White Rose Research Online

eprints@whiterose.ac.uk
https://eprints.whiterose.ac.uk
Universities of Leeds, Sheffield and York

Deposited via The University of Leeds.

White Rose Research Online URL for this paper:
https://eprints.whiterose.ac.uk/id/eprint/247128/

Version: Accepted Version

Article:
Wei, X., Chaudhuri, K. and Nasir, M.A. (Accepted: 2026) Welfare Effects of Trade Wars and Preferential Liberalization in a Multipolar World: The Role of Global Value Chain Reallocation. Oxford Economic Papers. ISSN: 0030-7653 (In Press)

This is an author produced version of an article accepted for publication in Oxford Economic Papers made available via the University of Leeds Research Outputs Policy under the terms of the Creative Commons Attribution License (CC-BY), which permits unrestricted use, distribution and reproduction in any medium, provided the original work is properly cited.

Reuse
This article is distributed under the terms of the Creative Commons Attribution (CC BY) licence. This licence allows you to distribute, remix, tweak, and build upon the work, even commercially, as long as you credit the authors for the original work. More information and the full terms of the licence here:
https://creativecommons.org/licenses/

Takedown
If you consider content in White Rose Research Online to be in breach of UK law, please notify us by emailing eprints@whiterose.ac.uk including the URL of the record and the reason for the withdrawal request.

UNIVERSITY OF LEEDS
University of Sheffield
UNIVERSITY of York

Welfare Effects of Trade Wars and Preferential Liberalization in a Multipolar World: The Role of Global Value Chain Reallocation

Xinxin Wei[1,*], Kausik Chaudhuri[1], and Muhammad Ali Nasir[1,2,3]

[1]Department of Economics, Leeds University Business School,
University of Leeds, Maurice Keyworth Building,
Leeds LS2 9JT, United Kingdom

[2]National School of Development, Peking University, Beijing, China

[3]Department of Land Economy, University of Cambridge, Cambridge, United Kingdom

Emails: weixinxinlalala@gmail.com (Xinxin Wei);
K.Chaudhuri@lubs.leeds.ac.uk (Kausik Chaudhuri);
M.A.Nasir@leeds.ac.uk (Muhammad Ali Nasir).

[*]Corresponding author: Xinxin Wei, weixinxinlalala@gmail.com.

Abstract

We develop a quantitative framework to examine how tariff escalation, retaliation, and selective tariff easing affect trade, sourcing, and welfare across major trading blocs. The framework combines a multi-country, multi-sector Eaton–Kortum model with input–output linkages and endogenous foreign value-added adjustment with a reduced-form capital-accumulation block that maps real-income changes into transition paths and lifetime consumption-equivalent welfare. Under unilateral US tariff escalation, US long-run welfare increases by 0.53%, while Mexico and Canada experience the largest losses. Comprehensive retaliation reverses the US gain into a 0.40% loss. Selective tariff easing among China, the EU, and ASEAN redirects sourcing and redistributes welfare without generating uniform gains. Capital adjustment generally smooths the transition to long-run welfare outcomes. Although global value chains have modest aggregate effects, they substantially alter country-level incidence, supplier composition, and foreign value-added exposure. Tariff welfare effects depend critically on retaliation and sourcing reallocation, rather than aggregate trade contraction alone.

Keywords: Trade wars; Tariff retaliation; Preferential liberalization; Global value chains; Sourcing reallocation; Dynamic welfare.

JEL classification: F13; F14; F17; C68.

1 Introduction

International trade plays a central role in the world economy. It supports growth, diffuses technology, raises consumer welfare, and underpins cooperation across countries. At the same time, trade outcomes are shaped by tariffs, industrial policy, and evolving global value chains (GVCs). Since 2018, a renewed protectionist cycle has reconfigured the trading system. It began with the tariff confrontation between the United States and China and then propagated across partner economies and sectors. The Phase One agreement in early 2020 stabilized but did not reverse elevated tariff levels.[1] More recently, in 2025, the United States announced a broad baseline import tariff together with partner-specific reciprocal tariffs, signalling a potentially durable shift in trade policy with sizeable general-equilibrium consequences.[2]

On the European side, tensions with China have intensified in clean-technology sectors. Following an anti-subsidy investigation, the European Commission imposed definitive countervailing duties on imports of Chinese battery electric vehicles in October 2024.[3] China responded with trade remedies of its own while continuing selective liberalization and deeper regional integration with ASEAN.[4] These developments raise a central question: how do unilateral tariff escalation, retaliation, and selective tariff easing redistribute welfare and reorganize sourcing across major trading blocs, and how do these effects evolve once capital adjusts over time?

Historical experience suggests that large tariff shocks propagate through relative prices, expenditure switching, and retaliation. The Smoot–Hawley episode is not a literal template for current events, but it illustrates how protectionist waves can compress trade volumes and redirect networks in ways that outlast the initiating policy (e.g. Eichengreen and Irwin, 2010; Irwin, 2011). Recent evidence on the 2018–2020 tariff cycle documents high pass-through to tariff-inclusive US import prices, limited short-run exporter absorption, and more limited retail-price effects (Amiti et al., 2019, 2020; Cavallo et al., 2021). Pass-through also varies across sectors, reflecting differences in pricing behaviour and protection levels (Mallick and Marques, 2008). Dynamic studies further show that tariffs can affect innovation and technology transfer (Ho, 2026), while work on intellectual property protection demonstrates that transition dynamics can change welfare assessments (Lin, 2026). Taken together, these findings motivate a framework that traces both direct price effects and indirect general-equilibrium channels through production networks, while moving beyond a once-off comparison of steady states.

Static quantitative trade analyses evaluate tariffs by comparing equilibria. Multi-country, multi-sector models in the spirit of Caliendo and Parro (2015) are well suited to measuring long-run changes in real income,

[1] See the official text: Office of the United States Trade Representative, 2020.
[2] White House fact sheets, April and September 2025: The White House (2025a,b).
[3] See Commission Implementing Regulation (EU) 2024/2754 and related communication: European Commission (2024a,b).
[4] For an illustrative case on EU brandy, see Hall and Hummel (2025); on China's zero-tariff policy, see Xinhua (2025).

terms of trade, and the allocation of production across sectors and partners. By construction, however, they do not describe transition dynamics, the intertemporal adjustment of capital and investment, or the way GVC restructuring maps into dynamic welfare. Dynamic computable general-equilibrium approaches incorporate capital accumulation, but often abstract from granular sourcing adjustment and an explicit foreign value-added margin. The remaining gap is therefore to connect detailed trade and GVC reallocation to the intertemporal welfare consequences of capital adjustment in a transparent way.

This paper develops a two-block framework that links long-run trade reallocation and GVC restructuring to dynamic macroeconomic adjustment. The first block is a multi-country, multi-sector Eaton–Kortum model with input–output linkages, sector-specific trade elasticities, and an explicit GVC margin that governs the foreign share of value added. Relative to standard applications, the trade block incorporates two adjustment mechanisms. First, intermediate-input shares respond to relative sectoral prices, allowing firms to substitute across input bundles when tariffs change production costs. Second, the foreign value-added share responds to the relative costs of domestic and foreign sourcing. Tariffs therefore affect not only trade volumes and prices but also the composition and foreign content of production.

The second block embeds the long-run trade outcomes in a discrete-time dynamic general-equilibrium environment with capital accumulation. For each country, the trade block delivers the proportional change in long-run real income implied by the new tariff regime. We represent this combined real-income effect by a productivity-equivalent efficiency wedge in the one-sector dynamic model. This reduced-form mapping is not interpreted as evidence that tariff policy directly changes underlying technology; rather, it allows the dynamic block to reproduce the long-run real-income effect while tracing the associated paths of consumption, investment, output, capital, and lifetime welfare. Macroeconomic data on real GDP, capital stock, depreciation rates, and employment are taken from Penn World Table version 11.0.

Very small baseline trade flows can generate unstable log changes in welfare accounting. We therefore compute first-order terms-of-trade and volume-of-trade contributions on baseline trade links above a minimum-flow threshold and limit the influence of extreme log changes. In addition to standard general-equilibrium outcomes, we report import concentration, total variation distance, largest-partner dependence, foreign input dependence, GVC depth, and the foreign share of value added. These measures distinguish changes in supplier identity and concentration from changes in overall reliance on foreign inputs.

Guided by public communications and reporting, we evaluate four stylized policy experiments capturing the main strategic margins in the current trade-policy environment.[5] The contribution of the paper is threefold. Methodologically, we combine a long-run Caliendo–Parro-style trade block, augmented with input substitution and endogenous foreign value-added adjustment, with a dynamic block featuring capi-

[5]For the formal definitions of the tariff scenarios and their exact parameterization, see Section 3.10.

tal accumulation. Substantively, we compare four directly comparable scenarios that isolate unilateral US escalation, comprehensive retaliation, unilateral Chinese tariff easing towards the EU and ASEAN, and reciprocal China–EU–ASEAN tariff easing. Finally, we quantify the contribution of the GVC mechanisms by comparing the full model with specifications that shut down input substitution and foreign value-added adjustment, and report both static welfare and lifetime consumption-equivalent variation across all four scenarios.

Using 2023 bilateral flows and tariffs as the baseline, we estimate sector-specific trade elasticities and solve the model under the four counterfactual scenarios. Three broad messages emerge. First, unilateral US escalation produces a modest US static welfare gain of about 0.53%, while China, the EU, ASEAN, the rest of the world, and especially Mexico and Canada incur losses. The US result reflects offsetting forces, with tariff revenue and favourable relative-price effects outweighing the adverse effects of higher trade costs. Second, comprehensive retaliation reverses the US gain into a loss of about 0.40%. Third, selective tariff easing redistributes rather than uniformly eliminates the costs of escalation: unilateral Chinese easing improves outcomes for the EU and ASEAN relative to retaliation but worsens China's own position, while reciprocal easing improves China relative to the unilateral-easing scenario without making every participating region better off.

The structural and dynamic results qualify the idea of wholesale GVC relocation. Supplier reallocation is economically meaningful but concentrated in particular economies and bilateral corridors, while aggregate GVC depth changes only modestly. Foreign value-added shares respond more visibly, indicating that the origin and foreign content of inputs adjust more readily than the overall intermediate-input intensity of production. Dynamic welfare preserves the signs and broad regional ranking of the static effects, but its absolute magnitude is generally smaller. The Full-GVC and No-GVC comparisons further show that the GVC mechanisms have modest effects on aggregate regional welfare but alter country-level incidence, supplier composition, and foreign value-added exposure.

The larger losses experienced by highly trade-exposed economies should not be interpreted as evidence that they would benefit from becoming less open through protectionism. Supplier diversification can reduce concentrated dependence while preserving access to efficient foreign inputs, whereas broad import restrictions raise input costs, weaken gains from specialization, and invite retaliation. Selective tariff easing can redirect sourcing towards preferred partners, but it can also create new concentrations and does not guarantee uniform gains within the preferential group.

The remainder of the paper is organized as follows. Section 2 reviews related work on tariff incidence, general-equilibrium evaluation with input–output linkages, and the political economy of trade policy. Section 3 presents the long-run trade block, the dynamic block, the data, the estimation of heterogeneous

elasticities, and the solution algorithm. Section 4 reports the long-run and dynamic results for the four scenarios, including how GVC restructuring maps into dynamic welfare. Section 5 concludes.

2 Literature Review

Since 2018, renewed trade frictions have generated a substantial empirical and quantitative literature on tariff incidence, real-economy adjustment, political economy, and GVC reconfiguration. This paper builds on that evidence to address a question that has become more salient in 2024 and 2025: when tariff escalation becomes broader and more reciprocal, and countermeasures extend beyond a single bilateral dispute, what determines whether losses arise mainly through prices, quantities, or supply-chain reorganization, and how persistent are these effects once capital adjusts?

A robust finding from the 2018–2020 tariff cycle is that US import tariffs were largely passed through to tariff-inclusive US import prices, with limited short-run absorption by foreign exporters (Amiti et al., 2019; Cavallo et al., 2021). Fajgelbaum et al. (2020) show that losses to US consumers and firms buying imports outweigh tariff revenue and gains to domestic producers once general-equilibrium reallocation is taken into account. Mallick and Marques (2008) further establish that pass-through varies substantially across sectors and differs between exchange-rate and tariff changes. Related OEP evidence also shows that vertical market structure shapes tariff pass-through and the consumer effects of liberalization. McCorriston and Sheldon (1996) demonstrate that additional production and distribution stages, together with imperfect competition, can materially change the incidence of tariff reform. When pass-through is high and partners retaliate, the initiating economy has limited scope to improve its terms of trade, while input-cost increases and expenditure switching transmit losses through production networks. This logic motivates our first-order decomposition of welfare into terms-of-trade and volume-of-trade components.

Recent work broadens these margins beyond statutory tariff rates. Bressan and Mattos (2026) show that non-tariff barriers affect customs compliance and unreported trade, while Kumar and Mallick (2026) link incomplete exchange-rate pass-through among exporters to markups, labour markdowns, and wages. These studies complement our focus on model-implied sourcing, GVC exposure, and lifetime welfare.

Tariff shocks propagate unevenly across sectors and space. Flaaen and Pierce (2026) document that the 2018–2019 tariff package raised intermediate input costs and depressed manufacturing performance, while Waugh (2019), Benguria and Saffie (2020), and Goswami (2020) find adverse effects on consumption growth, regional earnings, and employment. Supply chains provide an additional amplification channel: Handley et al. (2025) show that rising import tariffs reduce export growth through firms' exposure to tariff increases on imported inputs, and Chen et al. (2023) document heterogeneous financial market responses associated

with firms' output exposure to China's market. Consistent with this mechanism, Saito and Tokutsu (2015) show that endogenous input choice changes the adjustment of domestic and imported inputs during a major trade contraction. The key lesson is that propagation depends critically on where in the production network the tariff wedge lands, motivating our framework's allowance for input substitution across sources and our sectoral and partner-level diagnostics.

