Quantifying Decoupling in Global Production and Trade [*]

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Abstract

We analyze the short- and long-run welfare implications of fragmentation in global trade and multinational production (MP). Combining a multi-country semi-endogenous growth model with bilateral trade and MP flow data, we back out changes in bilateral trade and MP costs. We classify countries based on changes in trade and MP costs with the US and China: some align with the same bloc in both dimensions, others maintain split alignments across dimensions, and many remain unaligned. We find that three-quarters of countries in our sample belong to a bloc in at least one dimension, with MP alignments proving more persistent than trade alignments. We document that global MP networks exhibit greater fragmentation than trade networks. Our counterfactual analysis reveals that more than half of countries with split alignments would experience long-run welfare losses from consolidating into a single bloc, despite some achieving short-run gains.

Keywords: Economic fragmentation, Multinational production, Trade blocs, Technology diffusion

JEL Classification: F14, F23, F43, O33

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1 Introduction

The global economy is reversing from decades of integration, as countries sort into economic blocs centered around major powers. While recent literature has documented this shift through rising trade barriers between blocs (Goldberg and Reed, 2023; Gopinath et al., 2025; Bonadio et al., 2025), it has overlooked multinational production. This omission matters as MP accounts for significant world output and shapes substantial global trade and serves as a primary channel for international technology diffusion (Ramondo and Rodríguez-Clare, 2013; Keller and Yeaple, 2013; Cai and Xiang, 2025; Lu et al., 2025). We fill this gap by examining both trade and multinational production channels of fragmentation, quantifying the growth and welfare consequences of such dual fragmentation.

We proceed in three steps. First, we lay out a semi-endogenous growth model of multinational production. Second, combining gravity equations with bilateral MP and trade flow data from 2000–2019, we back out changes in MP costs and trade costs for each country pair. Using these cost changes, we classify countries into blocs: those experiencing declining MP (trade) costs with the US but rising MP (trade) costs with China join the US MP (trade) bloc, and vice versa. We find substantial divergence. While some countries align with the US in the trade dimension, they maintain production ties with China. Third, we quantify the welfare and growth implications of this dual fragmentation through counterfactual analysis where countries with partial or split alignments achieve full bloc commitment. Our results show that bloc consolidation typically generates long-run welfare losses despite short-run gains for some economies, suggesting that split alignments may reflect optimal strategies rather than policy inefficiencies in the long run.

Building on Cai and Xiang (2025), we construct a dynamic multi-country model where knowledge stocks and bilateral costs jointly determine global trade and production patterns. Over time, knowledge stocks evolve through technology diffusion from both sellers and producers. We show how to combine the structural gravity equation with MP and trade flow data to back out trade costs in three steps. We first use the observed bilateral MP and trade data to solve for the unobserved trilateral trade flows within the model's framework. With these trilateral shares determined, we can then invert the model to back out the model-consistent knowledge stock for each country. Finally, combining these inferred knowledge stocks and real output per worker from data provides a complete set of constraints, allowing us to uniquely recover the full matrices of bilateral MP and trade costs that rationalize the observed data.

After recovering the costs, we document the evolution of global economic relationships through the lens of changes in MP and trade costs from 2000 to 2019, revealing a complex landscape of economic bloc formation around China and the United States. Using data spanning three distinct periods (2000-2005, 2005-2016, and 2016-2019), we classify countries into China blocs, US blocs, or unaligned categories based on changes in both MP costs and trade costs. Our analysis uncovers asymmetries between production and trade-based economic alignments: while trade-based classifications show most countries remaining unaligned with relatively balanced bloc memberships, MP-based classifications reveal a more fragmented world where more countries align with one of the two major powers. China consistently attracts more MP bloc members than the United States, whereas the US maintains more trade bloc members than China.

Our bloc classification reveals that countries often do not exhibit consistent alignment strategies across both MP and trade dimensions within the same period. Specifically, we observe a range of patterns: some countries simultaneously belong to the China MP bloc and the US trade bloc, others display the reverse, and many align with either China or the US in one dimension while remaining unaligned in the other. The analysis also reveals fluidity in countries' positions across time periods, with fewer than half maintaining consistent alignment in either MP or trade from one period to the next. Notably, while direct transitions between opposing blocs are rare in MP-based classification, they are more common in trade bloc, hinting that MP networks exhibit stronger path dependencies than traditional trade alignment.

We then quantify the welfare and growth implications of dual fragmentation through a series of counterfactual experiments. First, we establish a baseline by evaluating how the actual changes in trade and MP costs between 2016-2019 affected welfare outcomes. By comparing 2019 outcomes to a counterfactual where costs remain fixed at 2016 levels while allowing knowledge stocks to evolve, we find that the median country experienced gains of approximately 0.58% in both real income and real wages from these cost changes. This suggests that movements to different blocs overall align with countries' economic interests.

Second, we examine scenarios where countries with partial or split alignments between the US and China blocs achieve full consolidation in both trade and multinational production dimensions. Our counterfactual analysis reveals that countries maintaining divergent alignments across these dimensions would predominantly experience welfare losses from consolidating into a single bloc. Among economies with split alignments between US and China, welfare effects range from -2.22% to 0.20%, with most experiencing negative outcomes. For economies in the China MP bloc but unaligned in trade, 16 of 20 countries would face welfare losses from adding trade alignment, despite some achieving positive static gains. The comparison between welfare and static gains demonstrates that bloc consolidation typically generates negative growth effects through disrupted technology diffusion, causing welfare gains to fall below static gains and frequently turning negative even when immediate efficiency improvements occur.

