d, L)}{\partial L} + R'(F(S_d, L)) \frac{\partial^2 F(S_d, L)}{\partial S_d \partial L} > 0. \tag{C.4}$$

Similarly, suppose the affiliate labor choice satisfies the second-order condition

$$R^{*\prime\prime}\left(F(S_a, L^*)\right) \left(\frac{\partial F(S_a, L^*)}{\partial L^*}\right)^2 + R^{*\prime}\left(F(S_a, L^*)\right) \frac{\partial^2 F(S_a, L^*)}{\partial (L^*)^2} < 0, \tag{C.5}$$

and suppose support services raise the marginal profitability of affiliate production labor:

$$R^{*\prime\prime}\left(F(S_a, L^*)\right) \frac{\partial F(S_a, L^*)}{\partial S_a} \frac{\partial F(S_a, L^*)}{\partial L^*} + R^{*\prime}\left(F(S_a, L^*)\right) \frac{\partial^2 F(S_a, L^*)}{\partial S_a \partial L^*} > 0. \tag{C.6}$$

Then optimized production-labor demand is increasing in allocated support services:

$$\ell'(S_d) > 0, \qquad \ell^{*\prime}(S_a) > 0.$$

Consequently, together with Proposition 4.1, a small depreciation raises affiliate production labor and reduces domestic production labor:

$$dL^* > 0, \qquad dL < 0.$$

Since production is increasing in both inputs, affiliate output rises and domestic output falls:

$$dY^* > 0, \qquad dY < 0.$$

Proof. For domestic operations, production labor is chosen from

$$V(S_d) = \max_L \{R(F(S_d, L)) - W_L L\}.$$

The domestic labor first-order condition is

$$R'(F(S_d, L)) \frac{\partial F(S_d, L)}{\partial L} = W_L.$$

Define

$$\Phi(S_d, L) \equiv R'(F(S_d, L)) \frac{\partial F(S_d, L)}{\partial L} - W_L.$$

At an interior optimum, $\Phi(S_d, L) = 0$. The derivative of the first-order condition with respect to L is

$$\frac{\partial \Phi(S_d, L)}{\partial L} = R''(F(S_d, L)) \left(\frac{\partial F(S_d, L)}{\partial L}\right)^2 + R'(F(S_d, L)) \frac{\partial^2 F(S_d, L)}{\partial L^2}.$$

By Equation (C.3), $\partial \Phi / \partial L < 0$. Hence the implicit function theorem implies that the first-order condition locally defines $L = \ell(S_d)$, with

$$\frac{dL}{dS_d} = -\frac{\partial \Phi / \partial S_d}{\partial \Phi / \partial L}.$$

Moreover,

$$\frac{\partial \Phi(S_d, L)}{\partial S_d} = R''(F(S_d, L)) \frac{\partial F(S_d, L)}{\partial S_d} \frac{\partial F(S_d, L)}{\partial L} + R'(F(S_d, L)) \frac{\partial^2 F(S_d, L)}{\partial S_d \partial L}.$$

By Equation (C.4), $\partial \Phi / \partial S_d > 0$. Therefore

$$\ell'(S_d) = \frac{dL}{dS_d} > 0.$$

The affiliate problem is analogous. Given affiliate support S_a, affiliate production labor is chosen from

$$V^*(S_a) = \max_{L^*} \left\{R^*\big(F(S_a, L^*)\big) - W_L^* L^*\right\}.$$

The affiliate labor first-order condition is

$$R^{*\prime}\big(F(S_a, L^*)\big) \frac{\partial F(S_a, L^*)}{\partial L^*} = W_L^*.$$

Define

$$\Phi^*(S_a, L^*) \equiv R^{*\prime}\big(F(S_a, L^*)\big) \frac{\partial F(S_a, L^*)}{\partial L^*} - W_L^*.$$

By Equation (C.5), $\partial \Phi^* / \partial L^* < 0$. Hence the implicit function theorem implies that the first-order condition locally defines $L^* = \ell^*(S_a)$, with

$$\frac{dL^*}{dS_a} = -\frac{\partial \Phi^* / \partial S_a}{\partial \Phi^* / \partial L^*}.$$

By Equation (C.6), $\partial\Phi^*/\partial S_a > 0$. Therefore

$$\ell^{*\prime}(S_a) = \frac{dL^*}{dS_a} > 0.$$

Proposition 4.1 implies that a depreciation raises affiliate support and reduces domestic support:

$$dS_a > 0, \qquad dS_d < 0.$$

Since $\ell'(S_d) > 0$ and $\ell^{*\prime}(S_a) > 0$, it follows that

$$dL = \ell'(S_d)dS_d < 0, \qquad dL^* = \ell^{*\prime}(S_a)dS_a > 0.$$

Since F is increasing in both inputs, $dS_a > 0$ and $dL^* > 0$ imply $dY^* > 0$, while $dS_d < 0$ and $dL < 0$ imply $dY < 0$. ■

C.3. Proof of Corollary 4.1

Suppose

$$R(Y) = AY^{\rho}, \qquad R^*(Y^*) = A^*(Y^*)^{\rho}, \qquad 0 < \rho < 1,$$

and

$$F(S,L) = S^{\alpha_S}L^{\alpha_L}, \qquad \alpha_S > 0, \quad \alpha_L > 0,$$

with

$$\rho(\alpha_S + \alpha_L) < 1.$$

For domestic operations, the problem is

$$V(S_d) = \max_L \left\{ AS_d^{\rho\alpha_S}L^{\rho\alpha_L} - W_L L \right\}.$$

The first-order condition is

$$\rho\alpha_L A S_d^{\rho\alpha_S} L^{\rho\alpha_L - 1} = W_L.$$

Solving for domestic production labor gives

$$L = \left(\frac{\rho\alpha_L A}{W_L}\right)^{\frac{1}{1-\rho\alpha_L}} S_d^{\frac{\rho\alpha_S}{1-\rho\alpha_L}}.$$

Since $\alpha_S > 0$, $\rho > 0$, and $\rho(\alpha_S + \alpha_L) < 1$, we have $1 - \rho\alpha_L > 0$. Hence

$$\frac{dL}{dS_d} > 0.$$

Substituting optimized labor demand back into the domestic value function implies

$$V(S_d) = \kappa S_d^{\frac{\rho\alpha_S}{1-\rho\alpha_L}},$$

for some constant $\kappa > 0$. The exponent satisfies

$$0 < \frac{\rho\alpha_S}{1-\rho\alpha_L} < 1,$$

because $\rho(\alpha_S + \alpha_L) < 1$. Hence

$$V'(S_d) > 0, \qquad V''(S_d) < 0.$$

For the affiliate, the problem is

$$V^*(S_a) = \max_{L^*}\left\{A^* S_a^{\rho\alpha_S}(L^*)^{\rho\alpha_L} - W_L^* L^*\right\}.$$

The first-order condition gives

$$L^* = \left(\frac{\rho\alpha_L A^*}{W_L^*}\right)^{\frac{1}{1-\rho\alpha_L}} S_a^{\frac{\rho\alpha_S}{1-\rho\alpha_L}}.$$

Thus

$$\frac{dL^*}{dS_a} > 0.$$

Substituting optimized affiliate labor demand back into the affiliate value function gives

$$V^*(S_a) = \kappa^* S_a^{\frac{\rho\alpha_S}{1-\rho\alpha_L}},$$

for some constant $\kappa^* > 0$. Therefore

$$V^{*\prime}(S_a) > 0, \qquad V^{*\prime\prime}(S_a) < 0.$$

The preceding expressions show that optimized production-labor demand is increasing in allocated support services for both domestic and affiliate operations, and that the induced value functions are increasing and strictly concave. Hence the conditions in Proposition 4.1 and Proposition C.1 are satisfied. ■

D Quantitative Model Details

This appendix presents the detailed two-country general-equilibrium model in Section 5. The model features households, tradable producers, multinational parents and their foreign affiliates, nominal rigidities, international asset trade, and monetary policy. We describe the Home economy below; the Foreign economy is symmetric unless otherwise noted. We then define market clearing, external accounts, and the equilibrium conditions that close the model.

D.1. Households

The Home representative household supplies two types of labor: production labor L_t, supplied to both tradable firms and multinational firms, and non-production support labor N_t, supplied to multinational parents. Support labor is differentiated across parent firms: N_t denotes an aggregate of firm-specific support-labor services $N_t(j)$, whose aggregation and allocation across firms are specified below.

The household maximizes expected lifetime utility under Greenwood–Hercowitz–Huffman (GHH) preferences:

$$E_0 \sum_{t=0}^{\infty} \beta^t \frac{X_t^{1-\sigma}}{1-\sigma}, \qquad X_t = C_t - \chi_L \frac{L_t^{1+\varphi}}{1+\varphi} - \chi_N \frac{N_t^{1+\varphi}}{1+\varphi},$$

where C_t denotes final consumption, σ governs the curvature of utility, χ_L and χ_N govern the disutility of production and support labor, and φ is the inverse Frisch elasticity. GHH preferences eliminate wealth effects on labor supply, so aggregate labor responds to wages rather than directly to exchange-rate-induced income gains.

Consumption structure. Final consumption has a nested CES structure. At the top level, households combine a multinational-goods composite $C_{M,t}$ and a tradable-goods composite $C_{T,t}$:

$$C_t = \left[\omega^{\frac{1}{\eta}} C_{M,t}^{\frac{\eta-1}{\eta}} + (1-\omega)^{\frac{1}{\eta}} C_{T,t}^{\frac{\eta-1}{\eta}} \right]^{\frac{\eta}{\eta-1}},$$

where $\eta > 0$ governs substitution between multinational and tradable goods, and ω determines the expenditure weight on the multinational sector.

Cost minimization implies

$$C_{M,t} = \omega \left(\frac{P_{M,t}}{P_t} \right)^{-\eta} C_t, \qquad C_{T,t} = (1-\omega) \left(\frac{P_{T,t}}{P_t} \right)^{-\eta} C_t,$$

where P_t, $P_{M,t}$, and $P_{T,t}$ denote the price indexes for final consumption, the multinational composite, and the tradable composite, respectively.

Each sectoral composite $C_{\ell,t}$, for $\ell \in \{M, T\}$, aggregates Home and Foreign components:

$$C_{\ell,t} = \left[\omega_\ell^{\frac{1}{\eta_\ell}} C_{\ell H,t}^{\frac{\eta_\ell-1}{\eta_\ell}} + (1-\omega_\ell)^{\frac{1}{\eta_\ell}} C_{\ell F,t}^{\frac{\eta_\ell-1}{\eta_\ell}} \right]^{\frac{\eta_\ell}{\eta_\ell-1}}.$$

For the multinational composite, $C_{MH,t}$ denotes goods produced in Home by Home-controlled multinational parents, while $C_{MF,t}$ denotes goods produced in Home by Foreign-controlled affiliates. For the tradable composite, $C_{TH,t}$ denotes Home-produced tradable goods and $C_{TF,t}$ denotes imported Foreign tradable goods. Thus, multinational goods are produced locally by either domestically controlled parents or foreign-controlled affiliates, whereas tradable goods may be produced domestically or imported.

The associated sectoral price index is

$$P_{\ell,t} = \left[\omega_\ell P_{\ell H,t}^{1-\eta_\ell} + (1-\omega_\ell) P_{\ell F,t}^{1-\eta_\ell} \right]^{\frac{1}{1-\eta_\ell}}, \qquad \ell \in \{M, T\}.$$

Cost minimization implies the demand functions

$$C_{\ell H,t} = \omega_\ell \left(\frac{P_{\ell H,t}}{P_{\ell,t}}\right)^{-\eta_\ell} C_{\ell,t}, \qquad C_{\ell F,t} = (1-\omega_\ell)\left(\frac{P_{\ell F,t}}{P_{\ell,t}}\right)^{-\eta_\ell} C_{\ell,t}, \qquad \ell \in \{M,T\}.$$

Here $P_{MH,t}$ and $P_{MF,t}$ denote the price indexes for Home-controlled multinational goods and Foreign-controlled affiliate goods sold in Home, while $P_{TH,t}$ and $P_{TF,t}$ denote the corresponding price indexes for Home and Foreign tradable goods sold in Home.

At the variety level, monopolistically competitive firms produce differentiated goods. For Home tradables, the CES composite is

$$C_{TH,t} = \left[\int_0^1 C_{TH,t}(j)^{\frac{\varepsilon_T-1}{\varepsilon_T}}\,dj\right]^{\frac{\varepsilon_T}{\varepsilon_T-1}}.$$

The corresponding variety-level aggregators for Foreign tradables and multinational goods are defined analogously. We introduce the implied variety-level demand schedules below when characterizing firms' pricing problems.

Labor supply. Production labor is supplied competitively at the common wage $W_{L,t}$. We focus on the structure of the support labor market, since support services are the input through which multinational activity affects domestic production.

The support labor market features monopsonistic competition, which provides a parsimonious way to generate the upward-sloping firm-level support labor supply curve used in Section 4. Each multinational parent firm j posts a firm-specific nominal support wage $W_{N,t}(j)$, and households allocate aggregate support labor across parent firms $j \in [0,1]$ according to

$$N_t = \left[\int_0^1 N_t(j)^{\frac{1+\varepsilon_N}{\varepsilon_N}}\,dj\right]^{\frac{\varepsilon_N}{1+\varepsilon_N}},$$

where $\varepsilon_N > 0$ governs the elasticity of support labor supply to firm-specific wages. Conditional on aggregate support labor N_t, the household allocates support labor across parent firms in response to firm-specific wages:

$$N_t(j) = \left(\frac{W_{N,t}(j)}{W_{N,t}}\right)^{\varepsilon_N} N_t, \tag{D.1}$$

where the aggregate support wage index is

$$W_{N,t} = \left[\int_0^1 W_{N,t}(j)^{1+\varepsilon_N}\,dj\right]^{\frac{1}{1+\varepsilon_N}}.$$

Thus, each parent firm faces an upward-sloping support labor supply schedule with elasticity ε_N. The support wage index also implies that aggregate support labor income satisfies

$$\int_0^1 W_{N,t}(j)N_t(j)\,dj = W_{N,t}N_t.$$

Budget constraint. The Home household trades one-period nominal bonds denominated in Home and Foreign currency. Home-currency bonds are traded domestically and pay the gross nominal return R_t. Foreign-currency bonds are traded internationally and pay the gross nominal return R_t^*. The household also pays a quadratic portfolio adjustment cost on its real Foreign-currency bond position, which ensures stationarity of net foreign assets (Schmitt-Grohé and Uribe, 2003). An exogenous risk-premium shock perturbs the return on Foreign-currency bonds and generates deviations from uncovered interest parity.