On the exporter side, Jiang et al. (2023) show that Chinese exporters responded by diverting exports to alternative destinations, while Sheng et al. (2025) document trade diversion towards Southern markets accompanied by changes in export quality and prices. Cui and Li (2021) and He et al. (2021) find broader labour market and entry effects in China, and trade diversion created new winners, notably Vietnam (Choi and Nguyen, 2023; Dhar et al., 2023). Critically, firms adjust the composition of domestic and foreign sourcing even when total quantities move slowly, motivating our explicit GVC margin. We treat the foreign share of value added as an adjustment margin responding to relative cost changes, and report national GVC depth and foreign value-added shares as outcome metrics. A decline in foreign value added may reflect short-run insulation from imported shocks but can also indicate costly substitution toward domestic inputs; a rise signals deeper integration but greater exposure to foreign disruptions. Making this trade-off visible is central in a policy environment where resilience and dependence are explicit objectives.

Escalation persists and retaliation is systematic rather than incidental for political reasons. Blanchard et al. (2024) estimate that the 2018 trade war reduced the Republican vote share and contributed to House seat losses, while Brutger et al. (2023) show that politically targeted retaliation increases public concerns about foreign election interference. Historical work underscores that the effects of protectionist waves can persist even when formal rates stabilize (Eichengreen and Irwin, 2010; Irwin, 2011), though Evenett (2019) cautions against simplistic analogies. In 2024 and 2025, policy actions combine broad instruments, partner-specific reciprocity, and targeted measures in politically salient sectors. Our scenarios are accordingly designed to separate escalation, broad retaliation, and selective easing within non-US blocs, which are the margins that plausibly govern where trade and value chains re-anchor.

The dominant quantitative tradition extends the Eaton and Kortum framework (Eaton and Kortum, 2002) to multi-sector general equilibrium with IO linkages. The workhorse model of Caliendo and Parro (2015) shows how sectoral heterogeneity, trade elasticities, and IO structure jointly determine the propagation of trade shocks and the decomposition of welfare into terms-of-trade and volume-of-trade components. Fajgelbaum and Khandelwal (2022) emphasize the central role of multilateral retaliation in limiting terms-of-trade gains, and Ignatenko et al. (2025) find that unilateral US tariff increases can yield modest welfare gains when tariff revenues reduce income taxes, whereas reciprocal retaliation produces net welfare losses. A growing theoretical literature further shows that IO linkages and input substitutability jointly govern shock

propagation: Oberfield (2018) endogenizes input–output architecture, Baqaee and Farhi (2019) show that non-unitary input elasticities generate aggregate responses that differ sharply from first-order approximations, and Blaum et al. (2018) provide firm-level evidence consistent with CES substitution between domestic and foreign inputs (see also Carvalho, 2014; Carvalho and Tahbaz-Salehi, 2019; Dhyne et al., 2021).

In complementary work, Ho (2026) shows in a Schumpeterian North–South model that tariffs generate persistent effects on innovation and wages through technology-transfer channels, and Beverelli et al. (2024) demonstrate that institutional conditions shape heterogeneous welfare gains from trade across countries. Lin (2026) further shows that transition dynamics can reverse welfare rankings relative to steady-state comparisons. Together, these OEP studies highlight the roles of innovation, institutions, input choice, and intertemporal adjustment. Relative to them, our paper evaluates four directly comparable tariff regimes in a multi-country, multi-sector framework with intermediate-input substitution, foreign value-added adjustment, and capital-accumulation welfare.

Our implementation extends the Caliendo–Parro structure by allowing intermediate-input shares to respond to relative sectoral prices and introducing an explicit foreign value-added margin. We complement these mechanisms with three families of structural metrics, including a Herfindahl–Hirschman import concentration index (UNCTAD, 2025; Ahn and Tan, 2025), the total variation distance of import share changes (Finger and Kreinin, 1979), and top-supplier dependence, which are designed to capture the shifts emphasized in recent policy frameworks on strategic dependencies (Arriola et al., 2024; André et al., 2024; Afonso et al., 2026). Taken together, this literature motivates a framework that jointly traces price, quantity, sourcing, and dynamic welfare adjustments through production networks.

3 Methodology

3.1 Overview

We study tariff counterfactuals in a two-block quantitative framework. The first block is a multi-country, multi-sector Eaton–Kortum (EK) trade model with input–output linkages and an explicit global value chain (GVC) margin. This block is used to evaluate how tariff changes affect sectoral prices, trade shares, expenditure allocations, and foreign value-added exposure in long-run counterfactual equilibrium.

The second block is a one-sector dynamic model with capital accumulation. The two-block structure is designed to separate the long-run trade reallocation mechanism from the intertemporal macroeconomic adjustment mechanism in a transparent way. The long-run real-income change implied by the static trade block is represented in the dynamic block by a productivity-equivalent efficiency wedge rather than interpreted as a direct change in underlying technology. This mapping delivers transition paths for consumption,

investment, output, capital, and welfare, summarized by lifetime consumption-equivalent variation (CEV).

Countries are indexed by n and i, sectors by j, time by t, and counterfactual policy scenarios by s. In bilateral variables, n denotes the destination (importing) country and i denotes the origin (exporting) country.

We consider tariff experiments in which the vector of ad valorem tariffs $\{\tau_{jnit}\}_{j,n,i}$ switches once from a baseline regime τ^0_{jni} to a new regime τ^s_{jni} at $t = 0$ and remains constant thereafter:

$$\tau_{jnit} = \begin{cases} \tau^0_{jni}, & t < 0, \\ \tau^s_{jni}, & t \geq 0, \end{cases}$$

where $s \in \{S1, S2, S3, S4\}$ indexes the policy scenarios defined in Section 3.10.

Operationally, our quantitative implementation proceeds in two steps. First, we solve the multi-sector EK block in relative changes from a base year under each tariff scenario. Second, we map the implied long-run real-income change into the dynamic block with capital accumulation to obtain transition paths and dynamic welfare.

3.2 Static environment and preferences (within-period trade block)

We consider N countries and J sectors. Country n contains L_n identical household members, each supplying one unit of labour inelastically. Hence, L_n denotes the aggregate labour endowment rather than labour supplied by a single representative individual. The representative household consumes sectoral final composites $\{C^j_n\}^J_{j=1}$. Preferences over sectoral final composites are Cobb–Douglas:

$$U^{\text{static}}_n = \prod_{j=1}^{J} (C^j_n)^{\alpha^j_n}, \qquad \sum_{j=1}^{J} \alpha^j_n = 1, \tag{1}$$

with corresponding final consumption price index

$$P_n = \prod_{j=1}^{J} \left(\frac{P^j_n}{\alpha^j_n} \right)^{\alpha^j_n}, \tag{2}$$

where P^j_n denotes the sector-j composite price in country n. Nominal absorption (income) is

$$I_n = w_n L_n + R_n + D_n, \tag{3}$$

where w_n is the wage, R_n tariff revenue rebated lump-sum, and D_n the trade deficit (exogenous with $\sum_n D_n = 0$). This static block is solved in changes, so D_n serves to match the observed base-year trade balance.

3.3 Production, input bundles, and sectoral linkages (within a period)

Within the static trade block, sectoral production combines domestic value added and intermediate inputs under constant returns to scale. The baseline production structure is summarized by the value-added share $\gamma^j_{\mathrm{va},n}$ and the input–output coefficients $\gamma^{k,j}_n$, which satisfy

$$\gamma^j_{\mathrm{va},n} + \sum_{k=1}^{J} \gamma^{k,j}_n = 1.$$

In the fixed-share benchmark, sectoral unit costs in levels are defined as

$$c^j_n = B^j_n w_n^{\gamma^j_{\mathrm{va},n}} \prod_{k=1}^{J} (P^k_n)^{\gamma^{k,j}_n}, \tag{4}$$

where B^j_n is a country-sector cost shifter. Since the quantitative implementation is solved in relative changes, this time-invariant shifter cancels. The proportional change in sectoral unit costs is therefore

$$\hat{c}^j_n = \hat{w}_n^{\gamma^j_{\mathrm{va},n}} \prod_{k=1}^{J} (\hat{P}^k_n)^{\gamma^{k,j}_n}. \tag{5}$$

EK trade structure. Following Eaton and Kortum, sector-j productivity draws in exporter i are Fréchet with scale parameter T_{ji} and shape parameter θ_j. The scale parameter T_{ji} captures the absolute productivity level of exporter i in sector j, while θ_j governs productivity dispersion and the trade elasticity. Let $\kappa_{jnit} = (1 + \tau_{jnit}) d^j_{ni}$ denote the bilateral trade cost, where τ_{jnit} is the tariff and $d^j_{ni} \geq 1$ is the non-tariff iceberg barrier, held fixed across counterfactuals. The EK structure implies bilateral expenditure shares

$$\pi_{jnit} = \frac{T_{ji}\big(\kappa_{jnit} c_{jit}\big)^{-\theta_j}}{\sum_{m=1}^{N} T_{jm}\big(\kappa_{jnmt} c_{jmt}\big)^{-\theta_j}}. \tag{6}$$

Given sectoral expenditure X_{jnt}, tariff-exclusive imports satisfy

$$M_{jnit} = \frac{\pi_{jnit}}{1 + \tau_{jnit}} X_{jnt}, \qquad X_{jnit} \equiv (1 + \tau_{jnit}) M_{jnit} = \pi_{jnit} X_{jnt}. \tag{7}$$

Expenditure recursion and market clearing. Let X_{jnt} denote total expenditure in destination n on sector-j goods. Goods-market clearing and intermediate use imply

$$X_{jnt} = \underbrace{\sum_{k=1}^{J} \gamma^{\text{mat}}_{jkn,t} \sum_{m=1}^{N} \frac{\pi_{kmnt}}{1+\tau_{kmnt}} X_{kmt}}_{\text{intermediate demand}} + \underbrace{\alpha^j_n I_{nt}}_{\text{final demand}}, \tag{8}$$

where $\gamma^{\text{mat}}_{jkn,t}$ is the share of sector-j intermediate inputs in the total production costs of sector k in country n. Tariff revenue is

$$R_{nt} = \sum_{j=1}^{J} \sum_{i=1}^{N} \tau_{jnit} M_{jnit}, \tag{9}$$

and trade balance holds given the exogenous base-year trade deficit D_n:

$$\sum_{j,i} M_{jnit} - D_n = \sum_{j,i} M_{jint}. \tag{10}$$

3.4 Equilibrium in relative changes

We evaluate counterfactuals in changes from the base year ($\hat{x} \equiv x'/x$). Holding non-tariff frictions fixed, $\hat{\kappa}^j_{ni} = \frac{1+\tau^{j\prime}_{ni}}{1+\tau^j_{ni}}$. The fixed-share EK block in changes can be written as:

$$\text{Input bundle:} \quad \hat{c}^j_n = \hat{w}_n^{\gamma^j_{\text{va},n}} \prod_{k=1}^{J} (\hat{P}^k_n)^{\gamma^{k,j}_n}, \tag{11}$$

$$\text{Price index:} \quad \hat{P}^j_n = \left(\sum_i \pi^j_{ni} \left(\hat{\kappa}^j_{ni} \hat{c}^j_i\right)^{-\theta_j} \right)^{-1/\theta_j}, \tag{12}$$

$$\text{Trade shares:} \quad \pi^{j\prime}_{ni} = \frac{\pi^j_{ni} (\hat{\kappa}^j_{ni} \hat{c}^j_i)^{-\theta_j}}{\sum_h \pi^j_{nh} (\hat{\kappa}^j_{nh} \hat{c}^j_h)^{-\theta_j}}, \tag{13}$$

$$\text{Expenditure:} \quad X^{j\prime}_n = \sum_k \gamma^{j,k\prime}_n \sum_i \frac{\pi^{k\prime}_{in}}{1+\tau^{k\prime}_{in}} X^{k\prime}_i + \alpha^j_n I'_n, \tag{14}$$

$$\text{Income:} \quad I'_n = \hat{w}_n w_n L_n + \sum_{j,i} \frac{\tau^{j\prime}_{ni}}{1+\tau^{j\prime}_{ni}} \pi^{j\prime}_{ni} X^{j\prime}_n + D_n, \tag{15}$$

$$\text{Trade balance:} \quad \sum_{j,i} \frac{\pi^{j\prime}_{ni}}{1+\tau^{j\prime}_{ni}} X^{j\prime}_n - D_n = \sum_{j,i} \frac{\pi^{j\prime}_{in}}{1+\tau^{j\prime}_{in}} X^{j\prime}_i. \tag{16}$$

Equations (11)–(16) determine the counterfactual allocation in each scenario, given the tariff matrix and parameters.

3.5 GVC extensions: IO substitution and foreign value added

We add two parsimonious GVC mechanisms that feed back into the within-period block.

Price-driven input-share adjustment. We allow materials cost shares to respond to relative input-price changes through a reduced-form adjustment rule. Let $\omega_n^{k,j}$ denote the baseline share of sector-k inputs in the intermediate expenditure of sector j in country n, with $\sum_k \omega_n^{k,j} = 1$. Writing $\widehat{P}_n^k = P_n^{k\prime}/P_n^k$, the updated shares are

$$\tilde{\gamma}_n^{k,j} = \big(1 - \gamma^j_{\mathrm{va},n,\mathrm{eff}}\big) \frac{\omega_n^{k,j} (\widehat{P}_n^k)^{-\sigma^{\mathrm{IO}}}}{\sum_h \omega_n^{h,j} (\widehat{P}_n^h)^{-\sigma^{\mathrm{IO}}}}, \tag{17}$$

where $\sigma^{\mathrm{IO}} > 0$ controls input-share responsiveness and $\gamma^j_{\mathrm{va},n,\mathrm{eff}}$ is the effective value-added share defined below. In (14), we replace $\gamma_n^{j,k}$ by $\tilde{\gamma}_n^{j,k}$, ensuring $\gamma^k_{\mathrm{va},n,\mathrm{eff}} + \sum_j \tilde{\gamma}_n^{j,k} = 1$.