The welfare effects of realignment reveal substantial heterogeneity without clear geographic patterns. While certain economies would benefit from consolidation, with Turkey (0.55%), Denmark (0.38%), and Peru (0.32%) gaining from joining the US bloc and Norway (0.31%) and France (0.24%) from full China alignment, the majority face losses. Cyprus experiences particularly severe welfare losses (-6.86%) from US MP alignment, while South Korea (-2.54%) and Germany (-2.25%) also face substantial declines. Notably, welfare effects often exhibit directional inconsistencies with static gains: countries such as Germany, Hong Kong, and Tunisia experience negative welfare despite positive static gains, while Denmark and Slovakia achieve positive welfare despite negative static gains. The predominance of negative welfare effects across various realignment scenarios indicates that the current fragmented landscape, while appearing inefficient, may actually represent an equilibrium where countries optimize their positions given complex tradeoffs between static efficiency, technology access, and geopolitical constraints.

This paper contributes to three strands of literature. First, we extend the growing body of work on fragmentation and the slowdown in globalization (Antràs, 2020), including analyses of Sino-US tariff frictions (Amiti et al., 2019; Fajgelbaum et al., 2024) and Brexit (Sampson, 2017; Dhingra and Sampson, 2022). Gopinath et al. (2025) and Bonadio et al. (2025) find that trade costs decline within blocs and increase between blocs, documenting fragmentation in trade. While existing studies focus primarily on trade disintegration through tariffs and non-tariff barriers, we complement these papers by analyzing global production decoupling through multinational networks. Recent work examines how fragmentation affects foreign direct investment flows (Alfaro and Chor, 2023; Aiyar et al., 2024; Pellegrino et al., 2025), but we go further by quantifying the macro implications for growth and welfare through both static efficiency losses and dynamic technology diffusion effects.

Second, this paper contributes to the burgeoning literature on geoeconomics and trade (Alesina et al., 2000; Caliendo and Parro, 2015; Caliendo et al., 2019; Caliendo and Parro, 2020; Caliendo et al., 2021; Couttenier et al., 2024; Becko and O'Connor, 2024; Attinasi et al., 2025; Abeliansky and Mayrhuber, 2025; Qiu et al., 2025; Mayer et al., 2025; Clayton et al., 2025a,b; Fan et al., 2025).[1] While this literature emphasizes how states use economic tools for strategic goals, we provide a framework to quantify the economic consequences when countries simultaneously weaponize both trade and multinational

[1]Early work dates back to Hirschman (1945). See Mohr and Trebesch (2025) for a comprehensive review.

production relationships. The most closely related empirical work is Bonadio et al. (2025), who measure trade fragmentation through data-driven changes in U.S. and China trade costs from 2015–2023. We complement their work by introducing multinational production blocs, which prove crucial for understanding the growth and welfare implications of global fragmentation.

Third, we extend Cai and Xiang (2025) by incorporating tariffs and diffusion through both trade and MP. This builds on foundational work on multinational production (Ramondo and Rodríguez-Clare, 2013; Tintelnot, 2017; Arkolakis et al., 2018; Alviarez et al., 2023; Li, 2023; Xiang, 2023; Fan, 2025; Cai and Xiang, 2025; Lu et al., 2025) and technology diffusion (Kortum, 1997; Eaton and Kortum, 1999; Lucas, 2009; Alvarez et al., 2013; Buera and Oberfield, 2020; Perla et al., 2021; Benhabib et al., 2021; Lind and Ramondo, 2022; Cai et al., 2022, 2025). Our contribution is to show how multinational production and technology diffusion it facilitates shape the consequence of global fragmentation and decoupling. The remainder of the paper is organized as follows. Section 2 presents the model. Section 3 describes the data and empirical strategy for backing out cost changes. Section 4 presents bloc classifications and characteristics. Section 5 reports counterfactual results. Section 6 concludes.

2 Model

In this section we outline the model we use, which follows Cai and Xiang (2025). The main difference in this paper is that we explicitly model both tariff and non-tariff component of trade costs, a distinction that becomes particularly relevant given the increased salience of tariff policies in recent trade disputes.

Basic Environment. The model features MP, trade and technology diffusion in a multi-country Ricardian world. Consider a world economy with N countries where labor is the only factor of production. In each country there is a continuum of goods of measure one. The production function for each variety $v \in [0, 1]$ has constant returns to scale, i.e., $y(v) = ql(v)$, where $y(v)$ is output, q is productivity, and $l(v)$ is labor input.

There is a large set of potential firms with different productivity to produce each variety. A firm originated in h (the *headquarter* country) is fully described by a vector of productivity $\mathbf{q}_h(v) = (q_{1h}(v), q_{2h}(v), \ldots, q_{Nh}(v))$, where $q_{jh}(v)$ is the productivity if the firm were to set up a plant in country j. The firm suffers an efficiency loss in producing abroad in the form of an iceberg MP cost $\gamma_{jh} \geq 1$, with $\gamma_{jj} = 1$. When the firm produces in j, its productivity is $q_{jh}(v)/\gamma_{jh}$.