The nominal budget constraint of the representative household is

$$\begin{aligned} P_t C_t + B_{H,t} + \mathscr{E}_t B_{F,t} + P_t \frac{\psi_b}{2}\left(\frac{\mathscr{E}_t B_{F,t}}{P_t} - \bar{b}_F\right)^2 \\ = R_{t-1} B_{H,t-1} + R_{t-1}^* \mathscr{E}_t B_{F,t-1} \exp(\psi_{rp,t-1}) + W_{L,t} L_t + W_{N,t} N_t + \Pi_t^H + \mathscr{I}_t^H. \end{aligned} \tag{D.2}$$

Here $B_{H,t}$ and $B_{F,t}$ denote holdings of Home- and Foreign-currency nominal bonds, respectively, and $\mathscr{E}_t$ is the nominal exchange rate expressed as Home currency per unit of Foreign currency. The parameter $\psi_b > 0$ governs the adjustment cost around the steady-state real foreign bond position $\bar{b}_F$, and $\psi_{rp,t}$ is an exogenous risk-premium shock on Foreign-currency bond returns. Labor income consists of production wage income, $W_{L,t} L_t$, and aggregate support wage income, $W_{N,t} N_t$. The term Π_t^H denotes Home-currency profits from Home-located production accruing to Home households. It includes profits of Home tradable producers, domestic operating profits of Home MNE parents net of their support wage bill, and the share $1-\xi^*$ of operating surplus generated by Foreign-controlled affiliates in Home that accrues to Home residents. The term $\mathscr{I}_t^H$ separately denotes Home-currency direct investment income accruing to Home households from Home-controlled affiliates operating abroad.

D.2. Tradable Producers

A continuum of Home tradable producers $j \in [0,1]$ produces differentiated varieties using Home production labor and sells them in both Home and Foreign markets. Technology is linear:

$$Y_{T,t}(j) = L_{T,t}(j). \tag{D.3}$$

Total output satisfies

$$Y_{T,t}(j) = C_{TH,t}(j) + C_{TH,t}^*(j). \tag{D.4}$$

Demand in each destination is

$$C_{TH,t}(j) = \left(\frac{P_{TH,t}(j)}{P_{TH,t}}\right)^{-\varepsilon_T} C_{TH,t}, \tag{D.5}$$

$$C_{TH,t}^*(j) = \left(\frac{P_{TH,t}^*(j)}{P_{TH,t}^*}\right)^{-\varepsilon_T} C_{TH,t}^*, \tag{D.6}$$

where $P_{TH,t}(j)$ is the Home-currency price charged in the Home market, and $P^*_{TH,t}(j)$ is the Foreign-currency price charged in the Foreign market.

Firms are monopolistically competitive and set destination-specific local-currency prices subject to Rotemberg adjustment costs. The nominal profit of Home tradable producer j is

$$\begin{aligned}\Pi_{T,t}(j) = {} & P_{TH,t}(j)C_{TH,t}(j) + \mathcal{E}_t P^*_{TH,t}(j)C^*_{TH,t}(j) - W_{L,t}L_{T,t}(j) \\ & - \frac{\psi_p^T}{2} P_{TH,t}C_{TH,t}\left(\frac{P_{TH,t}(j)}{P_{TH,t-1}(j)} - 1\right)^2 - \frac{\psi_p^{T,*}}{2}\mathcal{E}_t P^*_{TH,t}C^*_{TH,t}\left(\frac{P^*_{TH,t}(j)}{P^*_{TH,t-1}(j)} - 1\right)^2.\end{aligned}$$

Each firm chooses production labor and destination-specific local-currency prices to maximize the expected discounted value of profits, subject to the technology in Equation (D.3), the market-clearing condition in Equation (D.4), and the demand schedules in Equation (D.5)–Equation (D.6). Price adjustment is subject to Rotemberg costs, which are treated as real expenditures on the firm's own sectoral composite. These costs therefore enter goods-market clearing as adjustment absorption and reduce distributable profits. Because they are quadratic in price changes, the associated variety-level adjustment demand is second order around the zero-inflation steady state and does not affect the model's first-order dynamics.

Foreign tradable producers are defined symmetrically.

D.3. Multinational Firms

The multinational block implements the support-allocation mechanism developed in Section 4. A Home multinational parent $j \in [0,1]$ operates a domestic production unit and a Foreign affiliate. The parent hires non-production support labor $N_t(j)$ and transforms it one-for-one into support services,

$$S_t(j) = N_t(j),$$

which are allocated between domestic operations and the Foreign affiliate:

$$S_t(j) = S_{d,t}(j) + S_{a,t}(j).$$

Domestic parent production combines domestic support services and production labor,

$$Y_{MH,t}(j) = F\big(S_{d,t}(j), L_{MH,t}(j)\big), \tag{D.7}$$

while the Home-controlled affiliate abroad produces

$$Y^*_{MH,t}(j) = F\big(S_{a,t}(j), L^*_{MH,t}(j)\big),$$

where $L^*_{MH,t}(j)$ denotes production labor hired locally by the affiliate abroad. We use a constant-returns Cobb–Douglas technology,

$$F(S,L) = S^{\alpha_S}L^{1-\alpha_S}, \qquad \alpha_S \in (0,1).$$

Foreign multinationals are defined symmetrically.

The Home parent's domestic unit sells a differentiated multinational variety in the Home market. Demand is

$$C_{MH,t}(j) = \left(\frac{P_{MH,t}(j)}{P_{MH,t}}\right)^{-\varepsilon_M} C_{MH,t}, \tag{D.8}$$

where $P_{MH,t}(j)$ is the Home-currency price of variety j. The Home-controlled affiliate abroad sells a differentiated variety in the Foreign market. Demand is

$$C^*_{MH,t}(j) = \left(\frac{P^*_{MH,t}(j)}{P^*_{MH,t}}\right)^{-\varepsilon_M} C^*_{MH,t},$$

where $P^*_{MH,t}(j)$ is the Foreign-currency price charged by the affiliate.

Both the domestic unit and the Foreign affiliate set local-currency prices subject to Rotemberg adjustment costs. The nominal operating profit of the domestic unit, before support labor costs, is

$$\begin{aligned}\widetilde{\Pi}_{MH,t}(j) = P_{MH,t}(j)C_{MH,t}(j) - W_{L,t}L_{MH,t}(j) \\ - \frac{\psi_p^M}{2} P_{MH,t}C_{MH,t}\left(\frac{P_{MH,t}(j)}{P_{MH,t-1}(j)} - 1\right)^2.\end{aligned}$$

The nominal operating profit of the Foreign affiliate, before payments to the parent, is

$$\begin{aligned}\widetilde{\Pi}^*_{MH,t}(j) = P^*_{MH,t}(j)C^*_{MH,t}(j) - W^*_{L,t}L^*_{MH,t}(j) \\ - \frac{\psi_p^{M,*}}{2} P^*_{MH,t}C^*_{MH,t}\left(\frac{P^*_{MH,t}(j)}{P^*_{MH,t-1}(j)} - 1\right)^2.\end{aligned}$$

A fraction $\xi \in [0,1]$ of affiliate operating surplus accrues to the Home parent and is recorded as Home direct investment income. The corresponding Home-currency income flow is

$$\mathscr{E}_t \xi \widetilde{\Pi}^*_{MH,t}(j).$$

The remaining share $1-\xi$ accrues to Foreign residents. We treat ξ as a reduced-form income-accrual parameter rather than modeling payout, retained earnings, local ownership, and affiliate capital accumulation separately.

The Home-controlled affiliate abroad chooses local production labor and its Foreign-currency price, taking the support services allocated by the parent as given. Because prices are subject to Rotemberg adjustment costs, the affiliate's pricing problem is forward looking. For any support allocation, the affiliate solves

$$\max_{\{L^*_{MH,\tau}(j), P^*_{MH,\tau}(j)\}_{\tau \ge t}} E_t \sum_{\tau=t}^{\infty} \Lambda^*_{MH,t,\tau} \widetilde{\Pi}^*_{MH,\tau}(j), \tag{D.9}$$

subject to the affiliate production technology and demand schedule, where $\Lambda^*_{MH,t,\tau}$ is the parent's nominal stochastic discount factor converted into Foreign currency; see Equation (D.14). The affiliate prices to maximize its value to the controlling parent; the constant ξ scales this objective without affecting the optimal policy. Let $\widetilde{\Pi}^{*,opt}_{MH,\tau}(j)$ denote affiliate operating profit at date τ, evaluated at the solution to this dynamic problem. The optimized profit depends on parent support, aggregate states, and lagged prices; we suppress these arguments below to keep notation compact.

The Home parent chooses support hiring, support allocation, domestic production labor, and the domestic MNE price to maximize

$$\max_{\{S_{d,\tau}(j),S_{a,\tau}(j),N_\tau(j),L_{MH,\tau}(j),P_{MH,\tau}(j)\}_{\tau\geq t}} E_t \sum_{\tau=t}^{\infty} \Lambda_{t,\tau}\left[\widetilde{\Pi}_{MH,\tau}(j) + \xi \mathscr{E}_\tau \widetilde{\Pi}^{*,opt}_{MH,\tau}(j) - W_{N,\tau}(j)N_\tau(j)\right],$$

subject to the support constraint

$$N_\tau(j) = S_{d,\tau}(j) + S_{a,\tau}(j), \qquad \tau \geq t,$$

the domestic production technology Equation (D.7), the domestic demand schedule Equation (D.8), and the firm-level support labor supply schedule in Equation (D.1). The variable $\Lambda_{t,\tau}$ denotes the nominal stochastic discount factor of Home households between dates t and τ for Home-currency payoffs. The parent takes production wages as given and internalizes that expanding support employment requires posting a higher firm-specific support wage.

Let $Q_{MH,t}(j)$ denote the Home-currency shadow value of relaxing the domestic unit's date-t production constraint in the parent's problem, and let $Q^*_{MH,t}(j)$ denote the Foreign-currency shadow value of relaxing the affiliate's date-t production constraint in the affiliate's problem Equation (D.9). Both shadow values incorporate the forward-looking pricing conditions generated by Rotemberg adjustment costs. An additional unit of domestic support raises domestic output by $F_S(S_{d,t}(j), L_{MH,t}(j))$ and is therefore worth

$$Q_{MH,t}(j)F_S\big(S_{d,t}(j), L_{MH,t}(j)\big)$$

to the parent. An additional unit of affiliate support raises affiliate output by $F_S(S_{a,t}(j), L^*_{MH,t}(j))$, of which the parent receives the share ξ in Home currency, so its valuation is

$$\mathscr{E}_t \xi Q^*_{MH,t}(j) F_S\big(S_{a,t}(j), L^*_{MH,t}(j)\big).$$

The parent therefore allocates support according to

$$Q_{MH,t}(j)F_S\big(S_{d,t}(j), L_{MH,t}(j)\big) = \mathscr{E}_t \xi Q^*_{MH,t}(j) F_S\big(S_{a,t}(j), L^*_{MH,t}(j)\big) = MC^N_t(j), \tag{D.10}$$

where $MC^N_t(j)$ is the marginal cost of firm-specific support labor implied by Equation (D.1). Under the isoelastic support-labor supply schedule,

$$MC^N_t(j) = \left(1 + \frac{1}{\varepsilon_N}\right) W_{N,t}(j).$$

Equation (D.10) is the general-equilibrium version of the support-allocation condition in

Section 4. A Home depreciation raises $\mathcal{E}_t$, increasing the Home-currency marginal value of affiliate support and inducing the parent to shift support toward foreign affiliate operations. Because support services are rival within the parent firm, the increase in affiliate support limits the support available for domestic MNE production.

D.4. Monetary Policy and Market Clearing

Monetary policy follows a Taylor rule with interest-rate smoothing:

$$\widehat{R}_t = \rho_R \widehat{R}_{t-1} + (1-\rho_R)\left(\phi_\pi \widehat{\pi}_t + \phi_y \widehat{Y}_t\right) + \varepsilon_{R,t},$$

where

$$\widehat{R}_t \equiv \log\left(\frac{R_t}{\bar{R}}\right), \qquad \widehat{\pi}_t \equiv \log\left(\frac{\pi_t}{\bar{\pi}}\right), \qquad \widehat{Y}_t \equiv \log\left(\frac{Y_t}{\bar{Y}}\right)$$

denote log deviations of the gross nominal interest rate, inflation, and the Home real-GDP quantity index from their steady-state values. Foreign monetary policy is defined symmetrically.

Goods market clearing. Goods markets clear by sector and location. Home tradable output is absorbed by Home households, Foreign households, and the real resource costs of price adjustment. Aggregate Home tradable output satisfies

$$Y_{T,t} = C_{TH,t} + C^*_{TH,t} + \Phi_{TH,t} + \Phi^*_{TH,t},$$

where $\Phi_{TH,t}$ and $\Phi^*_{TH,t}$ denote the real resource costs of adjusting Home tradable prices in the Home and Foreign markets:

$$\Phi_{TH,t} = \frac{\psi_p^T}{2} C_{TH,t}\left(\frac{P_{TH,t}}{P_{TH,t-1}} - 1\right)^2,$$
$$\Phi^*_{TH,t} = \frac{\psi_p^{T,*}}{2} C^*_{TH,t}\left(\frac{P^*_{TH,t}}{P^*_{TH,t-1}} - 1\right)^2.$$

Foreign tradable market clearing is defined symmetrically.

Multinational goods are consumed locally in the market where they are produced. Home-controlled domestic MNE production satisfies

$$Y_{MH,t} = C_{MH,t} + \Phi_{MH,t},$$

where

$$\Phi_{MH,t} = \frac{\psi_p^M}{2} C_{MH,t}\left(\frac{P_{MH,t}}{P_{MH,t-1}} - 1\right)^2.$$

For Home-controlled affiliates abroad,

$$Y^*_{MH,t} = C^*_{MH,t} + \Phi^*_{MH,t},$$

where

$$\Phi^*_{MH,t} = \frac{\psi_p^{M,*}}{2} C^*_{MH,t} \left(\frac{P^*_{MH,t}}{P^*_{MH,t-1}} - 1 \right)^2 .$$

The corresponding market-clearing conditions for the other two multinational production units are defined symmetrically.