Foreign value added and offshoring/reshoring. Let $s_{jn}^{\mathrm{FVA},0}$ denote the baseline foreign value-added share in country n and sector j. We construct a relative offshoring incentive as a function of the price of the imported bundle relative to the domestic bundle, with chain elasticity $\sigma^{\mathrm{chain}} > 0$:

$$\mathrm{ratio}_n^j = \left(\frac{P_{jn}^{\mathrm{foreign}}}{P_{jn}^{\mathrm{dom}}} \right)^{-\sigma^{\mathrm{chain}}}, \tag{18}$$

where $P_{jn}^{\mathrm{dom}} = \hat{c}_n^j$ is the domestic unit-cost counterpart and

$$P_{jn}^{\mathrm{foreign}} = \sum_{i \neq n} \omega_{ni}^{j,0}\, \hat{\kappa}_{ni}^j \hat{c}_i^j, \qquad \omega_{ni}^{j,0} = \frac{\pi_{ni}^{j,0}}{\sum_{h \neq n} \pi_{nh}^{j,0}}, \tag{19}$$

is the base-share-weighted delivered cost of foreign sourcing options, excluding the domestic supplier. If the baseline foreign share is zero, we set $P_{jn}^{\mathrm{foreign}} = P_{jn}^{\mathrm{dom}}$. We update the foreign value-added share via a smooth logit mapping:

$$s_{jn,\mathrm{new}}^{\mathrm{FVA}} = \frac{s_{jn}^{\mathrm{FVA},0} \cdot \mathrm{ratio}_n^j}{(1 - s_{jn}^{\mathrm{FVA},0}) + s_{jn}^{\mathrm{FVA},0} \cdot \mathrm{ratio}_n^j}. \tag{20}$$

We then map this change into an effective value-added share:

$$\gamma^j_{\mathrm{va},n,\mathrm{eff}} = \gamma^j_{\mathrm{va},n} \left[1 + \phi_j \big(s_{jn}^{\mathrm{FVA},0} - s_{jn,\mathrm{new}}^{\mathrm{FVA}} \big) \right], \qquad \phi_j \in [0,1]. \tag{21}$$

Here ϕ_j is the sector-j pass-through parameter from changes in foreign value-added intensity to the effective domestic value-added share. A fall in offshoring (lower s^{FVA}) therefore increases domestic intensity. Materials shares are renormalized so that $\gamma^j_{\mathrm{va},n,\mathrm{eff}} + \sum_k \tilde{\gamma}_n^{k,j} = 1$. In the extended specification, these effective shares also replace the corresponding exponents in the log-linear unit-cost update (11).

Country-level GVC summaries. Country-level GVC depth and foreign value-added share are aggregated using fixed baseline sectoral output weights $\omega_{jn} = Y^0_{jn} / \sum_{j'} Y^0_{j'n}$:

$$\text{GVCdepth}_n = \sum_{j=1}^{J} \left(1 - \gamma^{j}_{\text{va},n,\text{eff}}\right) \omega_{jn}, \qquad s^{\text{FVA}}_n = \sum_{j=1}^{J} s^{\text{FVA}}_{jn,\text{new}}\, \omega_{jn}. \tag{22}$$

3.6 Dynamic mapping with capital accumulation

To connect the static trade counterfactuals to intertemporal welfare, we use a one-sector dynamic model with capital accumulation. This block is a reduced-form transition mapping rather than a fully integrated dynamic multi-country trade model. The trade block determines the long-run real-income effect of each tariff scenario, while the dynamic block translates that effect into country-specific paths for capital, output, consumption, and welfare.

Production in country n is

$$Y_{nt} = A_{nt} K^{\eta}_{nt} L^{1-\eta}_{n}, \tag{23}$$

where A_{nt} is effective productivity, $\eta \in (0,1)$ is the capital share, and employment L_n is fixed over the transition. Competitive factor prices are

$$r_{nt} = \eta \frac{Y_{nt}}{K_{nt}}, \qquad w_{nt} = (1-\eta)\frac{Y_{nt}}{L_n}. \tag{24}$$

In each country n, the representative household chooses consumption and next-period capital to maximize infinite-horizon lifetime utility

$$U_n = \sum_{t=0}^{\infty} \beta^t u(C_{nt}), \qquad u(C) = \frac{C^{1-\sigma} - 1}{1-\sigma}, \tag{25}$$

where $\beta \in (0,1)$ is the discount factor and σ is the coefficient of relative risk aversion. In the baseline implementation, we set $\sigma = 1$, so $u(C) = \log C$.

The dynamic resource constraint is

$$C_{nt} + I_{nt} = Y_{nt}, \tag{26}$$

where I_{nt} denotes investment in the dynamic block. Capital accumulates according to

$$K_{n,t+1} = (1 - \delta_n) K_{nt} + I_{nt}, \tag{27}$$

where δ_n is the country-specific depreciation rate. The initial capital stock K_{n0} and employment L_n are

taken from Penn World Table version 11.0. Both the baseline and counterfactual paths begin from the same observed initial capital stock.

The household's problem implies the Euler equation

$$u'(C_{nt}) = \beta\big(1 - \delta_n + r_{n,t+1}\big)u'(C_{n,t+1}). \tag{28}$$

Link from the trade block to the dynamic block. For country n and policy scenario s, the static trade block delivers the proportional change in long-run real income

$$\widehat{W}_n^s = \frac{I_n^s/P_n^s}{I_n^0/P_n^0}. \tag{29}$$

We do not interpret this real-income change as a directly observed change in total factor productivity. Instead, the dynamic block represents the combined long-run effects of wages, consumer prices, tariff revenue, trade volumes, and sourcing costs through a productivity-equivalent efficiency wedge. With fixed labour and unchanged values of β, δ_n, and η, steady-state consumption in the Cobb–Douglas growth model is proportional to $A_n^{1/(1-\eta)}$. We choose the wedge so that

$$\frac{C_{n,\mathrm{ss}}^s}{C_{n,\mathrm{ss}}^0} = \widehat{W}_n^s, \tag{30}$$

which implies

$$\frac{A_n^s}{A_n^0} = \left(\widehat{W}_n^s\right)^{1-\eta}. \tag{31}$$

The wedge applies from $t = 0$ onward. This is a reduced-form transition mapping rather than a structural claim that tariff policy directly changes technology. It ensures that the dynamic block reproduces the long-run real-income effect generated by the trade model while tracing the associated adjustment of consumption, investment, output, and capital. The dynamic welfare results are therefore interpreted as conditional on this mapping.

3.7 Dynamic welfare and consumption-equivalent variation

To summarize welfare consequences throughout the transition, we construct a dynamic consumption-equivalent variation (CEV). The numerical transition is solved for T periods and is followed by the scenario-specific steady state. With log utility, lifetime welfare is therefore

$$U_n^s = \sum_{t=0}^{T-1} \beta^t \log C_{nt}^s + \frac{\beta^T}{1-\beta} \log C_{n,\mathrm{ss}}^s. \tag{32}$$

Let U_n^{base} denote lifetime welfare along the baseline path, including its corresponding steady-state continuation value. The lifetime CEV λ_n^s is the constant proportional change in baseline consumption at every date that makes the household indifferent between the two paths. It is given by

$$\lambda_n^s = \exp\left[(1-\beta)\left(U_n^s - U_n^{\text{base}}\right)\right] - 1. \tag{33}$$

Including the continuation value avoids treating a finite-horizon utility comparison as lifetime welfare. For the Full-GVC specification, we verify that the reported CEV estimates are stable when the numerical transition horizon is extended from 20 to 30 and 50 years.

3.8 Welfare accounting and ToT/VoT decomposition

Within the trade block, country-level welfare is $W_n = I_n/P_n$, where I_n is nominal absorption in (3) and P_n is the final consumption price index in (2). Holding nominal trade deficits and non-tariff trade costs fixed, the first-order welfare change around the calibrated baseline can be decomposed into terms-of-trade (ToT) and volume-of-trade (VoT) components:

$$d\ln W_n = \underbrace{\frac{1}{I_n}\sum_{j=1}^{J}\sum_{i=1}^{N}\left(EX_{ni}^j\, d\ln c_n^j - IM_{ni}^j\, d\ln c_i^j\right)}_{\text{ToT}} + \underbrace{\frac{1}{I_n}\sum_{j=1}^{J}\sum_{i=1}^{N}\tau_{ni}^j M_{ni}^j\left(d\ln M_{ni}^j - d\ln c_i^j\right)}_{\text{VoT}}. \tag{34}$$

Here c_i^j denotes the exporter's unit cost, $IM_{ni}^j = M_{ni}^j$ is the tariff-exclusive import value, and $EX_{ni}^j = M_{in}^j$ is the corresponding export value.

For the numerical results, we use baseline weights and log changes between equilibria to obtain first-order approximations, with implementation details provided in the Online Appendix. Country, bilateral, and sector-by-country contributions are obtained by summing over (j,i), j, and i, respectively.

Robust implementation. The ToT/VoT decomposition is implemented as a transparent accounting exercise on the base-year trade network. Some bilateral sector links are zero or very small in the base year. Since the purpose of the decomposition is to attribute welfare changes along economically meaningful intensive-margin adjustments, we compute ToT/VoT on the base-year support by excluding zero-base and negligible-base edges from the decomposition. We also clip extreme log changes in trade values and costs at a conservative threshold so that the reported decomposition reflects systematic trade reallocation rather than isolated numerical outliers. These steps make the accounting transparent, reproducible, and consistent with the equilibrium counterfactuals generated by the model.

Regional aggregation with M^0_{ni} weights. When aggregating from countries to regions (e.g., six-region heatmaps), bilateral ToT/VoT components are summed within region pairs using base-year bilateral import weights:

$$\Delta\text{VoT}_{\mathcal{NI}} = \sum_{n\in\mathcal{N}}\sum_{i\in\mathcal{I}} \omega_{ni}^{M^0}\,\Delta\text{VoT}_{ni}, \qquad \omega_{ni}^{M^0} = \frac{M^0_{ni}}{\sum_{n'\in\mathcal{N}}\sum_{i'\in\mathcal{I}} M^0_{n'i'}}.$$

The same aggregation is used for ToT. Here M^0_{ni} is the base-year total bilateral imports from i to n (summed over tradable sectors), consistent with the weighting used in the region heatmaps.

3.9 Structural metrics reported in Results

Beyond welfare and the decomposition, we report four groups of structural diagnostics that map directly into the model mechanisms.

Total variation distance (TVD). Let s_{ni} be the import share of partner i in country n's total foreign imports, with $s_{nn} = 0$. The TVD between baseline and counterfactual import-share distributions is

$$\text{TVD}_n = \frac{1}{2}\sum_i \left|s'_{ni} - s_{ni}\right|.$$

TVD measures the extent of partner reallocation needed to move from the baseline import network to the counterfactual network.

Import concentration and top-partner dependence. Import concentration is measured using the Herfindahl–Hirschman index

$$\text{HHI}_n = \sum_i s_{ni}^2, \qquad \Delta\text{HHI}_n = \text{HHI}'_n - \text{HHI}_n.$$

We also report $\max_i s_{ni}$ as a transparent measure of dependence on the largest foreign supplier.

Input import dependence (ICE). Input import dependence is proxied by the foreign share of tariff-exclusive sectoral purchases in each country-sector pair:

$$\text{ICE}_{n,j} = \frac{\sum_{i\neq n} M^j_{ni}}{\sum_i M^j_{ni}}, \qquad \Delta\text{ICE}_{n,j} = \text{ICE}'_{n,j} - \text{ICE}_{n,j}.$$

Here M^j_{nn} denotes domestic purchases. A higher value of ICE indicates greater dependence on foreign sourcing, while a decline in ICE indicates a shift toward domestic sourcing. This metric is used to capture changes in input import dependence and supply-chain exposure under each tariff counterfactual scenario.

GVC depth and external dependence (sFVA). GVC depth and the foreign value-added share are defined in (22). GVC depth captures baseline-output-weighted intermediate-input intensity, while s_n^{FVA} captures external dependence through foreign content.

3.10 Estimation, calibration, and counterfactual implementation

This subsection summarizes the estimation of trade elasticities, the data and calibration, the tariff scenarios, and the implementation strategy. Detailed derivations, data construction, calibration rationale, and numerical diagnostics are reported in the Online Appendix.

Trade elasticities. In the EK framework, the sectoral trade elasticity θ_j governs the sensitivity of bilateral expenditure shares to changes in trade costs. We estimate θ_j using 2023 bilateral trade flows and tariffs and the triangular expenditure-ratio approach. Suppressing time indices, let X_{is}^j denote expenditure by importer i on goods from exporter s in sector j, and let $\tilde{t}_{is}^j = 1 + t_{is}^j$. Under symmetric bilateral non-tariff frictions and importer- and exporter-specific components, the triangular transformation eliminates these terms and identifies θ_j from bilateral tariff variation:

$$\ln\left(\frac{X_{is}^j X_{sr}^j X_{ri}^j}{X_{ir}^j X_{rs}^j X_{si}^j}\right) = -\theta_j \ln\left(\frac{\tilde{t}_{is}^j \tilde{t}_{sr}^j \tilde{t}_{ri}^j}{\tilde{t}_{si}^j \tilde{t}_{rs}^j \tilde{t}_{ir}^j}\right) + \widetilde{\epsilon}_{isr}^j. \tag{35}$$

For each sector, we rank countries by their shares of sectoral trade. We then exclude countries at the lower end of this ranking whose cumulative trade shares account for approximately 1% and 2.5% of the sectoral total, yielding the samples labelled 99% and 97.5%, respectively. The 99% estimates are used as the baseline elasticities for the 21 tradable goods sectors in the quantitative trade block. Non-tradable sectors, including mining support services, are assigned 8.62, the arithmetic mean of the 21 full-sample estimates. The full triangular-ratio derivation and additional estimation details are reported in the Online Appendix. See Online Appendix A.1.