When a firm serves market i with goods produced in j, it incurs trade cost $\tau_{ij} \geq 1$, with $\tau_{ii} = 1$. We assume that trade barriers obey the triangle inequality, i.e., $\tau_{in} \leq \tau_{ij}\tau_{jn}$ for any three countries i, j, n. In particular, $\tau_{ij} = (1 + t_{ij})(1 + d_{ij})$, where t_{ij} is the tariff rate and d_{ij} is the iceberg transportation cost.

Consumers all over the world have the same preferences over the continuum of varieties, which are constant elasticity of substitution (CES) with elasticity $\sigma > 1$. Consider consumers in country i. They get utility $u(C_{i,t})$ from the CES aggregate $C_{i,t} = \left(\int_0^1 c_{i,t}(v)^{\frac{\sigma-1}{\sigma}} dv\right)^{\frac{\sigma}{\sigma-1}}$ where $c_{i,t}(v)$ is the consumption of variety v. The associated price index is $P_{i,t} = \left(\int_0^1 p_{i,t}(v)^{1-\sigma} dv\right)^{1/(1-\sigma)}$, where $p_{i,t}(v)$ is the price of variety v in country i.

MP and Trade. Consider a firm whose headquarter is in h that produces variety v in country j. The efficiency level, $q_{jh}(v)$, is discounted by the MP cost, γ_{jh}, so the unit cost of production is $w_j\gamma_{jh}/q_{jh}(v)$, where w_j is the wage rate in country j. If the firm ships the good to market i, the unit cost incorporates transportation cost, τ_{ij}, as well. Denoting this augmented cost as $\kappa_{ijh,t} = \tau_{ij,t}w_{j,t}\gamma_{jh,t}$, the unit cost of serving market i with goods produced in j using ideas from h is $p_{ijh,t}(v) = \kappa_{ijh,t}/q_{jh}(v)$.

Consumers take prices as given. We assume perfect competition so $p_i(v)$ is equal to the lowest cost to serve market i:

$$p_{i,t}(v) = \min\{p_{ijh,t}(v);\ j, h = 1, \ldots, N\}.$$

New Ideas and Technology Frontier. Now we describe the dynamics of new ideas.[2] In each country h, new ideas arrive as a Poisson process. Each idea is about techniques to produce a single variety, drawn randomly from the uniform distribution on $[0, 1]$. An idea can be specified by a random vector of efficiencies of production in all countries,

$$\boldsymbol{Q} = \boldsymbol{Z} \cdot \left(Q_p^{'}\right)^{\rho_1} \left(Q_s^{'}\right)^{\rho_2},$$

The original component, random vector $\mathbf{Z}$, is drawn from an exogenous distribution. There are two insight components, where $Q_p^{'}$ is the quality of an new idea drawn from producers, and $Q_s^{'}$ is the quality of an new idea drawn from sellers. The parameter ρ_1 and ρ_2 govern the learning intensities.

In country h, the arrival rate of ideas with original component $\mathbf{Z}$ better than $\mathbf{z}$ in at least one dimension is $A_{h,t}(\mathbf{z}) = \alpha_{h,t}\left(\sum_{n=1}^{N} z_n^{-\frac{\theta}{1-\eta}}\right)^{1-\eta}$ for any $\mathbf{z} \in \mathbb{R}_+^N$ and $\mathbf{z} \neq \mathbf{0}$, where $\alpha_{h,t}$ is

[2]We introduce multi-dimensional ideas to Buera and Oberfield (2020) to incorporate the model of MP.

an exogenous arrival intensity at time t. The parameter $\theta > 0$ determines the shape of the right tail. The parameter $\eta \in [0,1)$ measures the correlation among entries of vector $\mathbf{Z}$.

The insight component, Q'_p, is drawn randomly from the distribution of the efficiency level of all producers in country h regardless of the variety they produce, and Q'_s is drawn randomly from the distribution of the efficiency level of all sellers to country h. We denote the distribution of efficiencies of actively producing plants located in country h at time t as $G_{h,t}(q')$, and the distribution of efficiencies of sellers to country h as $H_{h,t}(q')$.

The state of the art for producing a particular variety v using ideas originated in h is a vector $\mathbf{Q}^{(1)}(v)$, where the n-th entry in the vector is the highest efficiency of producing that variety in country n. Because of randomness in the arrival and quality of new ideas in h, the vector is random, with a cumulative distribution function $F_{h,t}$ characterized as a multivariate Fréchet distribution,

$$\Pr[\mathbf{Q}^{(1)}(v) \leq \mathbf{q}] = F_{h,t}(\mathbf{q}) = \exp\left(-\lambda_{h,t}\left(\sum_{n=1}^{N} q_n^{-\frac{\theta}{1-\eta}}\right)^{1-\eta}\right),$$

with support $q_n > 0$ for all n.[3] The location parameter

$$\lambda_{h,t} := \int_{-\infty}^{t} \alpha_{h,\tau} \int_0^\infty \int_0^\infty x^{\rho_1\theta} dG_{h,\tau}(x) \;\; y^{\rho_2\theta} dH_{h,\tau}(y) d\tau$$

is the cumulated knowledge stock of country h at time t.