Aggregate real GDP. Aggregate Home real GDP is measured as a fixed-weight quantity index of production located in Home. To first order,

$$\widehat{Y}_t = \bar{s}_T \widehat{Y}_{T,t} + \bar{s}_{MH} \widehat{Y}_{MH,t} + \bar{s}_{MF} \widehat{Y}_{MF,t},$$

where

$$\widehat{Y}_{i,t} \equiv \log\left(\frac{Y_{i,t}}{\bar{Y}_i} \right), \qquad i \in \{T, MH, MF\},$$

and $\bar{s}_T$, $\bar{s}_{MH}$, and $\bar{s}_{MF}$ are the corresponding steady-state value-added shares, which sum to one. Here $Y_{MF,t}$ denotes production by Foreign-controlled affiliates located in Home.

Labor market clearing. Production labor market clearing is

$$L_t = \int_0^1 \left[L_{T,t}(j) + L_{MH,t}(j) + L_{MF,t}(j) \right] dj.$$

Production labor is used by Home-located tradable producers, Home-controlled domestic MNE units, and Foreign-controlled affiliates located in Home. Production labor employed by Home affiliates abroad is supplied in the Foreign economy and enters the Foreign labor-market clearing condition.

Support labor market clearing requires that the aggregate support labor supplied by the household equal the CES aggregate of support labor hired by Home multinational parents.

Bond market clearing. Home-currency bonds are traded domestically and are in zero net supply, so

$$B_{H,t} = 0.$$

The Foreign-currency bond is traded internationally. Let $B^*_{F,t}$ denote the Foreign household's net position in the same bond, expressed in Foreign currency. International bond-market clearing requires

$$B_{F,t} + B^*_{F,t} = 0.$$

D.5. External Adjustment and Measurement

Trade balance. The nominal trade balance records cross-border sales of tradable goods:

$$TB_t = \mathcal{E}_t P^*_{TH,t} C^*_{TH,t} - P_{TF,t} C_{TF,t}. \tag{D.11}$$

The first term is Home export revenue from tradable goods sold to Foreign households, converted into Home currency. The second term is Home expenditure on imported Foreign tradable goods. Multinational goods are produced and consumed locally, so cross-border multinational activity affects external earnings through direct investment income rather than through the trade balance.

Combining the Home household budget constraint in Equation (D.2) with goods-market clearing gives the nominal external budget constraint below. In this aggregation, the price-adjustment expenditures subtracted from the profits of Home-located units cancel against the corresponding adjustment absorption of Home sectoral output in the clearing conditions, so no adjustment-cost terms remain in the external constraint apart from those inside the affiliate surpluses that define DII_t:

$$\mathscr{E}_t B_{F,t} + P_t \frac{\psi_b}{2}\left(\frac{\mathscr{E}_t B_{F,t}}{P_t} - \bar{b}_F\right)^2 = R^*_{t-1}\exp(\psi_{rp,t-1})\mathscr{E}_t B_{F,t-1} + TB_t + DII_t. \tag{D.12}$$

Here TB_t is the nominal trade balance defined in Equation (D.11), and DII_t is the nominal direct investment income balance

$$DII_t = \mathscr{E}_t \xi \widetilde{\Pi}^*_{MH,t} - \xi^* \widetilde{\Pi}_{MF,t},$$

where the first term is income received by Home residents from Home-controlled affiliates abroad, and the second term is income paid by Home-located affiliates to Foreign parents.Consistent with the convention in Section 5.4, the model assigns no separate transfer price to parent support. Hence $S_{a,t}$ generates neither a service export for Home nor an intermediate-service import for Foreign, and $S^*_{a,t}$ generates neither a service import for Home nor a service export for Foreign. The Home parent's entire support wage bill is already subtracted in its objective, while affiliate operating surplus enters the external accounts only through the DII_t terms above.

Define the Home-currency value of the model's Foreign-currency bond position as

$$NFA_t \equiv \mathscr{E}_t B_{F,t}.$$

Subtracting $\mathscr{E}_{t-1} B_{F,t-1}$ from both sides of Equation (D.12) gives

$$\underbrace{\mathscr{E}_t B_{F,t} - \mathscr{E}_{t-1} B_{F,t-1}}_{\Delta NFA_t} = \underbrace{CA_t}_{\text{current account}} + \underbrace{(\mathscr{E}_t - \mathscr{E}_{t-1})\, B_{F,t-1}}_{\text{exchange-rate valuation effect}} \underbrace{- P_t \frac{\psi_b}{2}\left(\frac{\mathscr{E}_t B_{F,t}}{P_t} - \bar{b}_F\right)^2}_{\text{portfolio adjustment cost}}, \tag{D.13}$$

where the model current account is

$$CA_t = TB_t + DII_t + \mathscr{E}_t\left[R^*_{t-1}\exp(\psi_{rp,t-1}) - 1\right] B_{F,t-1}.$$

The first term of CA_t is the trade balance, the second term is the direct investment income balance, and the third term is portfolio income on the existing Foreign-currency bond position. Because the model contains only a one-period Foreign-currency bond, the valuation term in

Equation (D.13) reflects exchange-rate revaluation of the principal. Interest payments on the bond are portfolio income and therefore enter the current account.

The mechanism emphasized in the paper concerns the production-related components of the current account: the trade balance and the direct investment income balance. The trade-balance component is linked to domestic tradable production, whereas the direct-investment-income component is linked to foreign affiliate activity. In standard models without multinational income, $DII_t = 0$, so this production-related current-account response operates entirely through the trade balance. In the quantitative exercises, the steady-state Foreign-currency bond position is set to zero, which ensures that portfolio-income and bond-valuation terms do not drive the main transmission results.

Relation to balance-of-payments measurement. The model abstracts from several measurement issues that arise in the data. First, exchange-rate movements affect the Home-currency value of foreign affiliate profits immediately in the model. In firm accounts, however, reported profits and affiliate-to-parent payments may respond more gradually because of transfer-pricing practices, invoicing conventions, hedging, and accounting rules. We therefore interpret the model's exchange-rate translation of affiliate profits as a shadow value of foreign operations rather than as a prediction of one-for-one contemporaneous pass-through into measured payments.

Second, balance-of-payments statistics include reinvested earnings as part of direct investment income even when no cash payment crosses borders. The offsetting accounting entry is recorded in the financial account as reinvestment in the foreign affiliate. Our model abstracts from this reinvestment margin by fixing affiliate capital and treating ξ as a reduced-form Home claim on affiliate operating surplus. In the quantitative exercise, ξ is disciplined using affiliate-to-parent payments relative to affiliate income. The residual share of operating surplus accrues to Foreign residents rather than financing retained earnings or affiliate capital accumulation. This convention focuses the analysis on the short-run exchange-rate transmission channel through affiliate profitability and parent support allocation. Endogenizing payout, retained earnings, and affiliate capital accumulation is beyond the scope of this paper but is a natural extension for studying lower-frequency multinational investment responses.

D.6. Full Equilibrium System

This subsection shows the equilibrium system of the quantitative baseline. Variables without asterisks denote Home and starred variables denote Foreign. M denotes multinational goods and T denotes tradable goods. Within the multinational sector, MH is output of a Home-controlled producer and MF is output of a Foreign-controlled producer; for example, $Y^*_{MH,t}$ is output of the Home affiliate located in Foreign. All quantities and relative prices are expressed in units of the country-specific CPI:

$$q_t \equiv \frac{\mathcal{E}_t P_t^*}{P_t}, \qquad b_t \equiv \frac{\mathcal{E}_t B_{F,t}}{P_t}, \qquad p_{i,t} \equiv \frac{P_{i,t}}{P_t}, \qquad \pi_{i,t} \equiv \frac{P_{i,t}}{P_{i,t-1}}.$$

Similarly, $w_{k,t} = W_{k,t}/P_t$ for $k \in \{L, N\}$. The Foreign demand weights and parent-income claim are ω_M^*, ω_T^*, and ξ^*; in the symmetric benchmark they equal their Home counterparts.

Households and international financial markets. Households have the GHH composite and marginal utility

$$X_t = C_t - \chi_L \frac{L_t^{1+\varphi}}{1+\varphi} - \chi_N \frac{N_t^{1+\varphi}}{1+\varphi}, \qquad \lambda_t = X_t^{-\sigma}.$$

The Euler equations for Home- and Foreign-currency bonds are

$$\begin{aligned}
1 &= \beta \mathbb{E}_t \left[\frac{\lambda_{t+1}}{\lambda_t} \frac{R_t}{\pi_{t+1}} \right], \\
1 &= \beta \mathbb{E}_t \left[\frac{\lambda_{t+1}}{\lambda_t} \frac{R_t^*}{\pi_{t+1}^*} \frac{q_{t+1}}{q_t} \frac{\exp(\psi_{rp,t})}{1+\psi_b(b_t - \bar{b})} \right].
\end{aligned}$$

The Foreign household obeys the starred counterpart of the first equation. GHH preferences imply labor-supply conditions without a wealth-effect term:

$$\chi_L L_t^{\varphi} = w_{L,t}, \qquad \chi_N N_t^{\varphi} = w_{N,t},$$

with analogous Foreign conditions.

Demand, prices, and price dynamics. Home consumption is a three-level CES aggregate. In CPI-relative prices, its price indices and demands are

$$\begin{aligned}
p_{M,t} &= \left[\omega_M p_{MH,t}^{1-\eta_M} + (1-\omega_M) p_{MF,t}^{1-\eta_M} \right]^{1/(1-\eta_M)}, \\
p_{T,t} &= \left[\omega_T p_{TH,t}^{1-\eta_T} + (1-\omega_T) p_{TF,t}^{1-\eta_T} \right]^{1/(1-\eta_T)}, \\
1 &= \omega p_{M,t}^{1-\eta} + (1-\omega) p_{T,t}^{1-\eta}, \\
C_{M,t} &= \omega p_{M,t}^{-\eta} C_t, \qquad C_{T,t} = (1-\omega) p_{T,t}^{-\eta} C_t, \\
C_{MH,t} &= \omega_M \left(\frac{p_{MH,t}}{p_{M,t}} \right)^{-\eta_M} C_{M,t}, \qquad C_{MF,t} = (1-\omega_M) \left(\frac{p_{MF,t}}{p_{M,t}} \right)^{-\eta_M} C_{M,t}, \\
C_{TH,t} &= \omega_T \left(\frac{p_{TH,t}}{p_{T,t}} \right)^{-\eta_T} C_{T,t}, \qquad C_{TF,t} = (1-\omega_T) \left(\frac{p_{TF,t}}{p_{T,t}} \right)^{-\eta_T} C_{T,t}.
\end{aligned}$$

Foreign demands are the mirror image, with the Foreign-controlled multinational good MF receiving the home-bias weight ω_M^* and the Foreign tradable receiving the weight ω_T^*. Relative prices evolve according to $p_{i,t}/p_{i,t-1} = \pi_{i,t}/\pi_t$ in Home and $p_{i,t}^*/p_{i,t-1}^* = \pi_{i,t}^*/\pi_t^*$ in Foreign.

Production, rival support, and marginal costs. The four multinational production technologies are

$$Y_{MH,t} = A_{M,t} S_{d,t}^{\alpha_S} L_{MH,t}^{1-\alpha_S}, \qquad Y_{MF,t} = A_{M,t} (S_{a,t}^*)^{\alpha_S} L_{MF,t}^{1-\alpha_S},$$
$$Y_{MF,t}^* = A_{M,t}^* (S_{d,t}^*)^{\alpha_S} (L_{MF,t}^*)^{1-\alpha_S}, \qquad Y_{MH,t}^* = A_{M,t}^* S_{a,t}^{\alpha_S} (L_{MH,t}^*)^{1-\alpha_S}.$$

Tradable technologies are linear:

$$Y_{T,t} = A_{T,t} L_{T,t}, \qquad Y_{T,t}^* = A_{T,t}^* L_{T,t}^*.$$

There are no intermediate inputs, support-efficiency shocks, or separate head-office employment category in the baseline.

Support services are rival within each parent and one-for-one in support labor:

$$N_t = S_{d,t} + S_{a,t}, \qquad N_t^* = S_{d,t}^* + S_{a,t}^*.$$

The allocation and support-wage conditions are

$$\frac{mc_{MH,t} p_{MH,t} Y_{MH,t}}{S_{d,t}} = \xi q_t \frac{mc_{MH,t}^* p_{MH,t}^* Y_{MH,t}^*}{S_{a,t}},$$
$$\frac{mc_{MF,t}^* p_{MF,t}^* Y_{MF,t}^*}{S_{d,t}^*} = \frac{\xi^*}{q_t} \frac{mc_{MF,t} p_{MF,t} Y_{MF,t}}{S_{a,t}^*},$$
$$w_{N,t}\left(1 + \frac{1}{\varepsilon_N}\right) = \alpha_S \frac{mc_{MH,t} p_{MH,t} Y_{MH,t}}{S_{d,t}},$$
$$w_{N,t}^*\left(1 + \frac{1}{\varepsilon_N}\right) = \alpha_S \frac{mc_{MF,t}^* p_{MF,t}^* Y_{MF,t}^*}{S_{d,t}^*}.$$

The first two equations are the rival-allocation conditions; the last two embed the parent support-labor monopsony wedge. Production-labor marginal costs are

$$mc_{MH,t} = \frac{1}{1-\alpha_S} \frac{w_{L,t}}{p_{MH,t}} \frac{L_{MH,t}}{Y_{MH,t}}, \qquad mc_{MF,t} = \frac{1}{1-\alpha_S} \frac{w_{L,t}}{p_{MF,t}} \frac{L_{MF,t}}{Y_{MF,t}},$$
$$mc_{MF,t}^* = \frac{1}{1-\alpha_S} \frac{w_{L,t}^*}{p_{MF,t}^*} \frac{L_{MF,t}^*}{Y_{MF,t}^*}, \qquad mc_{MH,t}^* = \frac{1}{1-\alpha_S} \frac{w_{L,t}^*}{p_{MH,t}^*} \frac{L_{MH,t}^*}{Y_{MH,t}^*},$$
$$mc_{TH,t} = \frac{w_{L,t}}{A_{T,t} p_{TH,t}}, \qquad mc_{TH,t}^x = mc_{TH,t} \frac{p_{TH,t}}{q_t p_{TH,t}^*},$$
$$mc_{TF,t} = mc_{TF,t}^* \frac{p_{TF,t}^* q_t}{p_{TF,t}}, \qquad mc_{TF,t}^* = \frac{w_{L,t}^*}{A_{T,t}^* p_{TF,t}^*}.$$