Data and calibration. Our quantitative implementation combines bilateral trade statistics, sectoral input–output tables, tariff schedules, value-added decompositions, and macroeconomic data. Bilateral trade flows are taken from UN Comtrade for 2023 and concorded from HS6 products to ISIC Rev. 4 sectors. Missing observations are replaced with those from the closest available year. The production structure is based on 2020 coefficients from OECD input–output tables; baseline tariffs are obtained from UNCTAD–TRAINS for 2023; value added and gross output are taken from OECD STAN for 2023; domestic and foreign value-added shares are taken from the 2023 edition of OECD TiVA; and the macroeconomic objects used in the dynamic block are taken from 2023 observations in Penn World Table version 11.0. Complete country and sector

coverage, concordance procedures, regional mapping, and data-preparation details are reported in Online Appendix A.2.

The model combines data-disciplined, estimated, and calibrated objects. IO coefficients, value-added shares, bilateral trade flows, tariffs, baseline foreign value-added shares, gross output, initial capital, depreciation, and employment are disciplined by the data. Trade elasticities for the 21 tradable goods sectors are estimated using equation (35). We set $\sigma^{\text{IO}} = 0.4$, $\sigma^{\text{chain}} = 1.0$, and $\phi_j = 0.3$, reflecting limited adjustment of intermediate-input shares and foreign content (Antràs and Chor, 2013; Baqaee and Farhi, 2019; Antràs and Chor, 2022; Fujiy et al., 2024). The dynamic block uses $\beta = 0.97$, $\sigma = 1$, and $\eta = 0.33$, in line with standard annual macroeconomic benchmarks (King and Rebelo, 1999; Coeurdacier et al., 2015; Caines and Lahiri, 2025). The estimated, calibrated, and data-disciplined parameters are consolidated in a single table, while the detailed calibration rationale is reported in the Online Appendix. See Table 1 and Online Appendix A.3.

Table 1: Model parameters and empirical discipline

Parameter	Baseline value	Role	Discipline
θ_j	Sector-specific	Trade elasticity	Estimated or assigned mean
σ^{IO}	0.4	Intermediate-input substitution	Calibrated
σ^{chain}	1.0	Foreign-content adjustment	Calibrated
ϕ_j	0.3	FVA-to-cost pass-through	Calibrated
β	0.97	Discount factor	Macro benchmark
σ	1	Relative risk aversion	Log utility
η	0.33	Capital share	Macro benchmark
δ_n	Country-specific	Depreciation rate	Penn World Table
L_n	Country-specific	Fixed employment	Penn World Table

Source: Authors' calculations and compilation based on the data sources and calibration references cited in the text.

Model variants and dynamic robustness. For each tariff scenario, we solve four static model specifications: No-GVC, IO-only, FVA-only, and Full-GVC. No-GVC retains baseline IO linkages but switches off both GVC adjustment margins. Dynamic welfare is compared between the Full-GVC and No-GVC specifications using the 20-year numerical transition. For the Full-GVC specification, we additionally assess horizon robustness using numerical transitions of 20, 30, and 50 years.

Tariff counterfactual scenarios. We consider four counterfactual scenarios for bilateral tariffs in the 21 tariff-covered tradable sectors. Each scenario is implemented as a once-and-for-all, permanent change from $t = 0$ onward relative to the baseline schedule τ^0_{jni}. For escalation and retaliation flows, the stated partner-specific rates are implemented as tariff floors,

$$\tau^s_{jni} = \max\left\{\tau^0_{jni}, \bar{\tau}^s_{ni}\right\},$$

so that escalation or retaliation never mechanically lowers an existing sectoral tariff. Domestic transactions retain their baseline tariff treatment.

- **Scenario 1 (S1) (unilateral US tariff escalation).** The United States applies partner-specific tariff floors of 30% to imports from China, 15% to imports from the EU economies represented in the sample and Japan, 35% to imports from Mexico and Canada, 50% to imports from Brazil and India, 19% to imports from South Korea, 20% to imports from ASEAN, and 10% to imports from the remaining foreign economies.

- **Scenario 2 (S2) (symmetric retaliation).** US tariffs remain as in S1. In addition, every foreign economy in the sample applies to imports from the United States the same partner-specific tariff floor that the United States applies to that economy under S1.

- **Scenario 3 (S3) (retaliation plus unilateral Chinese tariff easing).** Tariffs involving the United States remain as in S2. China additionally eliminates tariffs on imports from the EU economies represented in the sample and from ASEAN in the 21 tariff-covered tradable sectors.

- **Scenario 4 (S4) (reciprocal China–EU–ASEAN tariff easing).** China maintains the tariff elimination introduced in S3. The EU and ASEAN economies additionally eliminate tariffs on imports from China in the 21 tariff-covered tradable sectors, while tariffs involving the United States remain the same as in S2.

All bilateral tariffs not explicitly altered above remain at their baseline levels. The four scenarios are evaluated relative to the same baseline equilibrium and use identical country coverage, sector definitions, and aggregation procedures, making unilateral escalation, retaliation, unilateral selective easing, and reciprocal selective easing directly comparable. The exact tariff-matrix construction and audit checks are reported in Online Appendix A.4.

Identification and transparency. The tariff schedules $\{\tau^s_{jni}\}$ are treated as exogenous policy experiments. Identification therefore concerns the model-implied general-equilibrium response to a change from the common baseline tariff matrix τ^0_{jni} to a counterfactual matrix τ^s_{jni}, holding baseline technologies, non-tariff trade costs, and baseline input–output weights fixed. The object of interest is not a reduced-form causal estimate from historical time-series variation. The full equilibrium mapping, construction of reported outcomes, treatment of zero-base bilateral links, clipping of extreme log changes, regional weighting, and solver diagnostics are reported in the Online Appendix. See Online Appendix A.5.

4 Results

4.1 Estimating and using sectoral trade elasticities

We estimate sector-specific trade elasticities $\{\theta_j\}$ in the multisector Eaton–Kortum framework using the triangular expenditure-ratio regression in equation (35). For each sector j, we construct all admissible country triplets from the 2023 bilateral trade and tariff data for which the relevant trade flows are positive and the logarithmic ratios are defined. We then estimate an OLS regression of the log triangular trade-flow ratio on the corresponding log tariff-cost ratio. As discussed in Section 3.10, under the maintained assumptions on symmetric bilateral non-tariff frictions and importer- and exporter-specific components, the triangular transformation removes these terms and identifies θ_j from variation in ad valorem tariffs across partners.

Because the regression is unweighted, each admissible country-triplet observation receives the same weight. To assess the sensitivity of the estimates to countries with small sectoral trade volumes, we consider two restricted samples in addition to the full sample. Within each sector, countries are ranked in ascending order according to their contributions to total sectoral trade. We then exclude countries at the lower end of this ranking whose cumulative trade shares account for approximately 1% and 2.5% of the sectoral total, yielding the samples labelled 99% and 97.5%, respectively. For each restricted sample, we reconstruct the admissible triplets among the retained countries and re-estimate the sectoral trade elasticity. Table 2 reports the estimates, HC1 standard errors, and observation counts for all three specifications.

Three patterns are salient. First, the 99% sample estimates vary meaningfully across sectors, as expected in a Caliendo–Parro-type environment. Commodity-like and homogeneous-input sectors display comparatively high point estimates: Wood (13.44), Paper (20.11), Coke and refined petroleum (18.52), Non-energy Mining (11.02), and Fishing (12.42), implying that their bilateral expenditure shares respond strongly to changes in trade costs. Differentiated and complex-assembly sectors display lower point estimates: Electrical equipment (0.21), Motor vehicles (1.08), Machinery (1.24), Agriculture (1.34), Food (2.02), and Chemicals (3.41). This pattern is consistent with stronger price-driven substitution in standardized intermediates than in highly differentiated equipment, although several individual estimates are imprecisely estimated.

Second, several sectors yield implausible or unstable coefficients in the full sample that become more reasonable after trimming. Motor vehicles, for instance, carries a negative full-sample elasticity (-3.15) but a positive value near unity in the 99% sample (1.08); Basic metals falls from 5.38 to 1.54. Sectors with relatively few observations, notably Energy Mining, retain large standard errors across the trimming specifications, reflecting limited cross-partner tariff variation. The 99% sample balances variance reduction against the influence of extreme ratios, motivating its use as the baseline.

Third, the estimated sectoral profile $\{\theta_j\}$ shapes the incidence of the tariff experiments within the static trade block. For a given sector, a higher θ_j implies that bilateral expenditure shares respond more strongly to changes in tariffs and relative production costs. The elasticity profile therefore affects the extent of supplier reallocation, sectoral price and cost changes, and the resulting terms-of-trade and volume-of-trade contributions. Because the trade block compares the baseline and counterfactual long-run equilibria, θ_j governs the magnitude of reallocation rather than its speed. In the dynamic block, sectoral elasticities matter only indirectly: they affect the country-level long-run real-income change $\widehat{W}_n^s$, which is subsequently represented by the productivity-equivalent efficiency wedge governing the paths of consumption, investment, output, and capital.

	Full sample			99% sample			97.5% sample		
Sector	θ_j	s.e.	Obs.	θ_j	s.e.	Obs.	θ_j	s.e.	Obs.
Agriculture	1.64	0.26	5482	1.34	0.28	3102	0.73	0.30	1854
Fishing	10.26	1.24	1456	12.42	1.78	806	11.12	2.89	565
Mining (Energy)	63.49	37.86	157	36.03	45.39	109	52.48	44.39	92
Mining (Non-Energy)	13.24	1.48	3586	11.02	2.85	1333	2.94	3.46	648
Food	1.21	0.13	5700	2.02	0.14	3694	1.69	0.13	2647
Textiles	6.35	0.47	5720	6.17	0.49	4011	5.88	0.50	3071
Wood	12.75	0.93	4047	13.44	1.13	2950	11.11	1.27	1971
Paper	18.73	1.22	5432	20.11	1.36	3941	13.10	1.28	2933
Coke and refined petroleum	22.17	5.31	1175	18.52	5.76	797	17.28	5.91	727
Chemicals	4.10	0.78	4560	3.41	0.77	3192	1.96	0.60	2079
Pharmaceuticals	−1.17	1.77	4436	1.94	1.90	3089	3.03	2.08	2160
Plastics	2.98	0.56	4734	1.56	0.57	3503	−0.52	0.56	2888
Non-metallic minerals	7.45	0.70	4532	7.30	0.76	3685	8.07	0.84	3132
Basic metals	5.38	1.19	4793	1.54	1.29	3090	4.25	1.66	1805
Metal products	3.63	0.61	4774	3.20	0.65	3746	2.91	0.66	2990
Computer and electronic products	3.76	1.74	3246	4.76	1.77	1865	3.57	2.17	1155
Electrical equipment	0.15	0.73	4916	0.21	0.75	3165	0.47	0.81	2443
Machinery, nec	1.16	0.87	5121	1.24	0.80	3503	1.97	0.88	2872
Motor vehicles	−3.15	0.48	5032	1.08	0.61	1709	0.67	0.78	1019
Other transport equipment	7.28	0.65	4400	5.42	0.73	3267	4.90	0.78	2317
Manufacturing, nec	−0.38	0.42	5583	2.24	0.59	2263	1.96	0.62	1668

Table 2: Sectoral trade elasticity estimates by sector and sample specification. The 99% and 97.5% samples use sector-specific country selections. The 99% estimates provide the baseline elasticities used in the quantitative trade block. These elasticities enter the dynamic analysis indirectly through the long-run real-income changes generated by the trade model.

Source: Authors' calculations.

4.2 Static reallocation and GVC adjustment

The long-run static equilibrium reveals heterogeneous welfare and sourcing responses across the four tariff scenarios. For clarity, we aggregate the 41 economies into six regions: China, the United States, Mexico and Canada, ASEAN, the European Union (EU), and the rest of the world (ROW). Region-level welfare, TVD, and ICE are calculated using base-income weights proportional to $w_n L_n + R_n + D_n$. Foreign value-added shares and GVC depth use baseline gross-output weights. All four scenarios are evaluated relative to the same baseline equilibrium, with identical country coverage, sector definitions, partner sets, and aggregation weights.

Table 3 reports comparable static welfare effects across S1–S4. Under unilateral US tariff escalation in S1, the United States records a modest welfare gain, while all other regions experience welfare losses. Mexico and Canada incur the largest regional loss, reflecting their direct exposure to the US market and their close integration into North American production networks. Complete country-level static and dynamic welfare results are reported in the Online Appendix.

A positive terms-of-trade contribution and additional tariff revenue offset higher imported-input costs and weaker foreign demand. The result therefore does not imply that unilateral protection is costless.

Table 3: Static welfare effects and the contribution of the GVC mechanisms across tariff scenarios

Region	S1	S2	S3	S4
Panel A: Static welfare changes (%)				
China	-0.519	-0.383	-0.514	-0.335
United States	0.534	-0.401	-0.395	-0.404
Mexico and Canada	-2.863	-2.321	-2.316	-2.323
ASEAN	-0.410	-0.323	-0.192	-0.364
European Union	-0.157	-0.084	0.072	-0.019
Rest of the world	-0.234	-0.161	-0.167	-0.175
Panel B: Full-GVC minus No-GVC welfare effects (percentage points)				
China	-0.004	-0.004	-0.003	-0.005
United States	0.006	0.032	0.032	0.033
Mexico and Canada	0.048	0.053	0.055	0.054
ASEAN	-0.003	-0.010	-0.011	-0.008
European Union	-0.007	-0.012	-0.015	-0.016
Rest of the world	-0.004	-0.011	-0.009	-0.008

Notes: Panel A reports percentage changes in long-run real income relative to the common baseline equilibrium. Panel B reports the static welfare effect in the full model minus the corresponding effect when both input–output substitution and foreign value-added adjustment are shut down. A positive entry in Panel B indicates that welfare is higher in the Full-GVC specification than in the No-GVC specification. When the policy effect is negative, a positive entry cushions the loss; when the policy effect is positive, it amplifies the gain. A negative entry has the opposite interpretation. Regional values are base-income-weighted averages of country-level outcomes.