General Equilibrium. Given the results of the technology frontier, following Ramondo and Rodríguez-Clare (2013), we can characterize the allocation of expenditures and production with only the knowledge stocks, λ, and the augmented cost bundles, κ. In particular, the share of total expenditure in market i on goods produced using technology from h (the expenditure share) is

$$\pi^E_{ih,t} = \frac{\lambda_{h,t}\left(\sum_{k=1}^N \kappa_{ikh,t}^{-\frac{\theta}{1-\eta}}\right)^{1-\eta}}{\sum_{n=1}^N \lambda_{n,t}\left(\sum_{k=1}^N \kappa_{ikn,t}^{-\frac{\theta}{1-\eta}}\right)^{1-\eta}}.$$

[3]Here, $\mathbf{Q}^{(1)}(v) \leq \mathbf{q}$ means $Q_n^{(1)}(v) \leq q_n$ for all $n \in \{1, \ldots, N\}$.

The goods i buys from h will be produced in the countries where the cost is the lowest. The conditional probability that such a good is produced in j is

$$\psi_{ijh,t} = \frac{\kappa_{ijh,t}^{-\frac{\theta}{1-\eta}}}{\sum_{k=1}^{N} \kappa_{ikh,t}^{-\frac{\theta}{1-\eta}}}.$$

It follows that the share of expenditure of i on goods produced in j and originating in h (trilateral share) is

$$\pi_{ijh,t} = \psi_{ijh,t} \cdot \pi_{ih,t}^{E} = \frac{\kappa_{ijh,t}^{-\frac{\theta}{1-\eta}}}{\sum_{k=1}^{N} \kappa_{ikh,t}^{-\frac{\theta}{1-\eta}}} \frac{\lambda_{h,t} \left(\sum_{k=1}^{N} \kappa_{ikh,t}^{-\frac{\theta}{1-\eta}} \right)^{1-\eta}}{\sum_{n=1}^{N} \lambda_{n,t} \left(\sum_{k=1}^{N} \kappa_{ikn,t}^{-\frac{\theta}{1-\eta}} \right)^{1-\eta}}.$$

We can easily construct other aggregate shares of interest from the trilateral shares. For example, the share of total expenditure in market i on goods produced in j (the bilateral trade share) is $\pi_{ij}^{T} = \sum_{h=1}^{N} \pi_{ijh}$.

We define the equilibrium in the static model as follows. At each period t, given the knowledge stocks $\{\lambda_{i,t}\}_{i=1}^{N}$, MP costs, tariff rates and trade costs $\{\gamma_{ij,t}, t_{ij,t}, d_{ij,t}\}_{i=1,j=1}^{N,N}$, and labor $\{L_{i,t}\}_{i=1}^{N}$, a *temporary equilibrium* is a vector of wages $\{w_{i,t}\}_{i=1}^{N}$ that satisfies the labor market clearing condition for all economies

$$w_{nt} L_n = \sum_{i=1}^{N} \frac{1}{1 + t_{in,t}} \pi_{in}^{T} X_{it},$$

where the total expenditure X_{nt} includes lump sum transfer from tariff revenue

$$X_{nt} = w_{nt} L_n + \sum_{i=1}^{N} \frac{t_{ni,t}}{1 + t_{ni,t}} \pi_{ni}^{T} X_{nt}.$$

Given the production and trade pattern in the temporary equilibrium, the law of motion for knowledge stock is

$$\dot{\lambda}_{h,t} = \alpha_{h,t} \Gamma_{\rho_1,\rho_2} \left[\sum_{n} \frac{\pi_{hhn,t}}{\sum_n \pi_{hhn,t}} \left(\frac{\lambda_{n,t}}{\pi_{hn,t}^{E} \psi_{hhn,t}^{1-\eta}} \right)^{\rho_1} \right] \left[\sum_{n} \sum_{j} \frac{\pi_{hjn,t}}{\sum_j \sum_n \pi_{hjn,t}} \left(\frac{\lambda_{n,t}}{\pi_{hn,t}^{E} \psi_{hjn,t}^{1-\eta}} \right)^{\rho_2} \right]$$

for $h = 1, \ldots, N$, where $\Gamma_{\rho_1,\rho_2} = \Gamma(1-\rho_1) \cdot \Gamma(1-\rho_2)$. Given initial knowledge stocks $\{\lambda_{i,0}\}_{i=1}^{N}$, the path of arrival rates, costs, and labor allocations $\left(\{\alpha_{h,t}\}, \{\gamma_{ij,t}, \tau_{ij,t}\}_{i=1,j=1}^{N,N}, \{L_{i,t}\}_{i=1}^{N} \right)_{t \geq 0}$, a *sequential equilibrium* that describes the whole path of the world economy is a sequence of wage rates and knowledge stocks $\left(\{w_{i,t}\}_{i=1}^{N}, \{\lambda_{i,t}\}_{i=1}^{N}\right)_{t\geq 0}$ that that at each point in time, (a) $\{w_{i,t}\}_{i=1}^{N}$ is the temporary equilibrium given $\{\lambda_{i,t}\}_{i=1}^{N}$ and $\{\gamma_{ij,t}, t_{ij,t}, d_{ij,t}\}_{i=1,j=1}^{N,N}$; (b) $\{\lambda_{i,t}\}_{i=1}^{N}$ follows the law of motion specified above.