Local-currency price setting. Price adjustment is Rotemberg at the variety level in every market. For a variety i, the pricing equation can be written as

$$(1-\varepsilon_i) + \varepsilon_i mc_{i,t} = \psi_i \left[\pi_{i,t}(\pi_{i,t}-1) - \beta \mathbb{E}_t \left(\mathcal{Q}_{i,t,t+1} \frac{C_{i,t+1}}{C_{i,t}} \pi_{i,t+1}^2 (\pi_{i,t+1}-1)\right)\right].$$

Here ε_i is ε_M for multinational varieties and ε_T for tradable varieties. The adjustment-cost coefficients are ψ_p^M for parent multinational goods, ψ_p^A for affiliate multinational goods, ψ_p^T for domestic tradables, and ψ_p^X for export tradables. The relevant discount factors are

$$
\begin{aligned}
\mathcal{Q}_{MH,t,t+1} &= \frac{\lambda_{t+1}}{\lambda_t \pi_{t+1}}, & \mathcal{Q}_{MF,t,t+1} &= \Omega_{MF,t,t+1}, \\
\mathcal{Q}_{MF^*,t,t+1} &= \frac{\lambda^*_{t+1}}{\lambda^*_t \pi^*_{t+1}}, & \mathcal{Q}_{MH^*,t,t+1} &= \Omega_{MH^*,t,t+1}, \\
\mathcal{Q}_{TH,t,t+1} &= \frac{\lambda_{t+1}}{\lambda_t \pi_{t+1}}, & \mathcal{Q}_{TH^*,t,t+1} &= \frac{\lambda_{t+1}}{\lambda_t}\frac{q_{t+1}}{q_t \pi^*_{t+1}}, \\
\mathcal{Q}_{TF,t,t+1} &= \frac{\lambda^*_{t+1}}{\lambda^*_t}\frac{q_t}{q_{t+1}\pi_{t+1}}, & \mathcal{Q}_{TF^*,t,t+1} &= \frac{\lambda^*_{t+1}}{\lambda^*_t \pi^*_{t+1}},
\end{aligned}
$$

where the affiliate discount factors are the controlling parents' discount factors converted into the currency of the affiliate's revenues,

$$
\begin{aligned}
\Omega_{MF,t,t+1} &= \frac{\lambda^*_{t+1}}{\lambda^*_t}\frac{q_t}{q_{t+1}}\frac{1}{\pi_{t+1}}, \\
\Omega_{MH^*,t,t+1} &= \frac{\lambda_{t+1}}{\lambda_t}\frac{q_{t+1}}{q_t}\frac{1}{\pi^*_{t+1}}.
\end{aligned} \tag{D.14}
$$

Each affiliate thus discounts exactly as an exporter from its parent's country does, $\Omega_{MF} = \mathcal{Q}_{TF}$ and $\Omega_{MH^*} = \mathcal{Q}_{TH^*}$; the $1-\xi$ local claim on affiliate surplus affects income flows, not the pricing objective.

Goods, labor, and external-account clearing. Let $\mathscr{A}(\pi;\psi) \equiv 1+\frac{\psi}{2}(\pi-1)^2$ denote the gross-output factor implied by price adjustment: under the convention stated in Appendix D.2, adjustment expenditures purchase the sectoral composite, so sectoral gross output equals household demand plus adjustment absorption. Goods-market and production-labor clearing are

$$
\begin{aligned}
Y_{MH,t} &= C_{MH,t}\mathscr{A}(\pi_{MH,t};\psi_p^M), & Y_{MF,t} &= C_{MF,t}\mathscr{A}(\pi_{MF,t};\psi_p^A), \\
Y^*_{MF,t} &= C^*_{MF,t}\mathscr{A}(\pi^*_{MF,t};\psi_p^M), & Y^*_{MH,t} &= C^*_{MH,t}\mathscr{A}(\pi^*_{MH,t};\psi_p^A), \\
Y_{T,t} &= C_{TH,t}\mathscr{A}(\pi_{TH,t};\psi_p^T) + C^*_{TH,t}\mathscr{A}(\pi^*_{TH,t};\psi_p^X), \\
Y^*_{T,t} &= C^*_{TF,t}\mathscr{A}(\pi^*_{TF,t};\psi_p^T) + C_{TF,t}\mathscr{A}(\pi_{TF,t};\psi_p^X), \\
L_t &= L_{T,t} + L_{MH,t} + L_{MF,t}, & L^*_t &= L^*_{T,t} + L^*_{MF,t} + L^*_{MH,t}.
\end{aligned}
$$

External balance.

$$
\begin{aligned}
tb_t &= q_t p^*_{TH,t} C^*_{TH,t} - p_{TF,t} C_{TF,t},\\
dii^{in}_t &= \xi q_t \left[p^*_{MH,t} C^*_{MH,t} - w^*_{L,t} L^*_{MH,t} - \frac{\psi^A_p}{2} p^*_{MH,t} C^*_{MH,t} (\pi^*_{MH,t} - 1)^2 \right],\\
dii^{out}_t &= \xi^* \left[p_{MF,t} C_{MF,t} - w_{L,t} L_{MF,t} - \frac{\psi^A_p}{2} p_{MF,t} C_{MF,t} (\pi_{MF,t} - 1)^2 \right],\\
dii_t &= dii^{in}_t - dii^{out}_t,\\
ca_t &= tb_t + dii_t + \left(R^*_{t-1} \exp(\psi_{rp,t-1}) - 1 \right) \frac{q_t}{q_{t-1}} \frac{b_{t-1}}{\pi^*_t},\\
b_t + \frac{\psi_b}{2} (b_t - \bar{b})^2 &= R^*_{t-1} \exp(\psi_{rp,t-1}) \frac{q_t}{q_{t-1}} \frac{b_{t-1}}{\pi^*_t} + tb_t + dii_t,\\
tot_t &= \frac{p_{TF,t}}{q_t p^*_{TH,t}}.
\end{aligned}
$$

Thus, DII measures the parent's claim on affiliate operating surplus after local production-labor costs and the affiliate's price-adjustment expenditures; it is not a trade flow. There is no double-counting of adjustment costs in this accounting: production labor produces the affiliate's gross output, the affiliate's adjustment expenditure purchases sectoral output that appears as adjustment absorption in the clearing conditions above, and the same expenditure is subtracted once from the surplus available for distribution.

Aggregate output, policy, shocks, and steady state. The physical-output aggregate used in the Taylor rule, and Home GDP, are

$$
\begin{aligned}
Y_t &= p_{MH,ss} C_{MH,t} + p_{MF,ss} C_{MF,t} + p_{TH,ss} C_{TH,t} + q_{ss} p^*_{TH,ss} C^*_{TH,t},\\
gdp_t &= p_{MH,t} C_{MH,t} + p_{MF,t} C_{MF,t} + p_{TH,t} C_{TH,t} + q_t p^*_{TH,t} C^*_{TH,t}.
\end{aligned}
$$

GDP is measured as final sales of Home-located production, treating all sectors symmetrically. Under the price-adjustment convention above, adjustment resources are produced and used up within the firm; they are intermediate own-consumption and are therefore excluded from value added. This convention is innocuous for the quantitative results: the adjustment factor $\mathscr{A}(\pi;\psi)$ equals one at the zero-inflation steady state and its first-order deviation vanishes, so gross output and final sales coincide to first order and the GDP measure is identical under either convention in the linearized solution. The Home monetary rule is

$$
\log \frac{R_t}{\bar{R}} = \rho_R \log \frac{R_{t-1}}{\bar{R}} + (1 - \rho_R) \left[\phi_\pi \log \pi_t + \phi_y \log \frac{Y_t}{\bar{Y}} \right] + e^m_t,
$$

with a starred counterpart for Foreign. The exogenous processes are

$$\log A_{M,t} = \rho_{A_M} \log A_{M,t-1} + e_{A_M,t}, \qquad \log A_{T,t} = \rho_{A_T} \log A_{T,t-1} + e_{A_T,t},$$
$$\log A^*_{M,t} = \rho_{A_M} \log A^*_{M,t-1} + e_{A^*_M,t}, \qquad \log A^*_{T,t} = \rho_{A_T} \log A^*_{T,t-1} + e_{A^*_T,t},$$
$$\psi_{rp,t} = \rho_\psi \psi_{rp,t-1} + e_{\psi,t}.$$

Together with the two monetary shocks, this gives seven structural shocks.

The non-stochastic symmetric steady state has $A_M = A^*_M = A_T = A^*_T = 1$, $\psi_{rp} = 0$, $b = \bar{b} = 0$, unit inflation, $q = 1$, and $\bar{R} = \bar{R}^* = 1/\beta$. Multinational marginal costs equal $(\varepsilon_M - 1)/\varepsilon_M$ and tradable marginal costs equal $(\varepsilon_T - 1)/\varepsilon_T$. Symmetry implies equal gross DII receipts and payments, and hence $dii = tb = ca = 0$.

E Mapping Parent-Level Elasticities to the Support-Allocation Block

This appendix describes how the parent-level long-difference evidence disciplines the support block of the quantitative model. The calibration is a regression-to-regression mapping. For a candidate set of support-block parameters, we simulate model parents with the same revenue-side exchange-rate shocks used in the empirical parent regressions, solve the parent block firm by firm in partial equilibrium, and run the corresponding cross-sectional regression on the simulated model outcomes. The support-block parameters are chosen so that the model reproduces the relative responses estimated in the parent data.

This procedure separates two objects. The parent regressions identify how outcomes differ across parents with different revenue-side exchange-rate exposure during 2020–22. The aggregate exchange-rate experiment in Section 6.2 then determines how the calibrated support block responds in general equilibrium to a common depreciation.

E.1. Empirical Regression and Simulated Counterpart

The empirical parent regression relates each parent's 2020–22 log outcome change to its revenue-side foreign-exchange exposure, controlling for purchase-side exposure, industry fixed effects, and pre-period controls. Let E_j denote the revenue-side exchange-rate shock for parent j. For outcome y_j, the empirical specification can be written as

$$\Delta \ln y_j^{data} = a_y + \beta_y^{data} E_j + \Gamma'_y X_j + \delta_{i(j)} + u_{j,y},$$

where X_j contains purchase-side exposure and pre-period controls, and $\delta_{i(j)}$ denotes industry fixed effects. The coefficient β_y^{data} is identified from cross-sectional variation in revenue-side exposure across parents, conditional on these controls.

The model counterpart uses the same cross-sectional object. Parents are ex ante identical in the quantitative model, but in the micro-calibration exercise they are exposed to different realized revenue-side exchange-rate shocks E_j. For a candidate parameter vector $\theta = (\alpha_S, \varepsilon_N)$, we solve the parent block for each observed E_j, holding aggregate prices, wages, and demand shifters fixed at their symmetric steady-state values. Let $\Delta \ln y_j^{model}(\theta)$ denote the resulting simulated log change in the model counterpart of outcome y_j. We then run the simulated regression

$$\Delta \ln y_j^{model}(\theta) = a_y^{model}(\theta) + \beta_y^{model}(\theta) E_j + u_{j,y}^{model}(\theta). \tag{E.1}$$

The calibration chooses α_S and ε_N so that the simulated slopes match the empirical parent-regression slopes for support employment and non-support parent employment:

$$\beta_{H_N}^{model}(\alpha_S, \varepsilon_N) = \beta_{H_N}^{data}, \qquad \beta_{H_O}^{model}(\alpha_S, \varepsilon_N) = \beta_{H_O}^{data}. \tag{E.2}$$

The intercept in Equation (E.1) absorbs the component of the outcome change that is common across parents in the simulated cross section.[6] To see what the intercept does absorb, suppose the revenue-side shock can be written as

$$E_j = E_0 + \widetilde{E}_j,$$

where E_0 is a common component and $\widetilde{E}_j$ is relative exposure. Then

$$a_y^{model} + \beta_y^{model} E_j = \left(a_y^{model} + \beta_y^{model} E_0 \right) + \beta_y^{model} \widetilde{E}_j.$$

The common component moves the intercept, and the slope is identified from relative exposure. Because the parent block is nonlinear in exposure, however, the slope is itself a function of the point around which the cross-section is evaluated: β_y^{model} depends on E_0. Since the empirical slopes were estimated on outcomes generated under the 2020–22 depreciation, the model counterpart evaluates the parent block at the same realized exposures, and the aggregate UIP experiment continues to supply the general-equilibrium response to the common exchange-rate component.

The calibration uses the parent-level exchange-rate shocks from the 2020–22 episode.[7] We use the raw shock E_j rather than demeaning it before the nonlinear firm solve. This procedure adds shock-realization heterogeneity across parents without introducing ex-ante firm heterogeneity.

[6] The simulated regression is otherwise unconditional—the model has no counterpart of purchase-side exposure or industry composition—so the calibration matches conditional empirical slopes with unconditional model slopes generated by the same mechanism. This mismatch is quantitatively innocuous here because the two exposures are nearly orthogonal in the shock data (correlation 0.04); partialling the purchase-side exposure out of the simulated regression moves the calibrated parameters by less than 0.1%.

[7] Of the 4,050 parents with a revenue-side shock, we retain the 3,638 with both a revenue- and a purchase-side shock, mirroring the parent regressions' conditioning on purchase-side exposure. The sample-construction table reports a smaller count, 3,416, because it additionally requires the matched parent-survey data used in the regressions; the calibration needs only the exposure distribution, so it retains all parents with constructible shocks. The distinction is immaterial for the calibrated parameters.

E.2. Parent-Block Model Counterpart

The simulated regression is generated from the parent block of the quantitative model in partial equilibrium. The parent allocates support services between domestic MNE production and foreign-affiliate activity. Let $S_{d,j}$ denote support allocated to domestic production and $S_{a,j}$ support allocated to the foreign affiliate. The parent-block support-allocation condition is

$$\frac{mc_{MH,j}\,p_{MH,j}\,Y_{MH,j}}{S_{d,j}} = \xi\exp(E_j)\frac{mc^*_{MH,j}\,p^*_{MH,j}\,Y^*_{MH,j}}{S_{a,j}}.$$

The term $\exp(E_j)$ captures the parent-currency value of affiliate revenue. A higher revenue-side exchange-rate exposure raises the return to support used abroad relative to support used in domestic production. This is the model force that generates the cross-sectional responses in support employment, non-support parent employment, and wages.