Source: Authors' calculations.

Cross-scenario comparison (S1–S4):

Comprehensive retaliation reverses the modest US welfare gain into a loss. US welfare changes from

0.534% in S1 to −0.401% in S2 as retaliatory tariffs weaken foreign demand for US products and offset the tariff-revenue and relative-price benefits of unilateral escalation. Mexico and Canada remain the most adversely affected region in every scenario.

Moving from S2 to S3 shows how unilateral selective tariff easing redistributes welfare towards third-market suppliers. China's elimination of tariffs on imports from the EU and ASEAN improves EU welfare from −0.084% to 0.072% and reduces the aggregate ASEAN loss from 0.323% to 0.192%. China itself experiences a larger loss, however, because part of the benefit of unilateral tariff easing accrues to foreign suppliers, while domestic producers face stronger import competition and tariff revenue declines.

Moving from S3 to S4 shows that reciprocal tariff elimination does not generate uniform gains among the participating economies. China's welfare improves from −0.514% to −0.335%, but the EU moves from a small gain to a result close to baseline, while the aggregate ASEAN loss increases. These differences reflect sectoral composition, bilateral exposure, import competition, and trade diversion within the preferential network.

Supplier reallocation and foreign input dependence:

Table 4 separates two distinct sourcing margins. Panel A reports TVD, which measures reallocation across foreign suppliers. Panel B reports the change in ICE, a proxy for input import dependence based on the foreign share of sectoral purchases.

Table 4: Sourcing reallocation and GVC adjustment across tariff scenarios

Region	S1	S2	S3	S4
Panel A: Import-share reallocation, TVD (%)				
China	3.81	5.95	7.07	6.72
United States	13.57	13.44	13.15	13.45
Mexico and Canada	8.05	23.74	23.75	23.73
ASEAN	2.79	4.82	4.84	5.03
European Union	5.11	7.17	7.26	8.37
Rest of the world	4.14	5.42	5.44	5.42
Panel B: Change in foreign input dependence (percentage points)				
China	-0.39	-0.54	-0.38	-0.21
United States	-1.72	-2.54	-2.54	-2.54
Mexico and Canada	-2.12	-3.07	-3.08	-3.08
ASEAN	-0.14	-0.28	-0.21	-0.06
European Union	-0.10	-0.24	-0.14	-0.04
Rest of the world	-0.18	-0.30	-0.30	-0.31
Panel C: Change in foreign value-added share (percentage points)				
China	-0.136	-0.262	-0.211	-0.172
United States	-0.174	-0.305	-0.305	-0.306
Mexico and Canada	-0.498	-1.139	-1.141	-1.138
ASEAN	-0.064	-0.128	-0.111	-0.088
European Union	-0.081	-0.145	-0.111	-0.098
Rest of the world	-0.068	-0.128	-0.130	-0.131
Panel D: Change in GVC depth (percentage points)				
China	-0.010	-0.019	-0.015	-0.013
United States	-0.019	-0.033	-0.033	-0.033
Mexico and Canada	-0.049	-0.112	-0.112	-0.112
ASEAN	-0.006	-0.012	-0.011	-0.009
European Union	-0.008	-0.014	-0.011	-0.010
Rest of the world	-0.007	-0.012	-0.012	-0.012

Notes: Panel A reports 100 times the total variation distance between baseline and counterfactual foreign-partner import shares. It can be interpreted as the percentage of foreign import shares that must be reallocated to move from the baseline distribution to the counterfactual distribution. Panel B reports 100 times the change in ICE and is expressed in percentage points. Panels C and D report changes in the foreign value-added share and GVC depth, respectively, in percentage points. All scenarios use the same baseline equilibrium, country and sector coverage, partner definitions, and regional aggregation weights. Panels A and B use baseline-income weights, whereas Panels C and D use baseline gross-output weights.

Source: Authors' calculations.

Under S1, the United States records the largest foreign-partner reallocation, at 13.57%, while its overall foreign input dependence falls by 1.72 percentage points. Moving from S1 to S2 produces the largest increase in TVD in Mexico and Canada, where TVD rises from 8.05% to 23.74%. By contrast, selective tariff easing in S3 and S4 generates more moderate changes in TVD in China, the EU, and ASEAN.

All four scenarios reduce foreign input dependence, but the magnitude differs substantially across regions. The largest reductions occur in Mexico and Canada and the United States, whereas the EU and ASEAN display smaller changes. TVD and ΔICE therefore should not be interpreted interchangeably: an economy may substantially change the identity of its foreign suppliers without an equally large change in its aggregate reliance on foreign inputs.

Foreign value-added shares respond more visibly than GVC depth, especially in Mexico and Canada

under retaliation. Changes in GVC depth remain small in all regions and scenarios. Tariffs therefore alter the location, concentration, and foreign content of sourcing more strongly than the overall intermediate-input intensity of production.

The HHI results reported in the Online Appendix indicate greater diversification in the United States and Mexico and Canada, but modest increases in concentration in the EU and ASEAN under some selective-easing scenarios. A change in supplier concentration need not move one-for-one with welfare, because the prices and production roles of the affected suppliers also matter.

The comparison with the No-GVC specification shows that the two GVC mechanisms have modest effects on aggregate regional welfare but generate meaningful heterogeneity across economies. As shown in Panel B of Table 3, their regional welfare contribution ranges from approximately -0.016 to 0.055 percentage points. They slightly cushion the losses in Mexico and Canada and, under retaliation, in the United States, while modestly lowering welfare in the EU, ASEAN, and the rest of the world. Their main role is therefore to alter the composition and foreign content of sourcing rather than to overturn the regional welfare ranking.

The relatively large losses of highly trade-exposed economies should not be interpreted as evidence that these economies would benefit from becoming less open through protectionism. Supplier diversification can reduce concentrated dependence while preserving access to efficient foreign inputs, whereas protectionism raises input costs, weakens gains from specialization, and invites retaliation.

4.3 Dynamic welfare and medium-run divergence

The static results show that the four tariff scenarios generate heterogeneous changes in real income and sourcing patterns, while changes in aggregate GVC depth remain comparatively small. We now examine how these long-run trade effects translate into welfare over the transition once capital adjustment is incorporated. The dynamic block does not interpret the trade-induced real-income change as a structural change in technology. Instead, it represents the combined effects of wages, prices, tariff revenue, trade volumes, and sourcing costs through a permanent productivity-equivalent efficiency wedge. This reduced-form mapping allows the one-sector dynamic model to reproduce the long-run real-income effect from the trade block while tracing the associated paths of consumption, output, investment, and capital.

Table 5 and Figure 1 report comparable regional lifetime consumption-equivalent variation (CEV) for all four scenarios. Two patterns stand out. First, dynamic welfare preserves the signs and broad regional ranking of the static welfare effects. Second, the absolute CEV effects are generally smaller than the corresponding long-run static effects. Changes in the average return to capital have the same sign as the welfare response but are modest in magnitude. The long-run real-income effect remains the input into the dynamic block,

while the endogenous return response governs the subsequent adjustment of investment and capital.[6]

Table 5: Dynamic welfare and changes in the average return to capital by region (S1–S4)

	S1		S2		S3		S4	
Region	CEV (%)	$\Delta\overline{r}$ (p.p.)	CEV (%)	$\Delta\overline{r}$ (p.p.)	CEV (%)	$\Delta\overline{r}$ (p.p.)	CEV (%)	$\Delta\overline{r}$ (p.p.)
Panel A: Full-GVC dynamic outcomes								
China	-0.423	-0.011	-0.312	-0.008	-0.419	-0.011	-0.273	-0.007
United States	0.459	0.013	-0.345	-0.010	-0.340	-0.010	-0.347	-0.010
Mexico and Canada	-2.355	-0.062	-1.908	-0.050	-1.903	-0.050	-1.910	-0.050
ASEAN	-0.343	-0.010	-0.271	-0.008	-0.160	-0.005	-0.305	-0.009
European Union	-0.130	-0.004	-0.071	-0.002	0.057	0.001	-0.018	-0.001
Rest of the world	-0.194	-0.005	-0.134	-0.004	-0.139	-0.004	-0.146	-0.004
Panel B: Full-GVC minus No-GVC lifetime CEV (percentage points)								
China	-0.003		-0.003		-0.003		-0.004	
United States	0.006		0.027		0.028		0.028	
Mexico and Canada	0.039		0.044		0.045		0.045	
ASEAN	-0.003		-0.008		-0.009		-0.007	
European Union	-0.006		-0.010		-0.013		-0.013	
Rest of the world	-0.004		-0.009		-0.008		-0.007	

Notes: Panel A reports lifetime CEV and the change in the average return to capital over the 20-year numerical transition. Lifetime CEV includes the discounted steady-state continuation value after the numerical transition. Panel B reports the full-model CEV minus the corresponding CEV when both input–output substitution and foreign value-added adjustment are shut down. Positive entries in Panel B indicate that welfare is higher in the Full-GVC specification than in the No-GVC specification. When the policy effect is negative, a positive entry cushions the loss; when the policy effect is positive, it amplifies the gain. Negative entries have the opposite interpretation. Regional outcomes are aggregated using baseline-income weights proportional to $w_n L_n + R_n + D_n$.

Source: Authors' calculations.

[6]Construction details for $\Delta\overline{r}$ are reported in Appendix E.

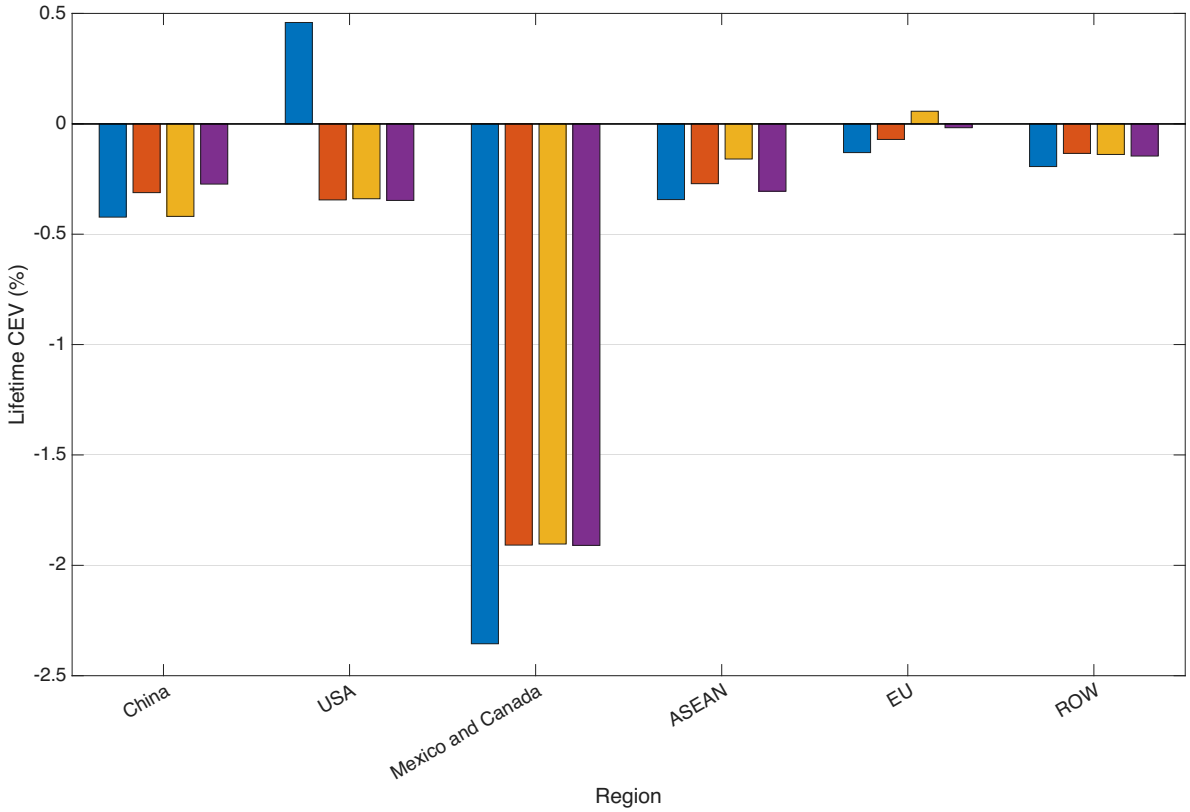


Figure 1: Lifetime consumption-equivalent variation by region across scenarios. Within each region, the bars correspond to S1–S4 from left to right.

The transition paths under unilateral escalation in Figure 2 are consistent with the corresponding long-run welfare effects. The United States experiences a modest and persistent increase in consumption and output, accompanied by gradual capital accumulation. This joint increase does not arise because tariffs directly raise US technology. Rather, the positive long-run real-income effect from the trade block is represented by a positive productivity-equivalent efficiency wedge in the dynamic mapping. Because the wedge raises available resources on impact, output can increase while the capital stock is initially predetermined. The increase in output exceeds the increase in consumption, so investment also rises and capital accumulates gradually over the transition.

Mexico and Canada display the largest and most persistent contraction in consumption, capital, and output. China, ASEAN, the EU, and the rest of the world also record negative but more moderate adjustment paths. The corresponding lifetime CEVs are 0.459% for the United States, −2.355% for Mexico and Canada, −0.423% for China, −0.343% for ASEAN, −0.130% for the EU, and −0.194% for the rest of the world.