If labor, trade cost and MP cost do not change in the long run, and if arrival rate of ideas has a common constant growth rate: $\dot{\alpha}_{h,t}/\alpha_{h,t} = g_{\alpha}$, a balanced growth path exists. Along the balanced growth path all equilibrium variables grow at a constant rate or stay constant.

3 Data

To classify countries into their respective economic blocs, we need to measure changes in bilateral MP and trade costs, which requires data on both trade flows and MP activities at the country level. This section presents the data sources employed and describes the methodology for deriving MP and trade costs from observed trade and production flows in a manner consistent with our theoretical framework.

For bilateral tariff rates, we use the Global Tariff Database from Teti (2024), which provides trade-weighted average bilateral tariffs and unweighted average bilateral tariffs. This allows us to construct the $N \times N$ tariff matrix between all importer-exporter pairs in our sample.[4] For trade data, we use trade flows from the OECD Inter-Country Input-Output tables (ICIO 2025 release) (OECD, 2025), which provide flows of international trade in goods and services between countries measured in basic prices (Yamano et al., 2023). By using this trade flow data and the aforementioned tariff matrix, we are able to construct the $N \times N$ matrix of trade shares, π_{ij}^{Tr}.[5]

To derive the empirical counterpart of bilateral MP data in the model, we use the Analytical Activities of MNEs (AMNE) database from OECD. The bilateral output matrix breaks down global gross output by producer country, industry, and country of ownership, which allows us to construct the $N \times N$ matrix of MP shares, π_{jh}^{MP}. [6]

[4] Specifically, the data source is Feodora Teti's Global Tariff Database (Version Beta1-2024-12). This database provides bilateral tariff rates for 200 importers and their partners, spanning 34 years (1988-2021). Its primary data are derived from multiple authoritative sources, including the WTO's RTA Database, the WTO's Integrated Data Base (IDB), ITC's Market Access Map, and US and EU tariff schedules from national authorities. Trade-weighted tariffs are constructed using contemporaneous trade data from CEPII's BACI starting from 1995. For details on the database construction, see Teti (2024).

[5] The OECD-ICIO Tables are presented for 80 economies and the Rest of the World from 1995 to 2022. For details on the database construction, see Yamano et al. (2023).

[6] The Analytical AMNE database includes 41 industries and 76 economies and the rest of the world region from 2000 to 2020. For details on the database construction, see Cadestin et al. (2018).

Finally, real national account data, including real GDP (X_i/P_i) and employment (emp_i), come from the Penn World Table 10.01 (Feenstra et al., 2015), which covers the period from 1950 to 2019.

MP and Trade Costs. We restrict our analysis to 76 economies where we have good data for both MP and trade between 2000 and 2019. We start by externally calibrating some parameters. We set the shape parameter of the Fréchet distribution θ to 4.5 and the correlation parameter η to 0.55, following Arkolakis, Ramondo, Rodríguez-Clare, and Yeaple (2018). We set the elasticity of substitution $\sigma = 3.79$, as in Bernard, Eaton, Jensen, and Kortum (2003). We set the growth rate of arrival rate, $g_\alpha = 0.7\%$, learning parameters $\rho_1 = 0.629$, $\rho_2 = 0.488$, and the discount factor $\beta = 0.95$ from Cai and Xiang (2025).

We first construct the trilateral flows based on the bilateral trade shares $\pi^T_{ij,t}$ and the bilateral MP shares $\pi^M_{jh,t}$. To see this, define $\xi^M_{jh,t} = \lambda_{h,t}\gamma^{-\theta}_{jh,t}$ and $\xi^T_{ij,t} = (\tau_{ij,t}w_{j,t})^{-\theta}$. We can rewrite the trilateral share equation as

$$\pi_{ijh,t} = \frac{(\xi^T_{ij,t}\xi^M_{jh,t})^{1/(1-\eta)}}{\sum_{k=1}^N (\xi^T_{ik,t}\xi^M_{kh,t})^{1/(1-\eta)}} \frac{\left(\sum_{k=1}^N (\xi^T_{ik,t}\xi^M_{kh,t})^{1/(1-\eta)}\right)^{1-\eta}}{\sum_{n=1}^N \left(\sum_{k=1}^N (\xi^T_{ik,t}\xi^M_{kn,t})^{1/(1-\eta)}\right)^{1-\eta}}.$$