For the two-year long-difference calibration, we use the flexible-price parent block. With goods demand elasticity ε_M, define

$$\varrho = \frac{\varepsilon_M - 1}{\varepsilon_M}, \qquad \phi = \frac{\varrho\alpha_S}{1-\varrho(1-\alpha_S)}, \qquad \psi_Y = \alpha_S + (1-\alpha_S)\phi,$$

where α_S is the support-input share in MNE production and the elasticity ε_N governs the firm-level support-labor supply curve. Combining the allocation condition with the support-labor supply condition gives the closed-form parent responses

$$\frac{S_{d,j}}{S_{a,j}} = \frac{\bar{S}_d}{\bar{S}_a}\exp\left(\frac{E_j}{\phi-1}\right), \tag{E.3}$$

$$\left(\frac{S_{d,j}}{\bar{S}_d}\right)^{\phi-1} = \left(\frac{N_j}{\bar{N}}\right)^{1/\varepsilon_N}. \tag{E.4}$$

Equation (E.3) is the within-parent allocation margin: higher exposure shifts support between domestic and affiliate use. Equation (E.4) is the scale margin: changes in the return to support affect total support services N_j. Domestic MNE production labor satisfies

$$L_{MH,j} \propto S^{\phi}_{d,j}. \tag{E.5}$$

Thus, for each observed exposure E_j, the parent block produces model outcomes N_j, $L_{MH,j}$, and wages. These simulated outcomes are then mapped into the parent data and used in the simulated regression Equation (E.1).

E.3. Mapping Model Variables to Parent Data

The parent data report employment categories, while the model is written in terms of support services and production labor. We map the model variables into the data as follows. Model support services N_j map into observed non-production support employment $H_{N,j}$. Model domestic MNE production labor $L_{MH,j}$ maps into observed other parent employment $H_{O,j}$, the residual category that excludes both head-office and support employment:

$$\Delta \ln H_{N,j} \longleftrightarrow \Delta \ln N_j, \qquad \Delta \ln H_{O,j} \longleftrightarrow \Delta \ln L_{MH,j}.$$

The two slope targets in Equation (E.2) are estimated on the support and other-employment categories, so their empirical counterparts and the model objects are defined on the same head-office-exclusive basis.

The variable N_j is measured in units of support services, not in worker headcount, and the units of support services are arbitrary up to a scale normalization. We therefore introduce two constant measurement conversions: Z_N converts support-service units into observed support workers, and μ converts the model price of one support-service unit into an observed wage per support worker,

$$H_{N,j} = \frac{N_j}{Z_N}, \qquad w^H_{N,j} = \mu\, w_{N,j}.$$

Here $w^H_{N,j}$ is the observed support wage per support worker, while $w_{N,j}$ is the model price of one unit of support services; because μ is constant, the observed support wage inherits the firm-level monopsony variation of the model wage. Both conversions are measurement constants: they enter no first-order condition and leave firm costs, the support allocation, and the aggregate equilibrium unchanged.

The value of Z_N is chosen to match the observed support-worker share on the model's own denominator. Because the model has two labor categories, the relevant share is support employment relative to support plus other employment, with the head office excluded on both sides. Let s_H denote this share. In steady state,

$$s_H = \frac{\bar{H}_N}{\bar{H}_N + \bar{H}_O} = \frac{\bar{N}/Z_N}{\bar{N}/Z_N + \bar{L}_{MH}}.$$

In the parent data shown in Table A.1, the mean shares of total employment are 43.2% head office, 22.5% support, and 34.3% other, so the model-denominator share is $s_H = 22.5/(22.5+34.3) = 0.396$, and the target identifies $Z_N = 7.26$. The two share concepts are mutually consistent: $0.396 \times (1 - 0.432) = 0.225$ recovers the observed support share of *total* parent employment. Alternative aggregations of the same data give 0.358 (employment-weighted aggregate) and 0.517 (mean of within-parent ratios); we use the ratio of mean shares and avoid the mean of ratios, which is dominated by parents with near-zero denominators, for the same skewness reason discussed for the affiliate payout ratio. Since Z_N is constant across firms, it does not affect support-employment elasticities:

$$\Delta \ln H_{N,j} = \Delta \ln N_j.$$

It only affects levels and the headcount weights used to compute average parent wages.

The observed average parent wage is constructed as the headcount-weighted average of support and non-support parent wages:

$$\bar{w}_j = \frac{w_{N,j}^H H_{N,j} + w_{L,j} L_{MH,j}}{H_{N,j} + L_{MH,j}}.$$

The wage conversion μ is chosen so that the simulated average-wage slope matches the estimated 0.169. The slope identifies μ because the average wage responds to exposure mainly through composition—high-exposure parents shift employment toward the support category—and this composition effect is stronger the higher the support wage relative to the production wage. We report μ through the implied steady-state support-wage premium, $\rho \equiv \bar{w}_N^H / w_L = 1.57$, a plausible magnitude for the commercial and sales staff in the support category.

E.4. Identification of α_S, ε_N, and the Measurement Conversions

The micro calibration uses four targeted moments. The support employment and other employment slopes jointly identify α_S and ε_N, the support-worker share identifies Z_N, and the average-wage slope identifies μ. Because the calibration is exactly identified, the targeted rows of Table E.1 fit by construction, and the informative rows are the untargeted ones.

Identification of the economic parameters is transparent in the closed forms Equation (E.3)–Equation (E.5). Both simulated employment outcomes are exact scalar multiples of a single function of exposure, so the *ratio* of the other-employment slope to the support-employment slope depends on $(\alpha_S, \varepsilon_N)$ only through ϕ and $1/\varepsilon_N$ and pins ε_N given α_S; the *level* of the support-employment slope then pins α_S. Economically, ε_N governs the scale margin—how much total support the parent can add when its return rises—while α_S governs how strongly the within-parent reallocation of support drags production labor.[8]

Table E.1 reports the fit. Among the untargeted checks, the total-employment slope is worth noting. Total observed parent employment weights the support and other categories at their headcount shares, and at the corrected support share the model delivers a slope of −0.009 against −0.014 in the data: the model reproduces the flat total-employment response in Table 2 as a near-cancellation of the support and other-employment margins.

E.5. Robustness to the Other-Employment Slope Target

The other-employment slope is the less precisely estimated of the two employment targets, and its point estimate varies across specifications: −0.270 without controls and fixed effects, −0.297 in the baseline, and −0.349 in the manufacturing-only sample, with the exposure-construction robustness estimates interior to this range. Table E.2 recalibrates $(\alpha_S, \varepsilon_N)$ at each of these values, and at a stress point one exposure-robust standard error above the baseline estimate (−0.124),

[8]The measurement conversions are block-recursive: (Z_N, μ) are computed after $(\alpha_S, \varepsilon_N)$, and no aggregate result in the paper depends on them.

Table E.1: Parent-level micro calibration: data and model moments

Moment	Data	Model	Role
Support-employment slope	0.384	0.384	Targeted (α_S, ε_N)
Other-employment slope	−0.297	−0.297	Targeted (α_S, ε_N)
Support-worker share, support+other denominator	0.396	0.396	Targeted (Z_N)
Average-wage slope	0.169	0.169	Targeted (μ)
Total-employment slope	−0.014	−0.009	Untargeted
Support p90–p10 effect	0.093	0.102	Untargeted
Other-employment p90–p10 effect	−0.070	−0.079	Untargeted
Average-wage p90–p10 effect	0.042	0.045	Untargeted

Notes: "Slope" is the coefficient from a long-difference regression on the parent revenue-side exchange-rate shock. Data coefficients are the conditional parent-regression estimates of Table 2, estimated on outcome-specific samples (support N=1,125; other N=1,446; average wage and total employment N=1,811); model coefficients come from intercept-only regressions on the 3,638 parents with both exchange-rate shocks. Calibrated values: $\alpha_S = 0.361$, $\varepsilon_N = 2.336$, $Z_N = 7.26$, and μ reported as the steady-state support-wage premium $\rho = 1.57$. The model holds aggregate objects fixed in this calibration exercise.

Table E.2: Robustness to the other-employment slope target

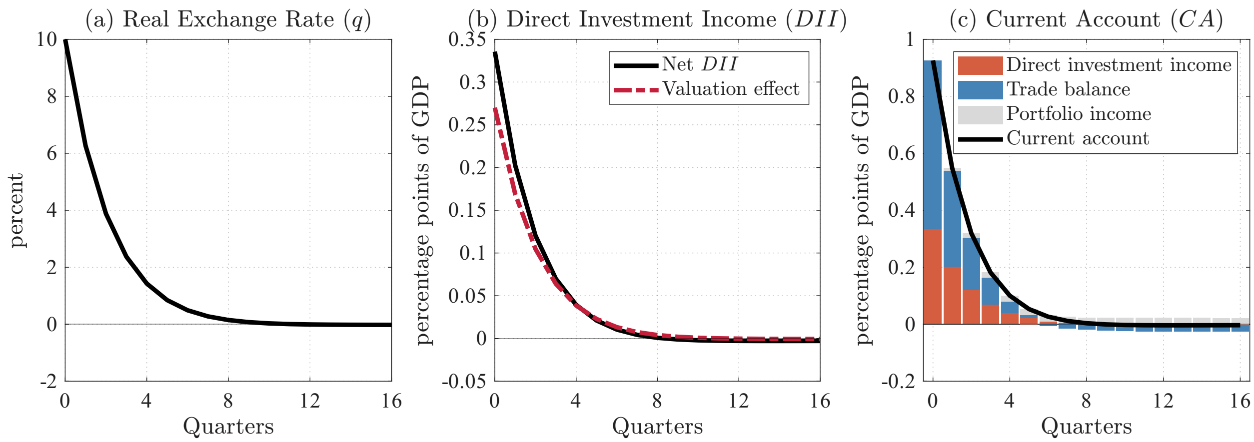
Other-employment target	α_S	ε_N	DII	DII endog.	Fixed RGDP	Fixed RGNI	CPI
No controls (−0.270)	0.343	2.443	0.518	0.248	0.111	0.629	3.725
Baseline (−0.297)	0.361	2.336	0.515	0.245	0.108	0.623	3.729
Manufacturing only (−0.349)	0.395	2.171	0.509	0.239	0.103	0.612	3.736
Stress: +1 robust SE (−0.124)	0.234	3.626	0.530	0.260	0.120	0.650	3.683

Notes: Each row recalibrates (α_S, ε_N) to the indicated other-employment slope, holding the support-employment target at 0.384, re-pins (ω, ω_T) to the gross-flow targets, and re-runs the UIP experiment normalized to a 10% impact real depreciation. DII is the impact net direct-investment-income response in percentage points of steady-state GDP; the endogenous component subtracts the pure currency-valuation term, which equals 0.27 percentage points in every row because the re-pinned calibration holds steady-state DII credits at 2.7% of GDP. Fixed-price RGDP and RGNI are impact percent changes; CPI is the annualized impact inflation response in percent. The stress row targets the baseline estimate plus one exposure-robust standard error.

holding the support-employment target at 0.384, re-pinning (ω, ω_T) to the gross-flow targets, and re-running the baseline depreciation experiment.

The aggregate results are robust across these targets: over all rows of Table E.2, the impact direct-investment-income response stays within 0.509–0.530 percentage points of GDP, real GDP, real GNI, and inflation vary comparably little, and the organizational reallocation is preserved at every grid point (affiliate support rises by 6.3–7.3% and domestic support falls by 0.58–0.74% on impact). The support-employment slope, held at its estimated value throughout, is the primary discipline on the aggregate response; the other-employment slope only divides it between α_S and ε_N, and the division largely cancels in the aggregate.

Figure F.1: External adjustment after a Foreign monetary policy shock



Notes: Impulse responses to a Foreign monetary policy shock, normalized to a 10% impact real depreciation. Panel (a) is in percent deviation from steady state; panels (b)–(c) are in percentage points of steady-state GDP. Panel (b) plots net direct-investment income against its pure currency-valuation component, $\xi\, q\, \bar{\tilde{\Pi}}^{*}_{MH} - \xi^{*}\, \bar{\tilde{\Pi}}_{MF}$, computed with the exchange rate on its dynamic path but the affiliate operating surpluses fixed at steady state. Panel (c) decomposes the current account into the trade balance, direct investment income, and portfolio income.

F Alternative Depreciation Shocks: Valuation and Affiliate Production

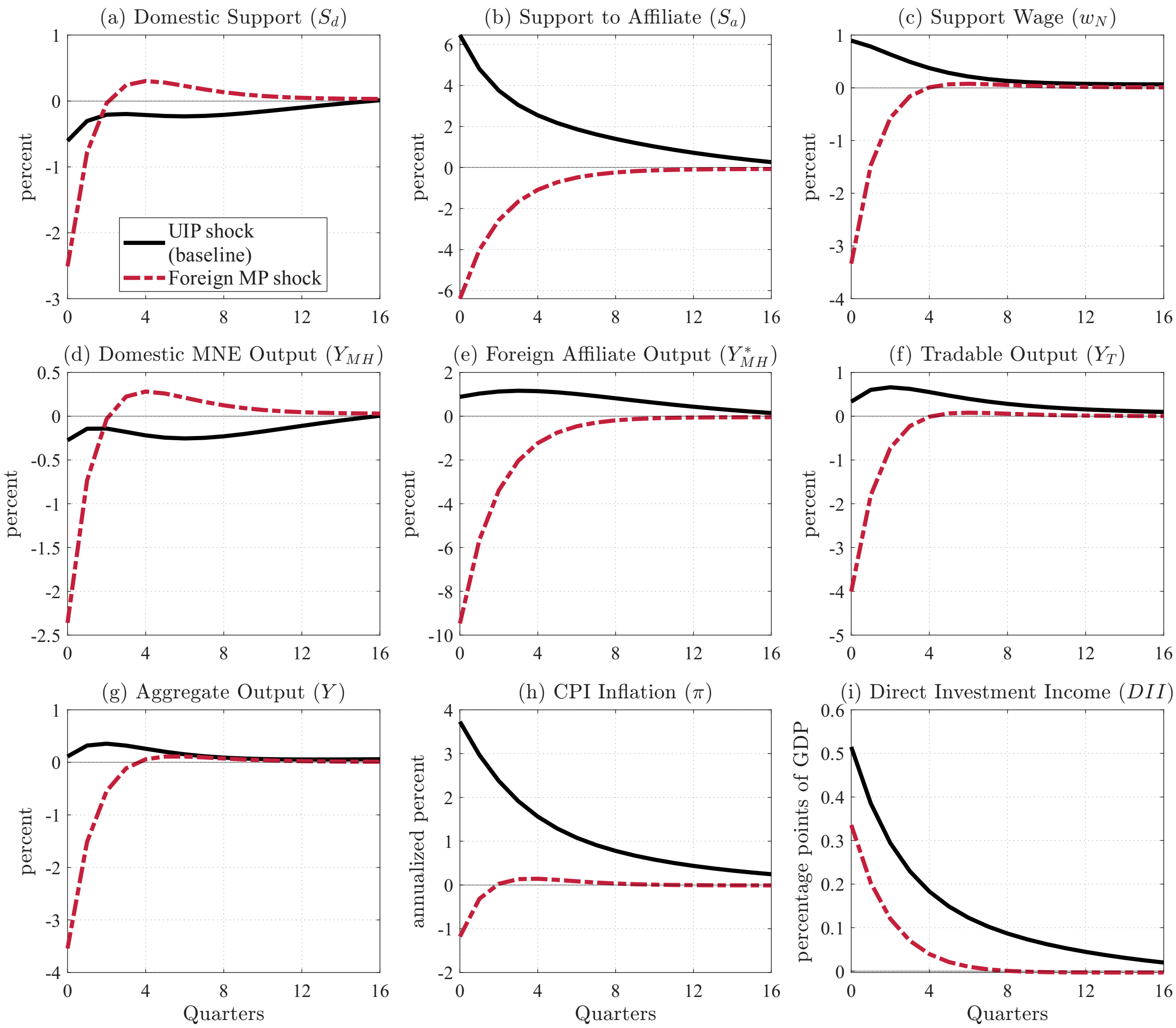
The baseline UIP experiment isolates the exchange-rate transmission mechanism by generating a Home depreciation without directly shocking Foreign demand. In this appendix, we consider two alternative shocks that generate the same 10% impact depreciation but move the profitability of foreign affiliate expansion in opposite directions. A contractionary Foreign monetary policy shock weakens Foreign demand and attenuates the real affiliate-income response. A Foreign discount-factor shock strengthens current Foreign demand and amplifies the real affiliate-income response. The comparison clarifies which part of the direct-investment-income response is tied mechanically to the exchange rate and which part reflects endogenous changes in affiliate production.