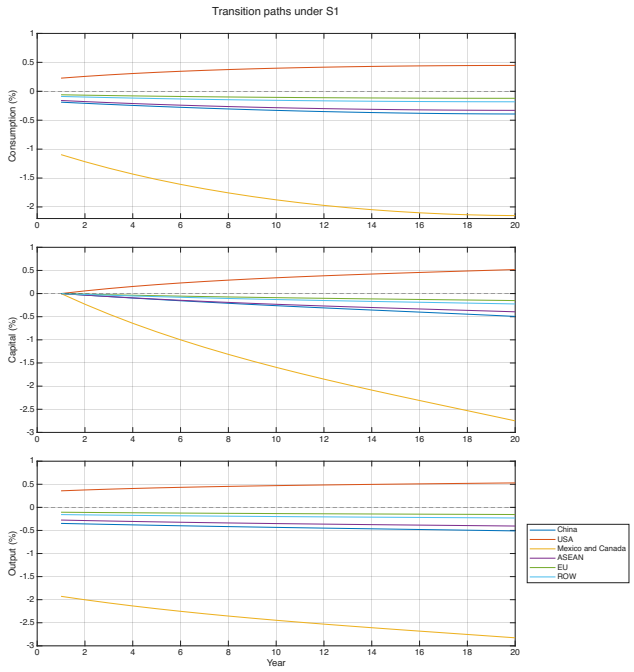


Figure 2: Transition paths under S1 (six-region aggregation). Lines show percentage deviations from their respective baseline paths.

The cross-scenario comparison shows how retaliation and selective tariff easing alter the dynamic incidence of the policy shock. Moving from S1 to S2, comprehensive retaliation reverses the modest US dynamic welfare gain. US lifetime CEV changes from 0.459% to −0.345% as retaliatory tariffs weaken foreign demand for US products and offset the positive long-run real-income effect generated under unilateral escalation.

The losses in China, Mexico and Canada, ASEAN, the EU, and the rest of the world become smaller in absolute value than under S1, indicating that retaliation redistributes part of the burden towards the initiating economy. Mexico and Canada nevertheless remain the most adversely affected region.

The US result changes only marginally across S2–S4 because all three scenarios retain the retaliatory tariffs imposed on US exports. The additional policy changes in S3 and S4 occur mainly within the China–EU–ASEAN bloc and affect the United States primarily through indirect general-equilibrium spillovers.

Moving from S2 to S3, China's unilateral tariff elimination towards the EU and ASEAN generates a positive EU CEV and reduces the ASEAN loss, while China's own dynamic welfare deteriorates. EU CEV rises from −0.071% to 0.057%, ASEAN improves from −0.271% to −0.160%, and China falls from −0.312% to −0.419%.

The effects on the United States, Mexico and Canada, and the rest of the world are comparatively small.

Moving from S3 to S4, reciprocal tariff elimination improves China's dynamic welfare but does not produce uniform gains among the participating economies. China's CEV improves from −0.419% to −0.273%. The EU moves from a small gain to a result close to baseline, while the ASEAN loss increases from 0.160%

to 0.305%. As in the static results, selective tariff easing redistributes welfare across participating economies rather than uniformly eliminating the costs of escalation.

These comparisons clarify the relationship between static reallocation and dynamic adjustment. The dynamic block does not generate a separate welfare ranking that overturns the trade model's long-run effects. Instead, the productivity-equivalent mapping translates those effects into gradual adjustments in consumption, investment, output, and capital. Capital accumulation spreads the adjustment over time. The Full-GVC results are numerically stable when the transition horizon is extended from 20 to 30 and 50 years; across all regions and scenarios, the maximum absolute difference between the 20- and 50-year lifetime CEV estimates is 0.0016 percentage points.

The dynamic comparison with the No-GVC specification leads to the same broad conclusion as the static comparison. GVC adjustment has a modest effect on aggregate regional welfare but changes the incidence of the transition across economies. As shown in Panel B of Table 5, the GVC mechanisms cushion the dynamic losses in Mexico and Canada by approximately 0.04–0.05 percentage points and modestly cushion the US effect under retaliation. They slightly lower welfare in China, ASEAN, the EU, and the rest of the world.

The GVC margins, therefore, affect the distribution and composition of dynamic adjustment without overturning the principal cross-scenario welfare ranking. These dynamic results should consequently be interpreted as conditional on the reduced-form productivity-equivalent mapping rather than as evidence that tariff policy directly changes underlying technology.

4.4 Bilateral transmission channels

Welfare differences across scenarios cannot be inferred from aggregate reallocation alone. Figures 3 and 4 report the bilateral first-order quantity and price contributions using six-region heatmaps and common baseline bilateral exposure weights M_{ni}^0. To make the policy mechanisms directly comparable, the four panels report sequential changes: unilateral US escalation relative to the baseline, retaliation relative to S1, unilateral Chinese tariff easing relative to S2, and reciprocal China–EU–ASEAN tariff easing relative to S3.[7] Rows denote importing regions and columns denote exporting regions; the ToT term includes both export- and import-price contributions for each pair. Each cell is a baseline-import-weighted average of bilateral accounting contributions rather than a stand-alone welfare effect, and the heatmap cells do not sum to regional welfare.

Figure 3 shows that bilateral VoT contributions are concentrated in a limited number of economically important corridors. Under S1, the largest negative quantity contribution occurs for Mexico and Canada importing from the United States, at -0.086 percentage points. Other negative US-export contributions

[7] For details on the aggregation of the heatmaps, see Appendix F.4.

arise for ASEAN, China, ROW, and the EU, at −0.069, −0.041, −0.038, and −0.027 percentage points, respectively. At the same time, positive contributions appear in ASEAN, the EU, and ROW imports from China, at approximately 0.013, 0.010, and 0.013 percentage points. The first panel therefore indicates that unilateral US escalation compresses several US-centred trade corridors while redirecting part of the quantity adjustment towards alternative Chinese supply links.

Moving from S1 to S2, retaliation reinforces quantity compression in corridors involving US exports and produces compensating reallocation towards alternative suppliers. The most negative additional VoT contribution occurs for Mexico and Canada importing from the United States, at −0.111 percentage points, while China importing from the United States records an additional contribution of −0.041 percentage points. Mexico and Canada simultaneously record a positive contribution of 0.042 percentage points from imports originating in China.

Relative to S2, China's unilateral tariff elimination in S3 raises the quantity contribution of its imports from the EU and ASEAN by approximately 0.010 and 0.003 percentage points. Positive general-equilibrium reallocation is also visible in ASEAN and EU imports from China, at approximately 0.010 and 0.007 percentage points. When tariff elimination becomes reciprocal in S4, the quantity response becomes considerably more concentrated in Chinese exports to the participating partners: the VoT contributions associated with ASEAN and EU imports from China increase by approximately 0.083 and 0.048 percentage points.

Figure 4 reports the corresponding bilateral price contributions. In the escalation and retaliation panels, the largest bilateral price contributions are substantially larger in absolute value than the corresponding quantity contributions, so the price channel cannot be characterized as uniformly secondary. Under S1, the largest negative ToT contribution occurs for Mexico and Canada in their trade with the United States, at −3.121 percentage points. Negative contributions are also observed for ASEAN, the EU, ROW, and China in their trade with the United States, at −0.917, −0.412, −0.394, and −0.294 percentage points. By contrast, the United States records positive bilateral ToT contributions in trade with Mexico and Canada and with China, at 0.201 and 0.165 percentage points, respectively, together with smaller positive contributions in trade with ASEAN, the EU, and ROW. These offsetting price effects help explain why unilateral escalation generates a modest positive aggregate US welfare effect while imposing substantially larger losses on closely connected partners.

Moving from S1 to S2 reverses much of the price incidence associated with US-centred trade corridors and shifts part of the welfare burden towards the initiating economy. The additional ToT contribution becomes positive for Mexico and Canada, ASEAN, the EU, ROW, and China in their trade with the United States, with the largest values occurring for Mexico and Canada and ASEAN, at 2.423 and 0.671 percentage points. Conversely, the additional ToT contributions for US trade with Mexico and Canada and China become

negative, at −0.155 and −0.111 percentage points. This reversal is consistent with the aggregate finding that comprehensive retaliation eliminates and then reverses the modest US welfare gain generated under unilateral escalation.

The price effects associated with selective tariff easing are smaller and more geographically concentrated than those associated with escalation and retaliation. Under S3, positive ToT contributions are concentrated in trade with China for ASEAN, the EU, Mexico and Canada, and ROW, at approximately 0.143, 0.052, 0.041, and 0.029 percentage points. China, in contrast, records negative price contributions in trade with the United States, the EU, ASEAN, and ROW. Under S4, the strong quantity expansion in ASEAN and EU imports from China is accompanied by negative ToT contributions of approximately −0.163 and −0.047 percentage points. Smaller negative contributions also occur for Mexico and Canada, ROW, and the United States in their trade with China. The same bilateral corridor can therefore generate a positive quantity contribution and an offsetting negative price contribution.

This interaction explains why reciprocal tariff easing can substantially increase trade within the preferential network without producing uniform welfare gains for all participating regions. In particular, the negative S4 price contribution more than offsets the positive quantity contribution on the China-to-ASEAN corridor and almost entirely offsets it on the China-to-EU corridor. Conversely, China records positive S4 ToT contributions in trade with the United States, the EU, ASEAN, and ROW, although the associated quantity changes are comparatively small.

Unilateral escalation primarily affects US-centred corridors; retaliation reverses part of the associated price incidence and redirects quantities towards alternative suppliers; unilateral Chinese tariff easing strengthens selected China–EU–ASEAN links; and reciprocal tariff elimination produces a much larger expansion in EU and ASEAN imports from China. The evidence also shows why aggregate reallocation measures such as TVD or the total change in foreign input dependence cannot by themselves determine welfare. Welfare depends on the direction of bilateral adjustment, the baseline exposure of each corridor, and whether quantity expansion is reinforced or offset by the corresponding price contribution.

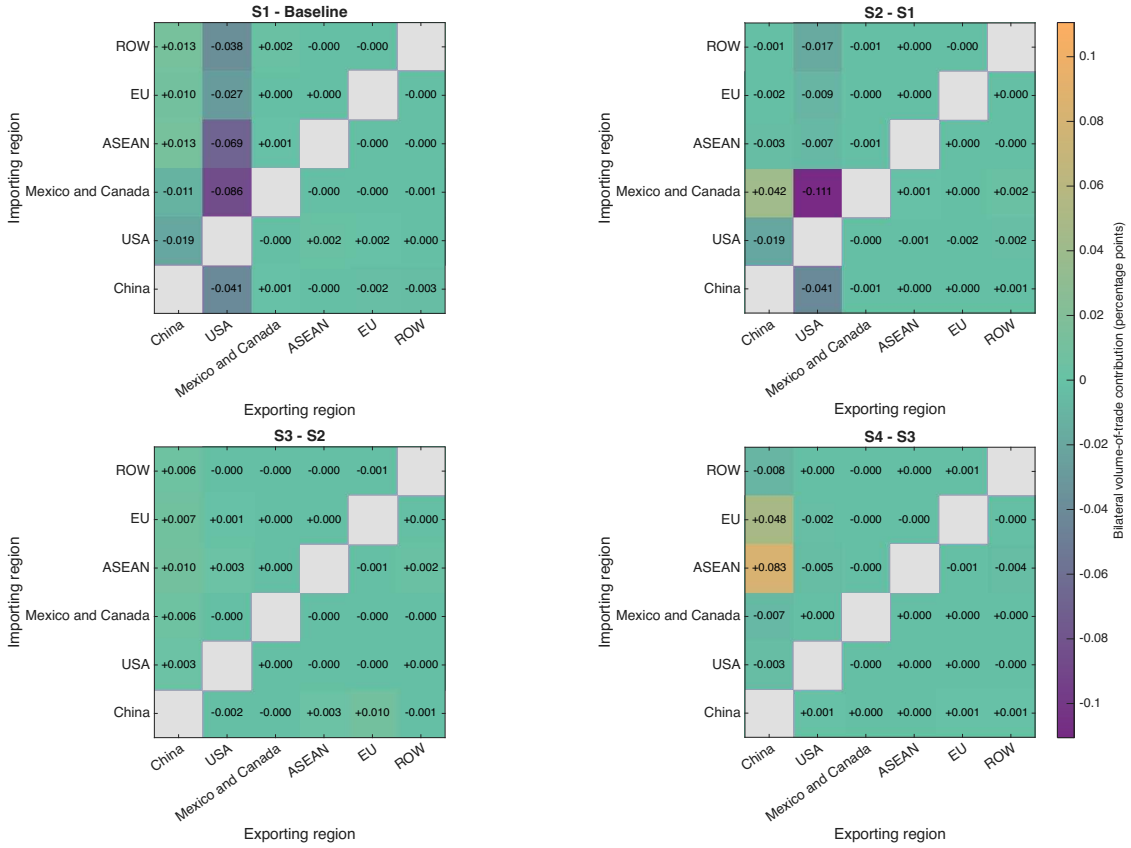


Figure 3: Sequential changes in bilateral volume-of-trade contributions (six-region aggregation). Rows denote importing regions and columns denote exporting regions. Bilateral contributions are aggregated using common baseline import weights M_{ni}^0. The panels report S1 minus the baseline, S2 minus S1, S3 minus S2, and S4 minus S3. All panels use a common colour scale, diagonal elements are masked, and values are reported in percentage points.