By definition, the bilateral trade share is $\pi^T_{ij,t} = \sum_h \pi_{ijh,t}$, and the bilateral MP production share is $\pi^M_{jh,t} = \sum_{i,t} X_{i,t}\pi_{ijh,t}\frac{1}{1+t_{ij,t}} / \sum_i \sum_h X_{i,t}\pi_{ijh,t}\frac{1}{1+t_{ij,t}}$. Thus, we can write

$$\pi^T_{ij,t} = \sum_{h=1}^N \frac{(\xi^T_{ij,t}\xi^M_{jh,t})^{1/(1-\eta)}}{\sum_{k=1}^N (\xi^T_{ik,t}\xi^M_{kh,t})^{1/(1-\eta)}} \frac{\left(\sum_{k=1}^N (\xi^T_{ik,t}\xi^M_{kh,t})^{1/(1-\eta)}\right)^{1-\eta}}{\sum_{n=1}^N \left(\sum_{k=1}^N (\xi^T_{ik,t}\xi^M_{kn,t})^{1/(1-\eta)}\right)^{1-\eta}}, \tag{1}$$

$$\pi^M_{jh,t} = \sum_{i=1}^N \frac{X_{i,t}}{Y_{j,t}} \frac{1}{1+t_{ij,t}} \frac{(\xi^T_{ij,t}\xi^M_{jh,t})^{1/(1-\eta)}}{\sum_{k=1}^N (\xi^T_{ik,t}\xi^M_{kh,t})^{1/(1-\eta)}} \frac{\left(\sum_{k=1}^N (\xi^T_{ik,t}\xi^M_{kh,t})^{1/(1-\eta)}\right)^{1-\eta}}{\sum_{n=1}^N \left(\sum_{k=1}^N (\xi^T_{ik,t}\xi^M_{kn,t})^{1/(1-\eta)}\right)^{1-\eta}}, \tag{2}$$

where $X_{i,t}$ is the total expenditure of country i, and $Y_{j,t} = \sum_i \sum_h X_{i,t}\pi_{ijh,t}\frac{1}{1+t_{ij,t}}$ is the total production in country j. (1) and (2) uniquely determine $\xi^M_{jh,t}$ and $\xi^T_{ij,t}$ up to some constraint. Even though we need extra conditions - to be supplemented below - to pin down the exact levels of $\xi^M_{jh,t}$ and $\xi^T_{ij,t}$, we can uniquely solve the trilateral shares.

After getting the trilateral shares, we can invert the model to back out the model consistent knowledge stocks,

$$\lambda_{i,t} = B^{-\theta}\omega^\theta_{i,t}\pi_{iii,t}\psi^{-\eta}_{iii,t},$$

where $B = \Gamma(1 + (1-\sigma)/\theta)^{1/(1-\sigma)}$ is a constant, and $\omega_{i,t}$ is the real output per worker which we take from the PWT.

With λ and ω, we can solve the bilateral MP and trade costs. Recall that

$$\xi^M_{ii,t} = \lambda_{i,t}, \tag{3}$$
$$\xi^T_{ii,t} = w^{-\theta}_{i,t} \tag{4}$$

hold for all $i \in \{1, ..., N\}$. These two $2N$ constraints in addition to equations (1) and (2) provide $2N^2$ linearly independent equations, which allow us to uniquely pin down the same number of unknowns in matrices $\{\xi^M_{jh}\}$, $\{\xi^T_{ij}\}$, hence the bilateral MP and trade costs.