F.1. Foreign Monetary Policy Shock

We first consider a contractionary Foreign monetary policy shock. The shock raises the Foreign policy rate and, through uncovered interest parity, depreciates the Home currency while weakening Foreign demand. We normalize the shock so that the impact real depreciation is 10%, matching the baseline UIP experiment.

Figure F.1 shows that the mechanical valuation component of direct-investment income is nearly unchanged from the baseline. Because the impact depreciation is the same, the Home-currency value of existing affiliate income again rises by about 0.27 percentage points of GDP. Net direct-investment income, however, increases by only 0.34 percentage points of GDP, implying that valuation accounts for roughly 80% of the impact response. In contrast to the baseline UIP

Figure F.2: Impulse responses: UIP shock vs. Foreign monetary policy shock



Notes: Each economy is normalized to a 10% impact real depreciation. Black solid: UIP risk-premium shock (baseline). Red dash-dotted: Foreign monetary policy shock. Panels follow the layout of Figure 7. Panel (h) reports annualized CPI inflation; panel (i) is in percentage points of steady-state GDP; the remaining panels are percent deviations from steady state.

experiment, the endogenous affiliate-income component is therefore very small.

The gross decomposition clarifies where the small residual comes from. On impact, DII receipts rise by 0.33 percentage points of GDP, of which 0.27 is pure translation; the endogenous outward-surplus component is therefore only +0.06. Affiliate revenue falls with host demand, but the affiliate's local wage bill falls even faster in the Foreign recession, so the affiliate's Foreign-currency operating surplus is approximately unchanged despite the sharp decline in output. The remaining +0.01 comes from lower payments on Foreign-owned affiliates located at Home, whose surplus also weakens. The proximity of net DII to the valuation benchmark thus reflects two small and partly offsetting gross margins, not a mechanical absence of endogenous responses.

The comparison in Figure F.2 explains why the endogenous component is so small. Unlike the UIP shock, tighter Foreign monetary policy contracts Foreign demand, causing Home-owned affiliates to sell less in their local market. Affiliate output falls sharply, and with it the incentive to reallocate scarce support toward foreign affiliates; support instead shifts back toward domestic operations. The exchange rate continues to generate a mechanical valuation gain on existing affiliate income, but the production response that amplified direct-investment income in the baseline is largely absent.

F.2. Foreign Discount-Factor Shock

We next consider a Foreign discount-factor shock that shifts Foreign expenditure toward the present and, through the Foreign Taylor rule and uncovered interest parity, depreciates the Home currency. We introduce the shock as a preference shifter in Foreign household utility. Let ζ_t^* denote the shock, with

$$\zeta_t^* = \rho_\zeta \zeta_{t-1}^* + \varepsilon_t^{\zeta^*}, \qquad \rho_\zeta = 0.9.$$

The Foreign household's marginal utility becomes

$$\lambda_t^* = \exp\left(\zeta_t^*\right)\left(X_t^*\right)^{-\sigma},$$

so the Foreign Euler equation is

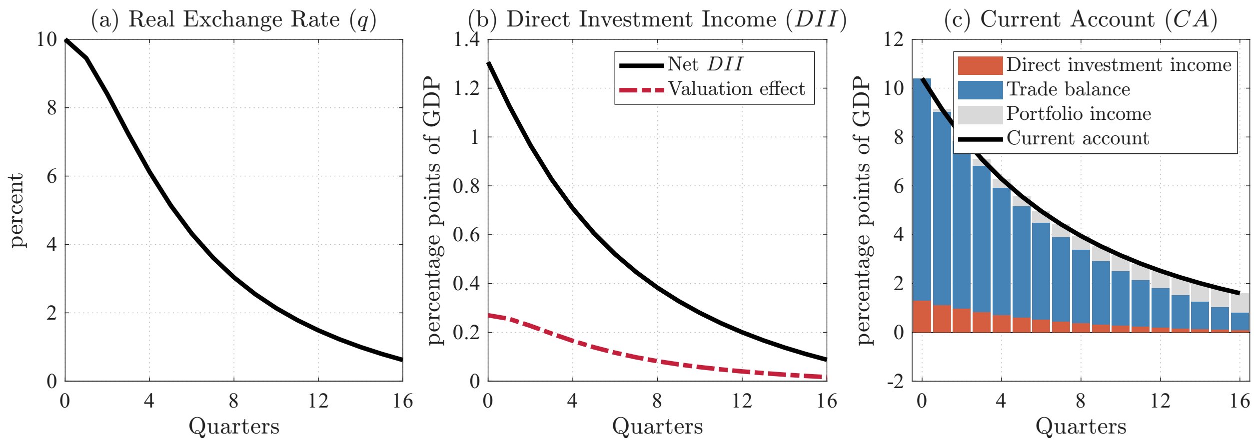
$$1 = \beta \mathbb{E}_t \left[\frac{\lambda_{t+1}^*}{\lambda_t^*} \frac{R_t^*}{\pi_{t+1}^*} \right].$$

A positive realization of ζ_t^* raises the marginal utility of current consumption. Because the shock is mean-reverting, it increases current Foreign expenditure relative to future expenditure. Through the Foreign Taylor rule and uncovered interest parity, this expansion depreciates the Home currency while strengthening demand for Home-owned affiliate output. As before, the innovation is normalized to a 10% impact real depreciation.

Figure F.3 shows that the pure valuation component is again essentially unchanged, reflecting the identical impact depreciation. Net direct-investment income, however, rises to 1.31 percentage points of GDP on impact, of which only about 20% is accounted for by mechanical valuation. The remaining increase comes from higher operating surpluses of Home-owned affiliates abroad and, in somewhat larger part, from lower payments on Foreign-owned affiliates located at Home.

The comparison with the baseline UIP experiment in Figure F.4 shows the mechanism. Stronger Foreign demand raises affiliate sales and operating profits. The higher return to foreign operations induces the parent to reallocate considerably more support toward its affiliate, further expanding affiliate production and income. Relative to the UIP experiment, the exchange-rate

Figure F.3: External adjustment after a Foreign discount-factor shock



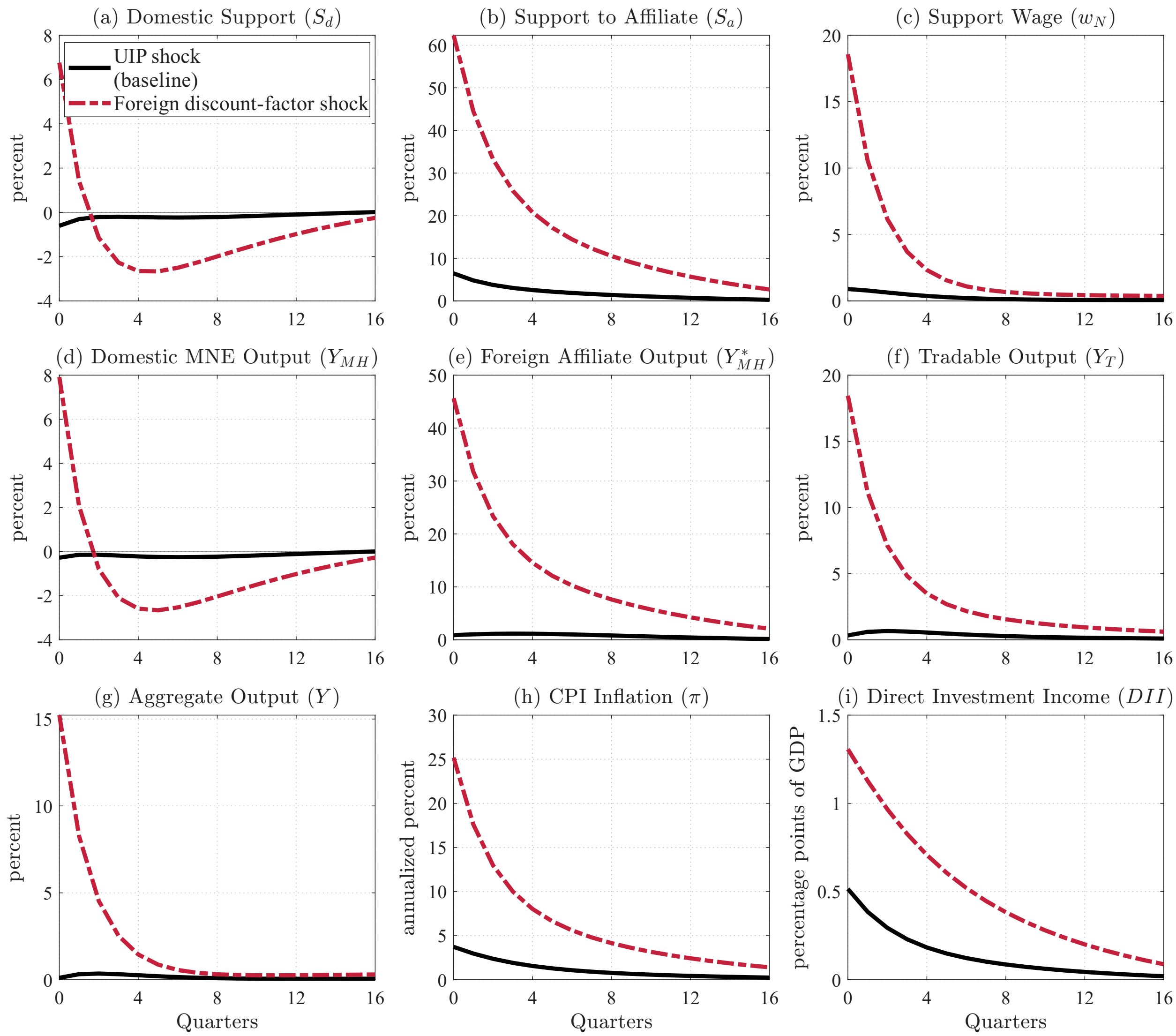
Notes: Impulse responses to a Foreign discount-factor shock, normalized to a 10% impact real depreciation. Panel (a) is in percent deviation from steady state; panels (b)–(c) are in percentage points of steady-state GDP. Panel (b) plots net direct-investment income against its pure currency-valuation component, $\xi q\tilde{\bar{\Pi}}^*_{MH} - \xi^*\tilde{\bar{\Pi}}_{MF}$, computed with the exchange rate on its dynamic path but the affiliate operating surpluses fixed at steady state. Panel (c) decomposes the current account into the trade balance, direct investment income, and portfolio income.

incentive to serve Foreign markets is reinforced rather than offset by the surrounding economic environment, so the real affiliate-income channel becomes the dominant source of direct-investment-income adjustment.

Generating a 10% impact depreciation from a discount-factor shock requires a large innovation, so the responses are correspondingly large; the informative object is the decomposition of the direct-investment-income response rather than its scale. The exercise shows how the direct-investment-income decomposition changes when the same depreciation is accompanied by stronger conditions for foreign affiliate expansion.

Taken together, the three experiments identify two distinct margins governing multinational external adjustment. The exchange rate determines the mechanical valuation gain on existing affiliate income. The real affiliate-income response, by contrast, depends on the economic forces that make foreign affiliate expansion more or less profitable. The Foreign monetary policy shock illustrates how weaker conditions for affiliate production suppress the real-income channel, whereas the Foreign discount-factor shock shows how stronger conditions amplify it.

Figure F.4: Impulse responses: UIP shock vs. Foreign discount-factor shock



Notes: Each economy is normalized to a 10% impact real depreciation. Black solid: UIP risk-premium shock (baseline). Red dash-dotted: Foreign discount-factor shock. Panels follow the layout of Figure 7.

G Quantitative Model Robustness

G.1. Sensitivity to the Affiliate-Income Pass-Through

The baseline calibration sets the effective affiliate-income pass-through parameter to the mean ratio of affiliate-to-parent payments to affiliate current income, $\xi = 0.743$; the corresponding median ratio is 0.315. These observed payments include several types of intrafirm transfers and do not provide an exact accrual-based measure of direct investment income, so we use the ratio only as a proxy for the strength of the affiliate-to-parent income linkage. The parameter ξ determines both the steady-state direct-investment-income credits generated per unit of affiliate surplus and the weight placed on affiliate surplus in the parent's support-allocation condition.