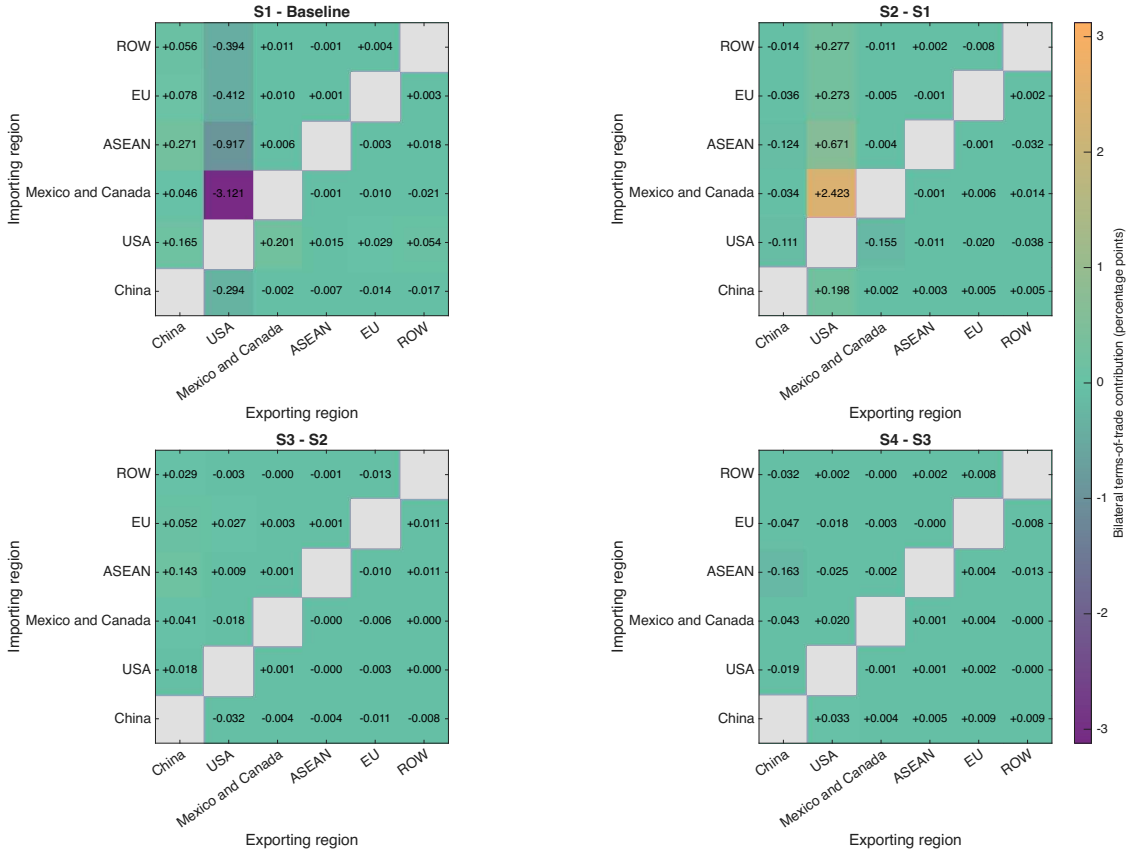


Figure 4: Sequential changes in bilateral terms-of-trade contributions (six-region aggregation). Rows denote importing regions and columns denote exporting regions. Bilateral contributions are aggregated using common baseline import weights M_{ni}^0. The panels report S1 minus the baseline, S2 minus S1, S3 minus S2, and S4 minus S3. All panels use a common colour scale, diagonal elements are masked, and values are reported in percentage points.

4.5 Bilateral sourcing re-anchoring

Tariff escalation changes not only the overall extent of supplier reallocation but also the bilateral sourcing relationships around which trade is organized. Figure 5 presents the 41-country network of changes in foreign import-partner shares relative to the common baseline. Directed edges run from exporting to importing economies, so an expansion indicates that the exporter becomes more important in the importer's foreign sourcing portfolio. This measure captures bilateral sourcing reallocation.

The four panels reveal distinct forms of re-anchoring across the policy sequence. Under S1, unilateral US tariff escalation weakens several established US-centred sourcing links. The United States reduces the shares sourced from China and Mexico and Canada, while several foreign economies reduce the importance of the United States in their own import portfolios and increase sourcing from alternative suppliers. The first scenario therefore generates broad supplier substitution, but the replacement partners differ across importing economies.

Moving from S1 to S2, retaliation deepens the compression of US-centred links and spreads the adjustment across a wider set of trading partners. The strongest reductions are concentrated in imports previously sourced from the United States, while China, the European Union, and the rest of the world gain importance as alternative suppliers for several affected economies. This pattern shows that retaliation does not simply offset the initiating tariff at the bilateral level; it changes the ranking of suppliers across the wider network.

Moving from S2 to S3, China's unilateral tariff easing towards the European Union and ASEAN further redirects sourcing towards those partners. The full bilateral results show that China's import shares sourced from the EU and ASEAN rise relative to the baseline, while China also becomes a more important supplier to several economies within the two regions. Moving from S3 to S4, reciprocal tariff easing strengthens this re-anchoring further, with the clearest expansions concentrated in China–EU and China–ASEAN sourcing relationships. Selective liberalization, therefore, changes the direction of network adjustment rather than restoring the pre-escalation allocation.

A persistent feature across all four scenarios is the weakening of the direct China–USA sourcing relationship. The US share sourced from China remains below baseline in every scenario, while China's share sourced from the United States declines more strongly once retaliation is introduced and remains compressed under S3 and S4. Later preferential tariff changes among China, the EU, and ASEAN therefore do not restore the original bilateral relationship.

The network response should not be interpreted as a uniform movement towards greater diversification. Some economies replace a dominant supplier with a broader set of alternatives, whereas selective tariff easing can increase the importance of a smaller group of preferential partners. Bilateral re-anchoring may therefore involve either diversification or renewed concentration, depending on the direction of the tariff change and the importer's initial sourcing structure.

These results help explain why similar aggregate values of TVD can coexist with different welfare outcomes. The welfare consequences of supplier reallocation depend not only on how much trade is reassigned but also on the cost, sectoral composition, and production role of the replacement suppliers. Reallocation towards efficient alternative inputs may cushion the shock, whereas substitution towards higher-cost or less suitable suppliers may reduce welfare even when dependence on the original partner falls.

The sourcing-network evidence is consistent with the bilateral decomposition in Section 4.4. Escalation and retaliation primarily compress US-centred corridors, while unilateral and reciprocal tariff easing strengthen selected China–EU–ASEAN links. The network figure therefore identifies where sourcing shares are re-anchored, whereas the bilateral ToT and VoT decomposition shows whether the associated welfare contribution operates through quantities, relative prices, or both.

For readability, Figure 5 displays fifteen large bilateral partner-share changes in each scenario, selected

using the threshold and degree constraints described in the caption, with identical country positions and a common edge-width scale across panels. The exact edges displayed in Figure 5 are reported in the Online Appendix, while the complete country-pair changes are retained in the underlying replication files.

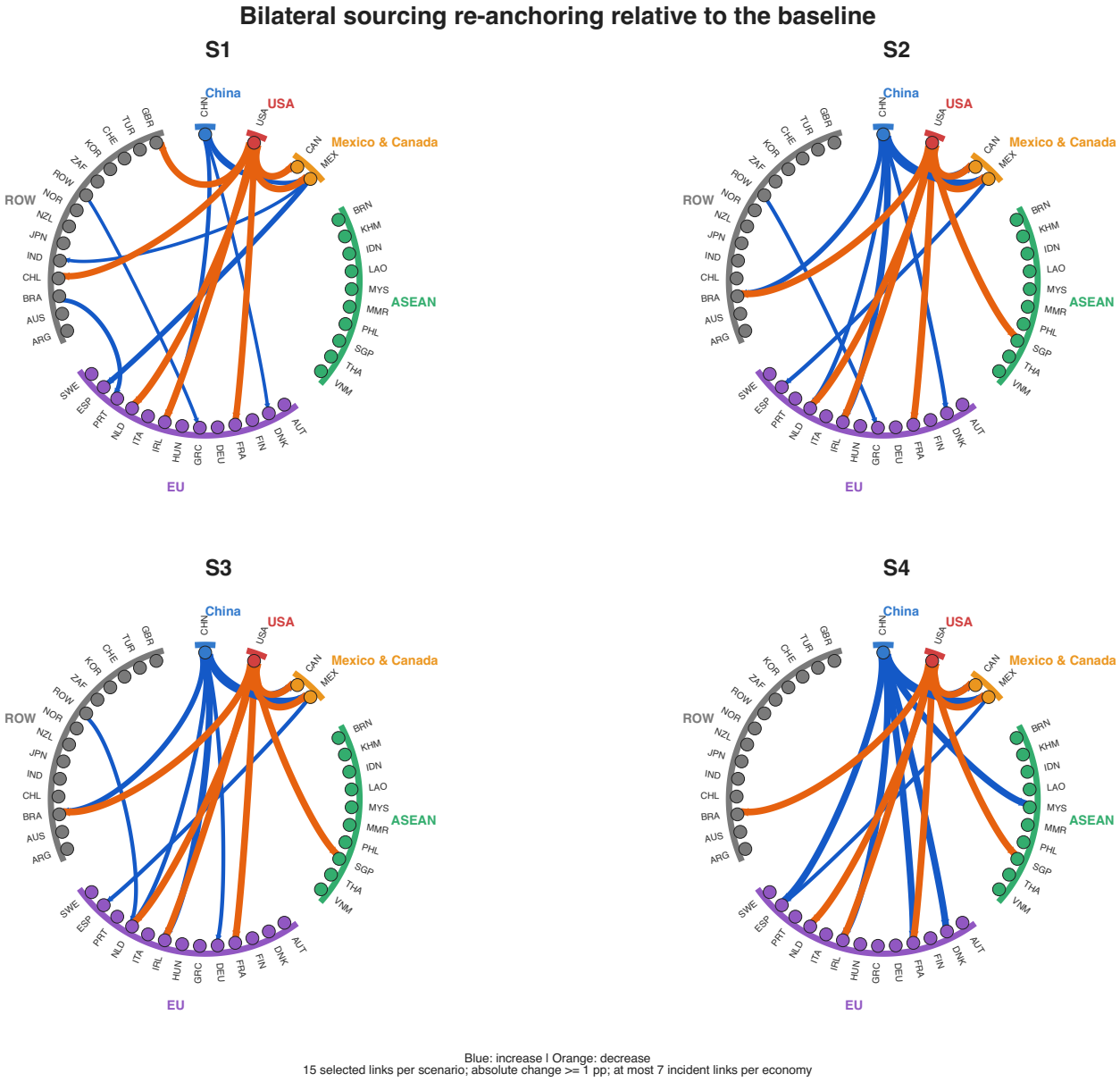


Figure 5: Changes in bilateral sourcing shares relative to the baseline across 41 economies under S1–S4. Arrows run from exporters to importers. Blue (orange) indicates an increase (decrease) in the exporter's share of the importer's total imports. Each panel shows 15 links selected in descending order of absolute change, subject to a minimum change of one percentage point and a maximum of seven links per economy. Node positions are fixed across panels, and line widths reflect absolute changes on a common capped scale.

5 Conclusion

This paper develops a two-block quantitative framework to evaluate renewed tariff escalation, retaliation, and selective tariff easing, together with the associated reconfiguration of trade and global value chains. The first block is a multi-country, multi-sector Eaton–Kortum environment with input–output linkages, substitution across intermediate inputs, and an endogenous foreign value-added margin. For each tariff scenario, it determines the long-run equilibrium in wages, prices, trade shares, sourcing patterns, foreign value-added exposure, and welfare. The second block translates the long-run real-income effect into transition paths for consumption, investment, output, capital, and the return to capital. This link is implemented through a permanent productivity-equivalent efficiency wedge in a reduced-form dynamic mapping. It should not be interpreted as a structural claim that tariff policy directly changes underlying technology.

Three main findings emerge. First, unilateral US tariff escalation under S1 generates meaningful but highly heterogeneous welfare and sourcing responses. The United States records a modest static welfare gain of 0.534%, whereas China, the EU, ASEAN, the rest of the world, and especially Mexico and Canada experience losses. Bilateral sourcing adjustment is concentrated in a limited number of economically important corridors rather than being uniformly distributed across all partners. The modest positive US welfare effect reflects offsetting general-equilibrium forces: additional tariff revenue and favourable relative-price effects offset higher imported-input costs and weaker foreign demand. This result therefore does not imply that unilateral protection is costless.

Second, the sequential comparison from S1 to S4 shows that the incidence of the policy shock depends critically on retaliation and on the direction of selective tariff easing. Moving from S1 to S2, comprehensive retaliation reverses the modest US gain and redistributes part of the burden towards the initiating economy rather than producing a uniform deterioration in every region. US static welfare changes from 0.534% to -0.401%, while Mexico and Canada remain the most adversely affected region. Moving from S2 to S3, China's unilateral tariff easing towards the EU and ASEAN improves the outcomes of those partners but increases China's own welfare loss. Moving from S3 to S4, reciprocal tariff easing improves China's position relative to S3 but does not generate uniform gains across the participating economies. The EU moves from a small gain under S3 to a result close to baseline under S4, while the aggregate ASEAN loss increases. Selective liberalization, therefore, redistributes the costs of escalation rather than automatically eliminating them.

Third, tariff policy changes both the scale and direction of bilateral sourcing. Escalation and retaliation compress several US-centred sourcing relationships, while S3 and S4 strengthen selected China–EU–ASEAN links. The direct China–US sourcing relationship remains below its baseline importance across all four

scenarios. At the same time, reciprocal tariff easing in S4 produces more visible re-anchoring towards Chinese supply in the EU and ASEAN. These results show that aggregate reallocation measures alone cannot determine welfare: the effect depends on which partners replace the original supplier, the sectors in which substitution occurs, and whether the new sourcing pattern preserves input efficiency.

The dynamic results preserve the signs and broad regional ranking of the long-run static welfare effects, but their absolute magnitudes are generally smaller. Under S1, lifetime CEV is 0.459% in the United States and −2.355% in Mexico and Canada, with more moderate losses elsewhere. Moving from S1 to S2 reverses the US dynamic welfare gain, while the US result changes only marginally across S2–S4 because all three scenarios retain retaliatory tariffs on US exports. The additional policy changes in S3 and S4 operate primarily within the China–EU–ASEAN bloc and affect the United States mainly through indirect general-equilibrium spillovers. Capital adjustment spreads the long-run real-income effect over time. The Full-GVC results are also stable when the numerical transition horizon is extended from 20 to 30 and 50 years.