4 MP and Trade Blocs

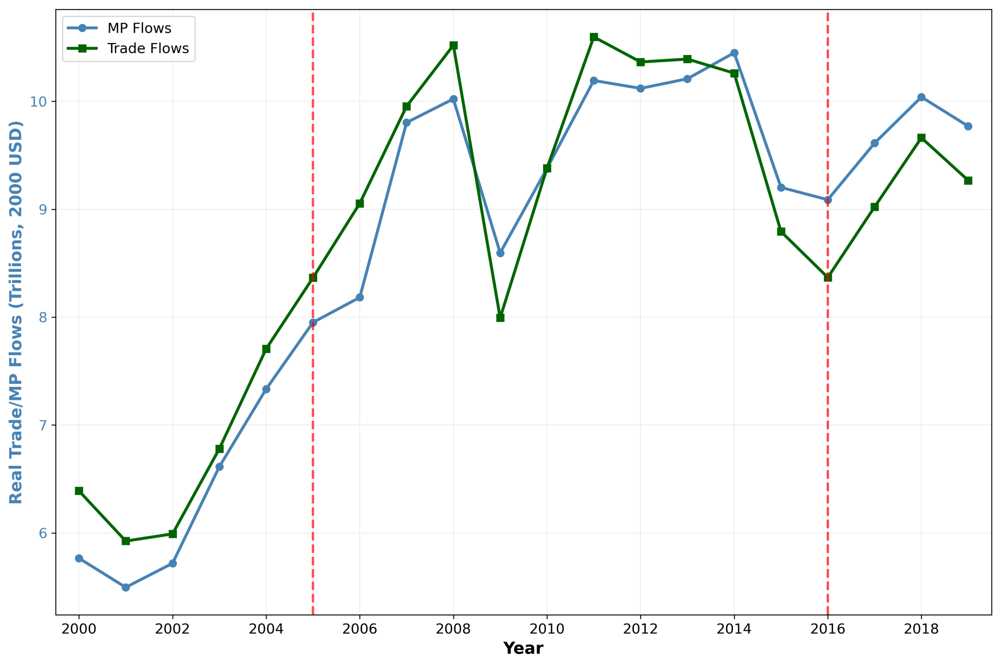
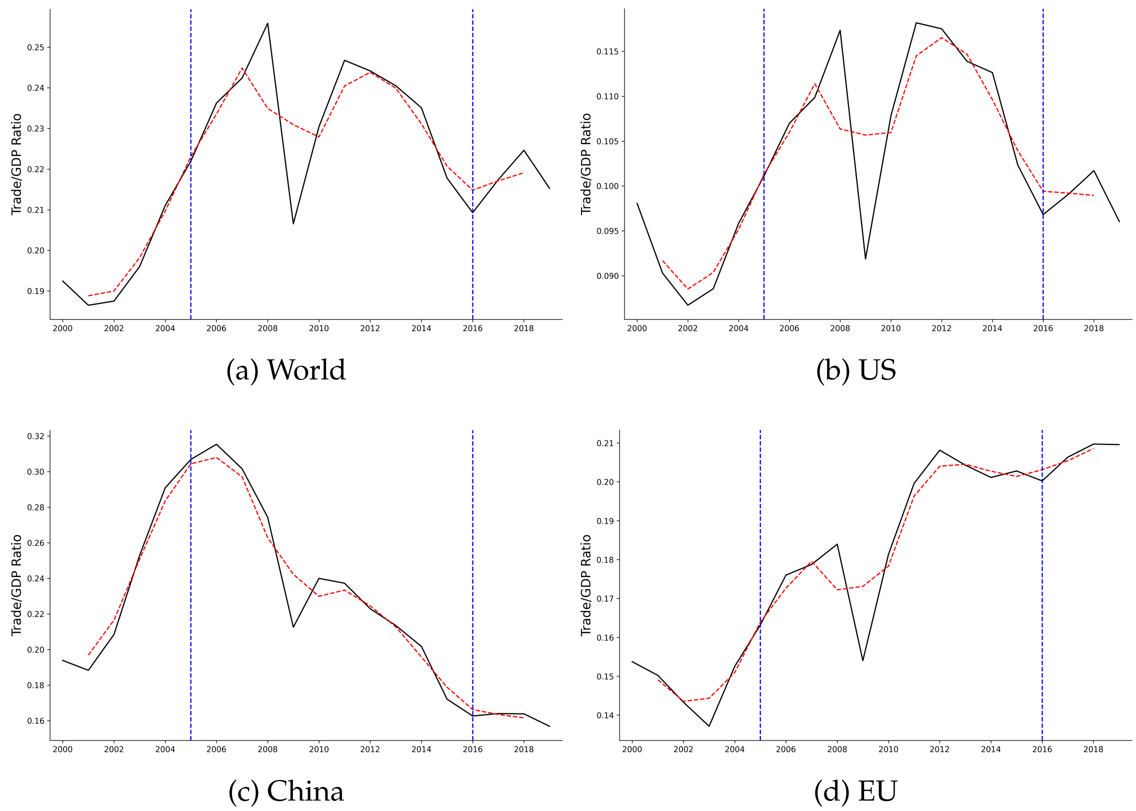


Figure 1: Evolution of MP and Trade Flows Over Time

Notes: This figure shows the time series of aggregate multinational production (MP) and trade flows between countries from 2000 to 2019. Sources: Analytical AMNE and UNCTADstat Data Center.

Our analysis employs data spanning from 2000 to 2019, which we partition into three distinct periods: 2000-2005, 2005-2016, and 2016-2019. The choice of these three periods is motivated by both empirical patterns in global economic flows and key policy developments. As shown in Figure 1, both MP and trade flows experienced distinct phases of growth and adjustment that align with our periodization. The middle period (2005-2016) corresponds to the era of Trans-Pacific Partnership (TPP) negotiations and broader multilateral trade initiatives, representing a phase of intensive economic integration efforts. The final period (2016-2019) captures the onset of trade tensions and policy reversals that marked a shift toward more fragmented global economic relationships.



(a) World

(b) US

(c) China

(d) EU

Figure 2: Trade / GDP Ratios

Notes: Solid line denotes the trade-GDP ratio, defined as 0.5(exports+imports)/GDP. Dashed line denotes the 3-year moving average of the trade-GDP ratio. Data Sources: DOTS and WEO.

Figure 2 plots the evolution of trade-to-GDP ratios from 2000 to 2019. Between the mid-2000s and 2016, China's trade-to-GDP ratio declined substantially. Table 1(a) provides more detailed evidence of these trade patterns. During this period, while US overall imports as a share of GDP decreased, its imports from China increased even as imports from other regions declined. Similarly, although China's exports to the US, EU, and rest of the world grew substantially, its overall imports-to-GDP ratio fell dramatically, with imports from these regions growing more slowly than China's GDP. The EU experienced growth in both overall imports and imports from specific partners including the US, China, intra-EU trade, and the rest of the world. After 2016, as documented by Bonadio et al. (2025), global trade and the trade-to-GDP ratios of major economies (US, China, and EU) remained stable. However, Table 1(b) shows that while US-China bilateral trade decreased, both countries increased trade with other partners. The overall changes in imports-to-GDP ratios during this later period were minimal.