Table G.1: Sensitivity of aggregate responses to the effective affiliate-income pass-through

ξ	ω	$\frac{A}{X+A}$	Net DII impact (ppt of GDP) Total	Valuation	Endogenous	Organizational	TB	CA	ERPT
0.743 (mean)	0.292	0.305	0.515	0.270	0.245	0.189	2.16	2.68	0.29
0.500	0.457	0.395	0.523	0.270	0.253	0.208	2.15	2.67	0.30
0.315 (median)	0.772	0.509	0.532	0.270	0.262	0.226	2.12	2.65	0.31

Notes: Impact responses to the baseline UIP shock, normalized to a 10% real depreciation, in percentage points of steady-state GDP. At each ξ, (ω, ω_T) are re-solved so that the steady state reproduces exports of 17.7% of GDP and DII credits of 2.7% of GDP; all other parameters are at baseline. $A/(X+A)$ is the affiliate share of steady-state foreign-facing sales. "Valuation" is the mechanical translation component computed with affiliate surpluses fixed at steady state; "Endogenous" is the total net DII response minus the valuation component; "Organizational" is the difference between the baseline endogenous-support model and the proportional-support counterfactual with the same steady state. TB and CA are impact responses of the trade balance and current account; ERPT is cumulative CPI exchange-rate pass-through at four quarters.

We therefore ask whether the aggregate results are sensitive to its calibration.

To answer this, we re-solve the model at $\xi \in \{0.315, 0.500, 0.743\}$. At each value, ω and ω_T are re-calibrated so that the steady state re-hits the two gross-flow targets, exports of 17.7% of GDP and direct-investment-income credits of 2.7% of GDP; all other parameters remain at baseline. Moving from the mean to the median payment share raises steady-state affiliate sales from 7.8% to 18.3% of GDP and the affiliate share of foreign-facing sales from 0.30 to 0.51.

Table G.1 reports the results. Because the credits target is re-imposed at every ξ, the mechanical valuation component of the impact response is 0.27 percentage points of GDP throughout. The total net direct-investment-income response is essentially invariant, rising slightly from 0.51 to 0.53 percentage points of GDP as ξ falls from the mean to the median. The endogenous component rises from 0.24 to 0.26, and the organizational component—the part attributable to the endogenous reallocation of rival support, measured against the proportional-support counterfactual—rises from 0.19 to 0.23. The trade balance, current account, and exchange-rate pass-through are essentially unchanged, as is the impact response of real GDP (about 0.11% at every ξ).

The invariance reflects two offsetting forces. A lower ξ reduces the Home parent's effective income claim per unit of affiliate surplus, but holding measured direct-investment-income credits fixed then requires a larger affiliate base, which strengthens the production side of the mechanism. The observed gross-flow targets discipline the product of the effective affiliate-income share and affiliate surplus, and the aggregate responses depend primarily on that product. Calibrating ξ to the mean payment share is therefore not driving the aggregate results; if anything, it is mildly conservative for the organizational channel.

G.2. National-Accounting Treatment of Parent Support Deployed Abroad

Our baseline model assumes the transfer price of parent support is normalized to zero. Support deployed to the foreign affiliate, $S_{a,t}$, is an internal, nontraded intra-firm input: the affiliate is charged nothing for it, so its productive contribution is recorded inside affiliate operating surplus and therefore in *Foreign* GDP, and it reaches Home only as the ξ share of that surplus, through direct investment income and hence through gross national income. At Home the support wage bill $w_{N,t}S_{a,t}$ is paid to Home households but is exactly offset by lower parent operating surplus, so it nets to zero in Home GDP. This section asks how much of the paper's ownership–location result depends on that normalization.

An alternative convention. Index the convention by an imputed transfer price $\tau_t = \chi\, w_{N,t}$ per unit of support. Measured Home service exports and imports are

$$X_t^S = \chi\, w_{N,t} S_{a,t}, \qquad M_t^S = \chi\, q_t\, w_{N,t}^* S_{a,t}^*, \tag{G.1}$$

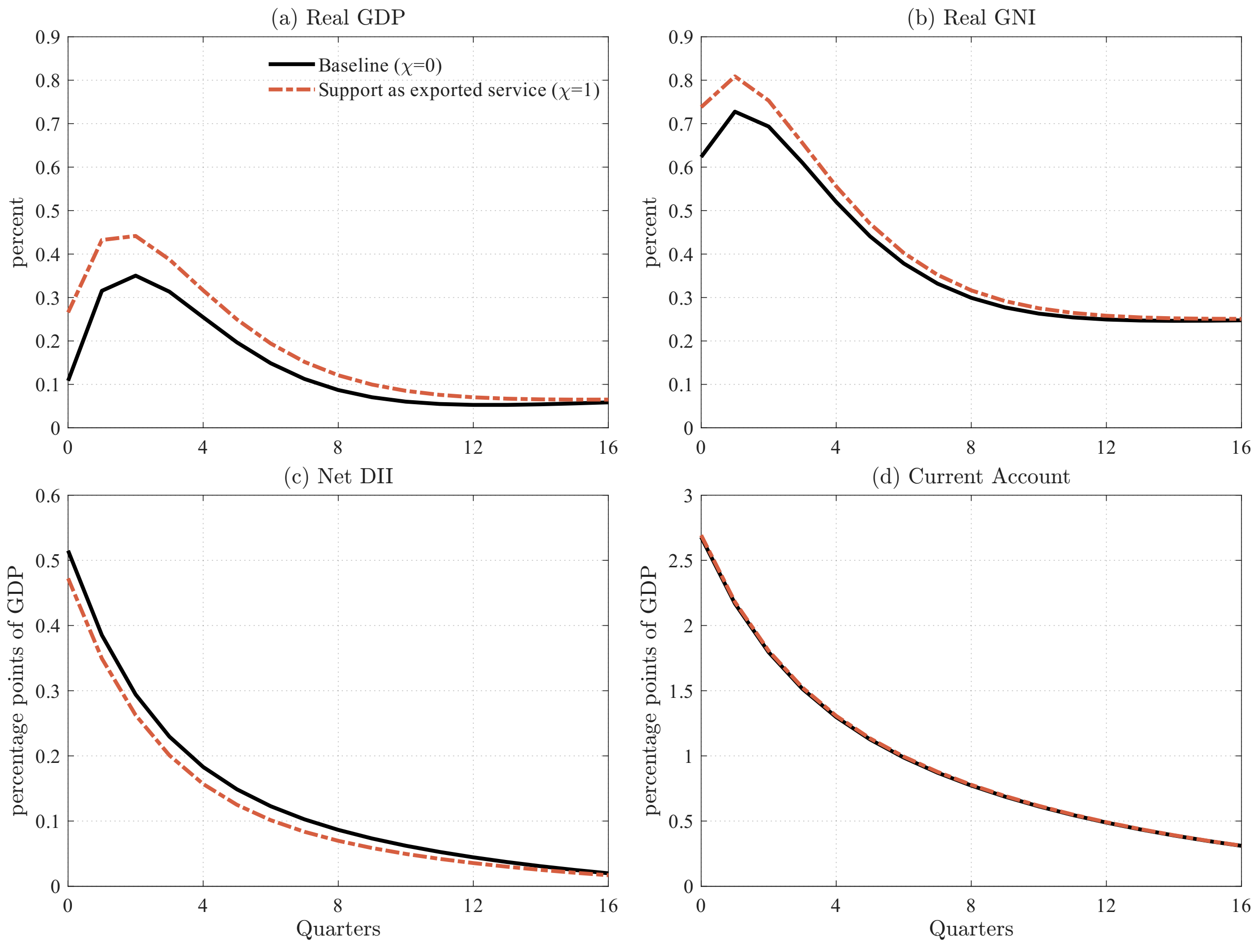
and the accounts become $gdp_t^\chi = gdp_t + X_t^S - M_t^S$, $tb_t^\chi = tb_t + X_t^S - M_t^S$, and $dii_t^\chi = dii_t - \xi X_t^S + \xi^* M_t^S$. We compare the baseline, $\chi = 0$, with cost-basis imputation, $\chi = 1$, which treats support as a service exported to the affiliate and values it at the support wage the parent actually pays.

The fee in Equation (G.1) is evaluated at *aggregate* $w_{N,t}$ and $S_{a,t}$, which the atomistic parent takes as given. It is therefore lump sum from the individual parent's viewpoint and enters no first-order condition, so the real allocation is invariant to χ. We verify this numerically rather than assert it: re-solving the model at each χ leaves every impulse response of q, C, Y_{MH}, Y_{MH}^*, S_a, S_d, N, w_N, w_L, inflation, and the policy rate unchanged to 2.7×10^{-15}. A literal *marginal* transfer price would not be innocuous: the parent would capture the full fee but only ξ of the surplus it displaces, which for $\xi < 1$ drives a wedge into the allocation condition and induces over-deployment of support abroad. That case is a change in the mechanism, not in the accounting, and we do not impose it.

An implicit intra-firm transfer. Under the re-recording, Home GDP and the trade balance each rise by $X_t^S - M_t^S$, while net direct investment income falls by only $\xi X_t^S - \xi^* M_t^S$, because just the ξ share of the displaced surplus was accruing to Home. The residual $(1-\xi)X_t^S - (1-\xi^*)M_t^S$ is a genuine unrequited transfer: the zero-transfer-price normalization implicitly hands the non-repatriated share of the support Home supplies to foreign residents, worth 0.31% of Home GDP each period in the symmetric steady state. A balance-of-payments-consistent recording of the imputation therefore has three entries—a service export, a reduction in the direct-investment-income credit, and a secondary-income debit—and with the transfer entry included the current account and gross national disposable income are invariant to χ exactly in the model.

Quantitative results. Figure G.1 shows the responses. On impact, the measured fixed-price real GDP response rises from 0.11% under the baseline to 0.27% under cost-basis imputation, while

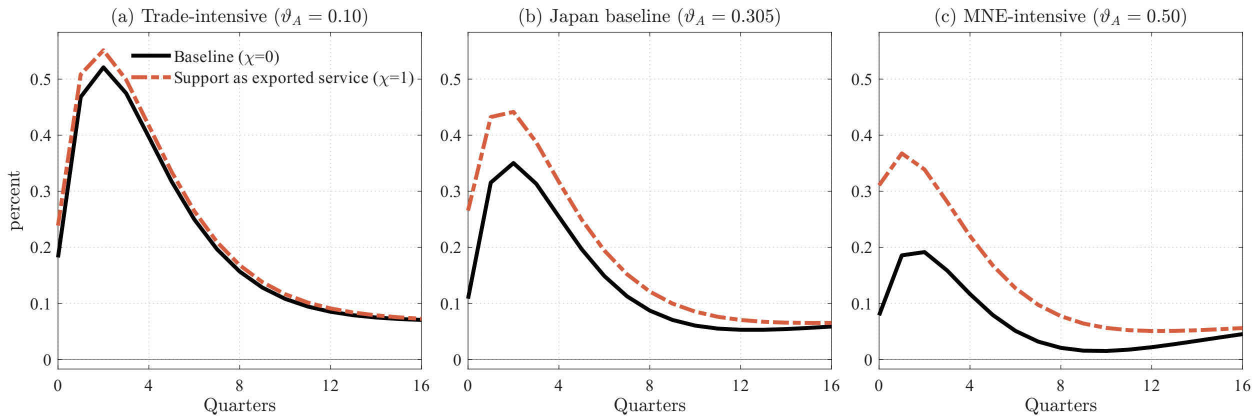
Figure G.1: External adjustment under alternative accounting conventions



Notes: Impulse responses to a UIP risk-premium shock normalized to a 10% impact real depreciation, under two transfer-price conventions for parent support deployed abroad: $\chi = 0$ (baseline, support expensed at Home and not recorded as a service export) and $\chi = 1$ (support recorded as a service export at the support wage). Real GDP and real GNI are fixed-price quantity indices; direct investment income and the current account are in percentage points of steady-state GDP, and $\Delta RGNI^F = \Delta RGDP^F + \Delta DII + \Delta PI$ as in Section 6.2. Panel (d) plots the current account without the secondary-income entry; with that entry recorded the two paths coincide exactly. The underlying real allocation is identical across conventions.

net direct investment income falls from 0.51 to 0.47 percentage points of GDP. The two move in opposite directions by construction: the convention reclassifies the same activity between domestic production and foreign income. The current account is essentially unaffected on impact (2.68 against 2.69 percentage points), and exactly unaffected once the secondary-income entry is recorded. The real content of the mechanism is convention-free—support reallocates abroad, affiliate output expands, and domestic parent output contracts by identical amounts under either convention—while the measured production–income split moves: gross national income responds 5.8 times more than domestic production under the baseline and 2.8 times under cost-basis imputation.

Figure G.2: Measured real GDP across foreign-market organizations, by accounting convention



Notes: Fixed-price real GDP responses to a UIP risk-premium shock normalized to a 10% impact real depreciation, for the three foreign-market-organization economies of Section 6.4, under the baseline convention ($\chi = 0$, solid) and with support recorded as an exported service ($\chi = 1$, dashed). Each economy is re-solved at its own counterfactual calibration, and the allocation-invariance check is repeated economy by economy. The vertical scale is common across panels.

Interaction with foreign-market organization. The size of the reclassification scales with the support actually deployed abroad, so the convention matters most exactly where affiliate production matters most. Figure G.2 repeats the exercise for the three foreign-market-organization economies of Section 6.4, re-solving the model at each counterfactual calibration. Under the baseline convention the measured real-GDP response declines with affiliate intensity: impacts of 0.18, 0.11, and 0.08 percent in the trade-intensive economy, the Japan baseline, and the MNE-intensive economy, with peaks of 0.52, 0.35, and 0.19. Recording support as an exported service raises all three responses and reverses the impact ordering—0.24, 0.27, and 0.31—because the imputed service export scales with the support reallocation, which is largest where the affiliate sector is largest. The reversal is confined to short horizons: the peak responses under $\chi = 1$ are 0.55, 0.44, and 0.37, so the trade-intensive economy again shows the strongest measured response, because its expenditure-switching gains build over several quarters while the imputed service export mean-reverts with the exchange rate.

The counterfactual conclusion should therefore be stated in convention-robust form: shifting foreign-market activity from exports toward affiliate production weakens the domestic goods-production response and shifts external adjustment toward income generated abroad. Recording parent support as an exported service raises measured Home GDP, particularly at short horizons, but does not eliminate the distinction between production for export at Home and production undertaken by foreign affiliates.