The GVC results refine this interpretation. Foreign value-added shares respond more visibly than aggregate GVC depth under the calibrated adjustment rules. Comparing the full model with the No-GVC specification shows that the two GVC mechanisms have modest effects on aggregate regional welfare but meaningful effects on the incidence of adjustment across economies. In the static results, the Full-GVC minus No-GVC contribution ranges from approximately −0.016 to 0.055 percentage points across regions and scenarios; the corresponding dynamic contribution ranges from approximately −0.013 to 0.045 percentage points. The mechanisms modestly cushion the losses in Mexico and Canada and, under retaliation, in the United States, while slightly lowering welfare in several other regions. They therefore alter the composition and distribution of adjustment without overturning the principal regional welfare ranking.

The bilateral welfare decomposition further shows that the relative importance of the price and quantity channels is scenario-dependent. Under unilateral escalation and retaliation, the largest bilateral terms-of-trade contributions along US-centred corridors are quantitatively larger than the corresponding volume contributions. Under selective and reciprocal tariff easing, quantity rerouting within the China–EU–ASEAN group becomes more visible. A positive quantity response may also be partly offset by an adverse price contribution on the same corridor. The welfare consequences of trade reallocation, therefore, cannot be characterized as operating uniformly through either prices or quantities alone.

The findings have three policy implications. First, unilateral tariff escalation can generate substantial supplier substitution and input-cost adjustment even when the initiating economy records a small aggregate gain. Second, retaliation is pivotal because it weakens foreign demand for the initiating country's products and substantially reduces the scope for sustaining any unilateral benefit. Third, selective tariff easing can redirect trade towards preferential partners, but its gains are uneven and may create new concentrations

of dependence. The relatively large losses of highly trade-exposed economies should not be interpreted as evidence that they would benefit from becoming less open through protectionism. Supplier diversification can reduce concentrated dependence while preserving access to efficient foreign inputs, whereas protectionism raises input costs, weakens gains from specialization, and invites retaliation. Resilience policies should therefore distinguish diversification across efficient suppliers from abrupt reshoring or broad-based import restrictions.

Several limitations point to future research. The dynamic block is a reduced-form transition mapping rather than a fully integrated dynamic multi-country trade model. It abstracts from sector-specific capital, endogenous labour supply, firm and household heterogeneity, and the gradual updating of trade shares during the transition. A richer framework could allow tariff-induced sourcing changes, sectoral investment, and capital accumulation to evolve jointly over time. Future work could also combine the bilateral sourcing measures used here with path-based value-added accounting to distinguish changes in direct import-partner shares from indirect production routes through specific intermediary countries. These extensions would provide a tighter link between the gradual reorganization of global value chains and its distributional and intertemporal welfare consequences.

Supplementary Material

Supplementary material is available on the OUP website. It includes the online appendix, replication data, and MATLAB code.

Funding

No funding was received for this study.

Conflict of Interest

The authors declare that they have no conflicts of interest.

Acknowledgements

We thank Sushanta K. Mallick, Managing Editor of *Oxford Economic Papers*, and two anonymous referees for their helpful comments and suggestions.

References

Afonso, A., Alves, J., Menescal, L., and Monteiro, S. (2026). Reduced-Form Correlates of Trade Partner Concentration: An Analysis for European Countries. *International Finance*, pages 1–17. Accessed 12 October 2026.

Ahn, J. and Tan, B. J. (2025). Supply Chain Diversification and Resilience. IMF Working Paper 2025/102, International Monetary Fund, Washington, DC. Accessed 12 October 2026.

Amiti, M., Redding, S. J., and Weinstein, D. E. (2019). The Impact of the 2018 Tariffs on Prices and Welfare. *Journal of Economic Perspectives*, 33:187–210.

Amiti, M., Redding, S. J., and Weinstein, D. E. (2020). Who's Paying for the US Tariffs? A Longer-Term Perspective. *AEA Papers and Proceedings*, 110:541–546.

André, M. C., Delanote, J., Aira Gutierrez, D., Harasztosi, P., and Weiss, C. (2024). Navigating Supply Chain Disruptions: New Insights into the Resilience and Transformation of EU Firms. Technical report, European Investment Bank, Luxembourg. Accessed 12 October 2026.

Antràs, P. and Chor, D. (2013). Organizing the Global Value Chain. *Econometrica*, 81:2127–2204.

Antràs, P. and Chor, D. (2022). Global Value Chains. In Gopinath, G., Helpman, E., and Rogoff, K., editors, *Handbook of International Economics*, volume 5, pages 297–376. Elsevier, Amsterdam. Accessed 12 October 2026.

Arriola, C., Cai, M., Kowalski, P., Miroudot, S., and van Tongeren, F. (2024). Towards Demystifying Trade Dependencies: At What Point Do Trade Linkages Become a Concern? OECD Trade Policy Papers 280, OECD Publishing, Paris. Accessed 12 October 2026.

Baqaee, D. R. and Farhi, E. (2019). The Macroeconomic Impact of Microeconomic Shocks: Beyond Hulten's Theorem. *Econometrica*, 87:1155–1203.

Benguria, F. and Saffie, F. (2020). The Impact of the 2018–2019 Trade War on U.S. Local Labor Markets. SSRN working paper No. 3542362, University of Kentucky, Lexington, KY, and University of Maryland, College Park, MD.

Beverelli, C., Keck, A., Larch, M., and Yotov, Y. V. (2024). Institutions, trade, and development: identifying the impact of country-specific characteristics on international trade. *Oxford Economic Papers*, 76:469–494.

Blanchard, E. J., Bown, C. P., and Chor, D. (2024). Did Trump's Trade War Impact the 2018 Election? *Journal of International Economics*, 148:103891.

Blaum, J., Lelarge, C., and Peters, M. (2018). The Gains from Input Trade with Heterogeneous Importers. *American Economic Journal: Macroeconomics*, 10:77–127.

Bressan, R. and Mattos, E. (2026). The Effect of Nontariff Barriers on Unreported Trade: Exploring a Customs Duty Reform. *Oxford Economic Papers*, 78:259–288.

Brutger, R., Chaudoin, S., and Kagan, M. (2023). Trade Wars and Election Interference. *The Review of International Organizations*, 18:1–25.

Caines, C. and Lahiri, A. (2025). Explaining World Savings. International Finance Discussion Papers 1416, Board of Governors of the Federal Reserve System, Washington, DC. Accessed 12 October 2026.

Caliendo, L. and Parro, F. (2015). Estimates of the Trade and Welfare Effects of NAFTA. *Review of Economic Studies*, 82:1–44.

Carvalho, V. M. (2014). From Micro to Macro via Production Networks. *Journal of Economic Perspectives*, 28:23–48.

Carvalho, V. M. and Tahbaz-Salehi, A. (2019). Production Networks: A Primer. *Annual Review of Economics*, 11:635–663.

Cavallo, A., Gopinath, G., Neiman, B., and Tang, J. (2021). Tariff Pass-Through at the Border and at the Store: Evidence from US Trade Policy. *American Economic Review: Insights*, 3:19–34.

Chen, Y., Fang, J., and Liu, D. (2023). The Effects of Trump's Trade War on U.S. Financial Markets. *Journal of International Money and Finance*, 134:102842.

Choi, B.-Y. and Nguyen, T. L. (2023). Trade Diversion Effects of the US–China Trade War on Vietnam. *Pacific Economic Review*, 28:570–588.

Coeurdacier, N., Guibaud, S., and Jin, K. (2015). Credit Constraints and Growth in a Global Economy. *American Economic Review*, 105:2838–2881.

Cui, C. and Li, L. S.-Z. (2021). The Effect of the US–China Trade War on Chinese New Firm Entry. *Economics Letters*, 203:109846.

Dhar, B. K., Le, T. T., Coffelt, T. A., and Shaturaev, J. (2023). US–China Trade War and Competitive Advantage of Vietnam. *Thunderbird International Business Review*, 65:255–263.

Dhyne, E., Kikkawa, A. K., Mogstad, M., and Tintelnot, F. (2021). Trade and Domestic Production Networks. *The Review of Economic Studies*, 88:643–668.

Eaton, J. and Kortum, S. (2002). Technology, Geography, and Trade. *Econometrica*, 70:1741–1779.

Eichengreen, B. and Irwin, D. A. (2010). The Slide to Protectionism in the Great Depression: Who Succumbed and Why? *Journal of Economic History*, 70:871–897.

European Commission (2024a). Commission Implementing Regulation (EU) 2024/2754 of 29 October 2024 imposing a definitive countervailing duty on imports of new battery electric vehicles designed for the transport of persons originating in the People's Republic of China. Accessed 12 October 2026.

European Commission (2024b). EU Imposes Duties on Unfairly Subsidised Electric Vehicles from China while Discussions on Price Undertakings Continue. Accessed 10 August 2026.

Evenett, S. J. (2019). The Smoot–Hawley Fixation: Putting the Sino–US Trade War in Contemporary and Historical Perspective. *Journal of International Economic Law*, 22:535–555.

Fajgelbaum, P. D., Goldberg, P. K., Kennedy, P. J., and Khandelwal, A. K. (2020). The Return to Protectionism. *Quarterly Journal of Economics*, 135:1–55.

Fajgelbaum, P. D. and Khandelwal, A. K. (2022). The Economic Impacts of the US–China Trade War. *Annual Review of Economics*, 14:205–228.

Finger, J. M. and Kreinin, M. E. (1979). A Measure of 'Export Similarity' and Its Possible Uses. *The Economic Journal*, 89:905–912.

Flaaen, A. and Pierce, J. R. (2026). Disentangling the Effects of the 2018–2019 Tariffs on a Globally Connected U.S. Manufacturing Sector. *The Review of Economics and Statistics*, 108:1289–1303.

Fujiy, B. C., Ghose, D., and Khanna, G. (2024). Production Networks and Firm-Level Elasticities of Substitution. Policy Research Working Paper 10782, World Bank, Washington, DC. Accessed 12 October 2026.

Goswami, S. (2020). Employment Consequences of U.S. Trade Wars. Working paper, University of California, Irvine, Irvine, CA.

Hall, C. and Hummel, T. (2025). China Spares Major Cognac Makers from EU Brandy Dumping Duties. Reuters. Accessed 12 October 2026.

Handley, K., Kamal, F., and Monarch, R. (2025). Rising Import Tariffs, Falling Exports: When Modern Supply Chains Meet Old-Style Protectionism. *American Economic Journal: Applied Economics*, 17:208–238.

He, C., Mau, K., and Xu, M. (2021). Trade Shocks and Firms' Hiring Decisions: Evidence from Vacancy Postings of Chinese Firms in the Trade War. *Labour Economics*, 71:102021.

Ho, F. U. M. (2026). Tariffs and innovation in a Schumpeterian economy with North–South technology transfer. *Oxford Economic Papers*, 78:42–67.

Ignatenko, A., Lashkaripour, A., Macedoni, L., and Simonovska, I. (2025). Making America Great Again? The Economic Impacts of Liberation Day Tariffs. *Journal of International Economics*, 157:104138.

Irwin, D. A. (2011). *Peddling Protectionism: Smoot–Hawley and the Great Depression*. Princeton University Press, Princeton, NJ.

Jiang, L., Lu, Y., Song, H., and Zhang, G. (2023). Responses of Exporters to Trade Protectionism: Inferences from the US–China Trade War. *Journal of International Economics*, 140:103687.

King, R. G. and Rebelo, S. T. (1999). Resuscitating Real Business Cycles. In Taylor, J. B. and Woodford, M., editors, *Handbook of Macroeconomics*, volume 1B, chapter 14, pages 927–1007. Elsevier, Amsterdam. Accessed 12 October 2026.

Kumar, A. and Mallick, S. (2026). Labor Market Effects of Exporter Pricing Behavior: Evidence from a Developing Economy. *Journal of Development Economics*, 181:103723.

Lin, H. C. (2026). A dynamic modelling approach to North-South disparities in IPR protection. *Oxford Economic Papers*, 78:132–156.

Mallick, S. and Marques, H. (2008). Passthrough of exchange rate and tariffs into import prices of India: currency depreciation versus import liberalization. *Review of International Economics*, 16:765–782.

McCorriston, S. and Sheldon, I. M. (1996). The Effects of Vertical Markets on Trade Policy Reform. *Oxford Economic Papers*, 48:664–672.

Oberfield, E. (2018). A Theory of Input–Output Architecture. *Econometrica*, 86:559–589.

Office of the United States Trade Representative (2020). Economic and Trade Agreement Between the Government of the United States of America and the Government of the People's Republic of China. Signed Jan. 15, 2020; provisions effective Feb. 14, 2020. Accessed 12 October 2026.

Saito, M. and Tokutsu, I. (2015). Revisiting the 'great trade collapse' with the endogenous input-choice model. *Oxford Economic Papers*, 67:1123–1145.

Sheng, L., Song, H., and Zheng, X. (2025). How Did Chinese Exporters Manage the Trade War? *Journal of International Money and Finance*, 153:103300.

The White House (2025a). Fact Sheet: President Donald J. Trump Declares National Emergency to Increase Our Competitive Edge, Protect Our Sovereignty, and Strengthen Our National and Economic Security. Announces a 10% universal tariff base and higher reciprocal rates. Accessed 12 October 2026.

The White House (2025b). Fact Sheet: President Donald J. Trump Modifies the Scope of Reciprocal Tariffs and Establishes Procedures for Implementing Trade Deals. Accessed 12 October 2026.

UNCTAD (2025). Key Statistics and Trends in International Trade 2024. Technical report, United Nations Conference on Trade and Development, Geneva. Accessed 12 October 2026.

Waugh, M. E. (2019). The Consumption Response to Trade Shocks: Evidence from the US–China Trade War. Working Paper 26353, National Bureau of Economic Research, Cambridge, MA. Accessed 12 October 2026.

Xinhua (2025). China expands zero-tariff policy for least developed countries. Ministry of Commerce of the PRC. Reproduced by the Ministry of Commerce of the PRC; policy took effect on 1 December 2024. Accessed 12 October 2026.