G.3. Asymmetric Inward and Outward Multinational Positions

The benchmark calibration is symmetric across countries, so the inward multinational block—Foreign-owned affiliates producing in Home, with output Y_{MF}—is the same size as the outward block Y^*_{MH}, and steady-state net direct investment income is zero. Japan is the most asymmetric of the G7 economies on this dimension. In 2019 its direct-investment-income credits were 2.7% of GDP against debits of 0.66%, a debit-to-credit ratio of 0.245, reflecting an inward direct-investment position far smaller than the outward one. Because the headline objects in Section 6.2 are the *net* direct-investment-income and current-account responses, and because both are differences between a credit and a debit leg, the symmetric benchmark abstracts from the asymmetry that shapes them. This appendix therefore re-solves the model with a Japan-consistent inward block.

An asymmetric steady state. Dropping symmetry costs the closed form: with $\omega_M \neq \omega^*_M$, the real exchange rate, the trade balance, and net direct investment income are no longer pinned at 1, 0, and 0 by construction, and the steady state must be solved numerically. We hold preferences fixed—the scale parameters χ_L and χ_N keep their baseline values, so Home and Foreign share preferences and technology, and the four labor-supply conditions become genuine equilibrium restrictions rather than definitions—and solve for w_L, w^*_L, q, C, and C^*. Four demand weights are then chosen so that the asymmetric steady state reproduces four moments: ω_M delivers the Japanese debit-to-credit ratio of 0.245, ω^*_M holds direct-investment-income credits at 2.7% of GDP, ω^*_T holds exports at 17.7% of GDP, and ω_T normalizes $\bar{q} = 1$. Holding the credits and export targets at their baseline values, rather than re-reading them from the data, is what makes the exercise informative: the mechanical valuation benchmark $\xi \bar{q} \bar{\bar{\Pi}}^*_{MH}$ is then numerically identical across the two calibrations, so any difference in the net response is attributable to the debit side and to the endogenous credit response rather than to a rescaled steady-state level. All remaining parameters, including ξ and the micro-calibrated $(\alpha_S, \varepsilon_N)$, are unchanged.

The asymmetry has to be absorbed somewhere in the steady-state external accounts. With $\bar{b}_F = 0$, net-foreign-asset stationarity requires $\overline{TB} = -\overline{DII}$: the steady-state direct-investment-income surplus of 2.0% of GDP finances a trade deficit of the same size. Japan's actual configuration—a current-account surplus of about 3.5% of GDP alongside a positive net foreign asset position—cannot be a stationary steady state of a model without growth, so some closure must be imposed. We choose $\bar{b}_F = 0$ because it keeps the portfolio position, and hence any portfolio valuation gain, out of the exchange-rate experiment, leaving the direct-investment-income decomposition clean. The alternative closure, matching Japan's near-zero trade balance by giving Home a large net portfolio debt, would introduce a second valuation channel and confound the decomposition.

Two features of the resulting steady state are worth noting because they bound how much else the exercise changes. First, the outward block is unchanged: affiliate sales abroad remain 7.8% of

Table G.2: Symmetric benchmark versus a Japan-consistent asymmetric calibration

	Symmetric benchmark	Japan-consistent asymmetric
Steady state		
DII credits (% of GDP)	2.70	2.70
DII debits (% of GDP)	2.70	0.66
Inward/outward affiliate sales	1.00	0.25
Net DII (% of GDP)	0.00	2.04
Trade balance (% of GDP)	0.00	−2.04
Impact response to a 10% *depreciation (ppt of GDP)*		
Gross DII credits	0.392	0.397
Gross DII debits	−0.122	−0.032
Net DII	0.515	0.429
Valuation component	0.270	0.270
Endogenous component	0.245	0.159
of which organizational	0.189	0.126
Trade balance	2.163	2.227
Current account	2.678	2.656
Real GDP (percent)	0.108	0.031
First year, cumulative (ppt of annual GDP)		
Net DII	0.356	0.292
Valuation component	0.178	0.178
Current account	2.039	2.020

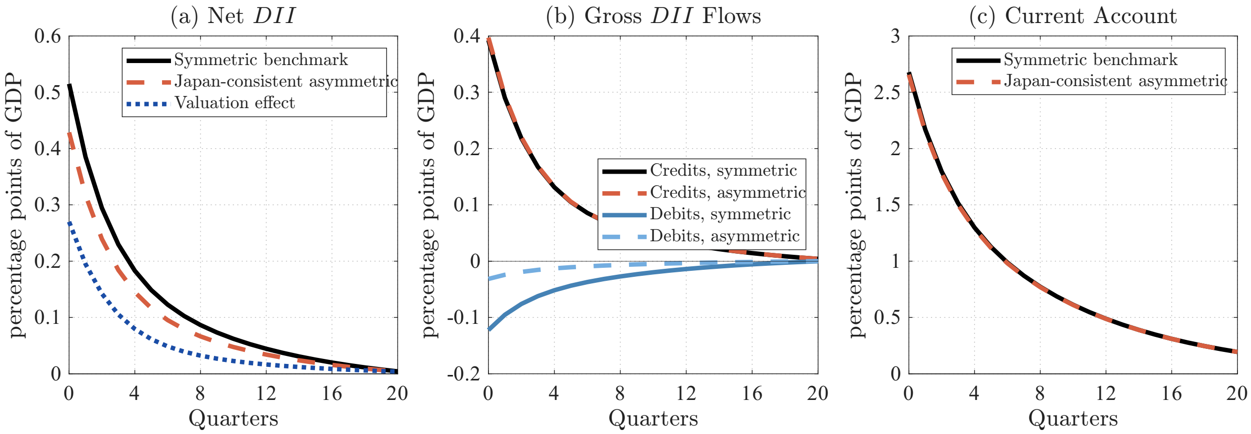
Notes: Responses to the baseline UIP shock, normalized to a 10% impact real depreciation. In the asymmetric calibration $(\omega_M, \omega_M^*, \omega_T, \omega_T^*) = (0.935, 0.718, 0.726, 0.751)$ against $(0.723, 0.723, 0.750, 0.750)$ in the benchmark; credits, exports, and $\bar{q}$ are held at their benchmark values, so only the inward/outward asymmetry changes. "Organizational" is the difference between the endogenous-support model and the proportional-support counterfactual with the same steady state. Impact rows are quarterly flows relative to quarterly steady-state GDP; the final block is the first-year cumulative flow relative to annual GDP.

Home GDP, while inward affiliate sales fall from 7.8% to 1.9%. Second, the two countries remain almost exactly the same size—Home GDP falls by 1.0% and Foreign GDP rises by 1.2% relative to the symmetric benchmark—so the comparison does not confound asymmetric multinational positions with a change in relative country size.

The credit side is unchanged; the net response falls. Table G.2 and Figure G.3 report the results. The gross credit response is essentially identical across the two calibrations, 0.392 against 0.397 percentage points of GDP on impact, and the two paths are visually indistinguishable in panel (b) of Figure G.3. This is the central diagnostic: the mechanism of the paper, and the micro evidence that disciplines it, both live on the outward block, whose steady-state size and whose response to the depreciation are unaffected by how large the inward block is.

The net response nonetheless falls, from 0.515 to 0.429 percentage points of GDP on impact,

Figure G.3: Direct investment income under symmetric and asymmetric multinational positions



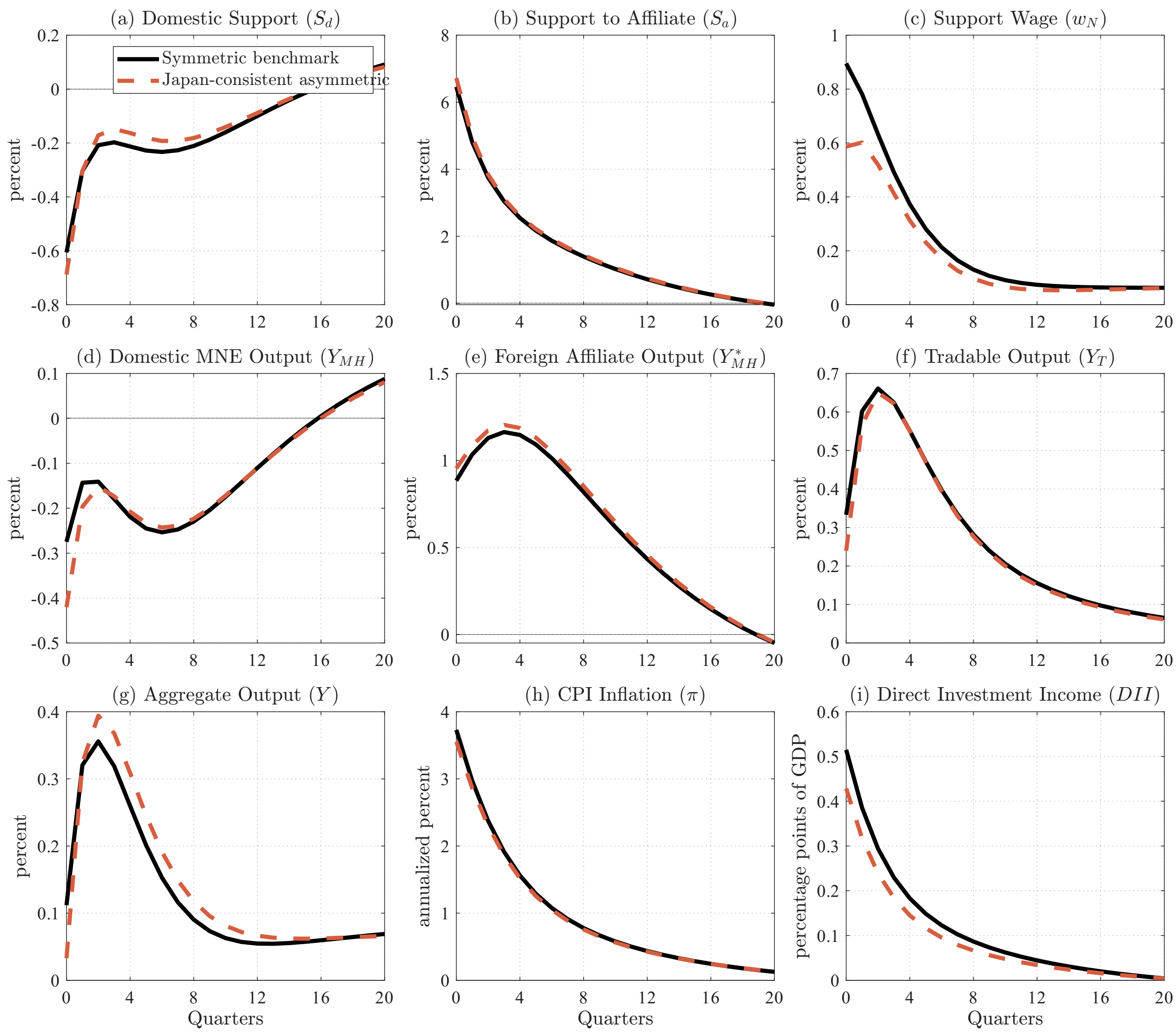
Notes: Impulse responses to the baseline UIP shock, normalized to a 10% impact real depreciation, in percentage points of steady-state GDP. Black solid: symmetric benchmark. Red dashed: Japan-consistent asymmetric calibration. Panel (a) plots net direct investment income against the common pure currency-valuation component. Panel (b) plots the gross credit and debit legs separately; the two credit paths coincide. Panel (c) plots the current account.

a reduction of about one sixth. The entire difference comes from the debit leg. In the symmetric benchmark, a Home depreciation lowers payments to Foreign parents by 0.122 percentage points of GDP—the mirror image of the paper's own mechanism, with the Foreign parent withdrawing support from its now less profitable Home affiliate—and because these payments are a debit, their decline *adds* to net direct investment income. Shrinking the inward block to Japan's actual size shrinks that contribution to 0.032. The symmetric benchmark is therefore not a conservative lower bound for the net response: it modestly *overstates* it, by crediting Japan with an inward block roughly four times larger than the data support.

The current account and the mechanism decomposition are robust. Two further results matter for the paper's claims. First, the current-account response is almost unchanged, 2.678 against 2.656 percentage points of GDP on impact, because the smaller direct-investment-income response is offset by a slightly larger trade-balance response: with a smaller inward block, more of Home's multinational demand is met by Home parents, and the expenditure-switching response of the trade balance is correspondingly stronger. The headline external-adjustment result is thus not an artifact of symmetry.

Second, the organizational decomposition survives. The endogenous component of the net direct-investment-income response falls from 0.245 to 0.159 percentage points of GDP, and the part attributable to the endogenous reallocation of rival support—measured against the proportional-support counterfactual—falls from 0.189 to 0.126. As a share of the endogenous component, however, the organizational channel is essentially unchanged, 77% against 80%. The claim that the endogenous response is driven by the reallocation of scarce parent support, rather than by a scale effect, is therefore invariant to the asymmetry.

Figure G.4: Impulse responses under symmetric and asymmetric multinational positions



Notes: Each economy is normalized to a 10% impact real depreciation. Black solid: symmetric benchmark. Red dashed: Japan-consistent asymmetric calibration. Panels follow the layout of Figure 7. Panel (h) reports annualized CPI inflation; panel (i) is in percentage points of steady-state GDP; the remaining panels are percent deviations from steady state.

Not everything is invariant. The impact response of real GDP falls from 0.108% to 0.031%, because in the symmetric benchmark a substantial part of the Home real-activity response comes from Foreign-owned affiliates located in Home expanding after the depreciation, and that block is now small. The full set of impulse responses is compared in Figure G.4: the support-allocation, affiliate-output, tradable-output, and inflation responses are nearly identical across the two calibrations, and the differences are concentrated in the Home-located multinational aggregates, whose steady-state composition is what the asymmetry changes. Since the paper's quantitative claims concern the external accounts rather than the level of the domestic output response, we read this as a caveat on the real-activity numbers rather than on the mechanism.

Implication for the Japanese benchmark. The comparison with the 2022 episode in Section 6.2 is affected in the expected direction. Under the asymmetric calibration the model's first-year net direct-investment-income response is 0.292 percentage points of annual GDP per 10% depreciation, against 0.356 in the benchmark, while the valuation component is unchanged at 0.178. Scaling proportionally to a 25–30% depreciation gives 0.7–0.9 percentage points of annual GDP rather than 0.9–1.1, so the model accounts for roughly 40% of the observed increase rather than about half. The qualitative reading is unchanged—the response is about 1.6 times the valuation-only path, and the endogenous margin remains essential to explaining the size of the observed move—but the asymmetric calibration is the more appropriate basis for a Japan-specific magnitude, and it is the more conservative one.

Appendix References

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