(a) 2005–2016

	USA	CHN	EU	ROW
USA		-0.44	0.19	-0.01
CHN	0.24		0.70	1.63
EU	-0.09	-0.43	0.07	-0.06
ROW	-0.21	-0.53	0.09	-0.08
Change in total imports-to-GDP	-0.12	-0.51	0.11	0.07

(b) 2016–2019

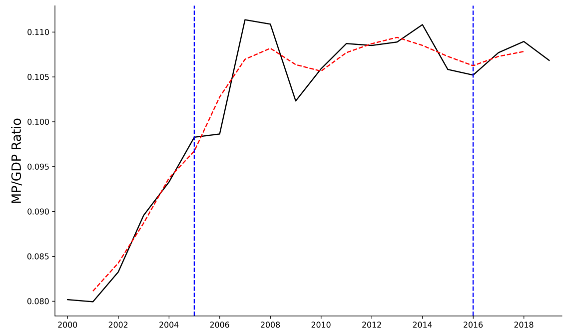
	USA	CHN	EU	ROW
USA		-0.29	0.07	0.02
CHN	-0.15		0.07	0.10
EU	0.08	0.04	0.03	0.01
ROW	0.02	0.05	0.07	0.10
Change in total imports-to-GDP	-0.01	0.02	0.05	0.06

Table 1: Changes in Trade

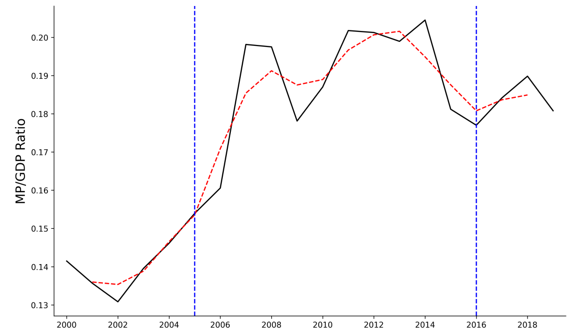
Notes: This table reports the percentage change in the ratio of import to GDP from the source economy (rows) to destination (columns) in different periods.

Turning to multinational production, we also observe patterns of fragmentation similar to trade. Figure 3 illustrates the evolution of MP-to-GDP ratios. While world multinational production grew rapidly before 2005, growth moderated in subsequent years. Like global trade, world MP remained stable rather than declining after 2016. The major economies (US, China and EU) exhibited MP patterns similar to the global trend. Table 2 reveals divergent trajectories in outward MP between the US and China. During 2005-2016, US outward MP to the EU increased but decreased to China and ROW as a share of recipient GDP. In 2016-2019, US outward MP declined for both China and EU destinations. Meanwhile, China's outward MP continued to grow during both periods, albeit at a slower pace in the latter period.

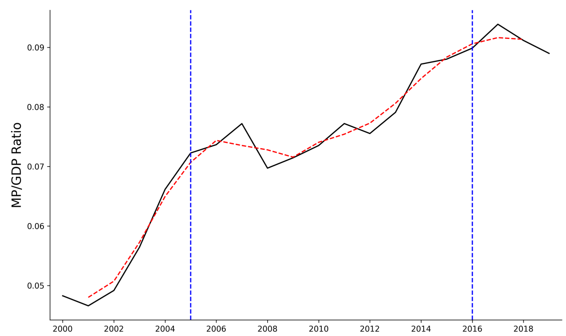
For each period, we classify countries into one of three economic blocs—China bloc, US bloc, or unaligned—based on two complementary approaches. We first examine changes in MP costs to determine bloc affiliation, and then, we apply the same classification framework using changes in trade costs. Our classification approach follows Bonadio et al. (2025). Specifically, for each t, we define the average MP costs between two countries $\overline{\gamma}_{ij,t}$



(a) World



(b) US



(c) China

(d) EU

Figure 3: MP / GDP Ratios

Notes: Solid line denotes the MP-GDP ratio, defined as 0.5(inward mp + outward mp)/GDP. Dashed line denotes the 3-year moving average of the MP-GDP ratio. Data Sources: Analytical AMNE and WEO.

as the weighted average of the two bilateral MP costs, weighted by the respective MP flows,

$$\overline{\gamma}_{ij,t} = \frac{X^{MP}_{ij,t}}{X^{MP}_{ij,t} + X^{MP}_{ji,t}} \gamma_{ij,t} + \frac{X^{MP}_{ji,t}}{X^{MP}_{ij,t} + X^{MP}_{ji,t}} \gamma_{ji,t}.$$

Then, for each of the three periods, we compare how a country's MP costs with China and with US change. Countries experiencing increased MP costs with China but decreased MP costs with the US are classified as belonging to the US MP bloc. Conversely, those with increased MP costs with the US but decreased MP costs with China belong to the China MP bloc. Countries exhibiting neither pattern are defined as unaligned.

$$i \in \begin{cases} \text{US MP bloc} & \text{if } \Delta\overline{\gamma}_{i,CHN} \geq 0 \text{ and } \Delta\overline{\gamma}_{i,USA} < 0 \\ \text{China MP bloc} & \text{if } \Delta\overline{\gamma}_{i,CHN} < 0 \text{ and } \Delta\overline{\gamma}_{i,USA} \geq 0 \\ \text{Unaligned} & \text{otherwise.} \end{cases}$$

We apply this same classification framework to trade costs. We define the average trade

(a) 2005–2016

	USA	CHN	EU	ROW
USA		-0.17	0.24	-0.03
CHN	14.08		24.52	9.18
EU	0.11	0.01	0.18	-0.08
ROW	0.41	0.18	0.43	0.21
Change in total inward MP-to-GDP	0.24	0.07	0.25	0.07

(b) 2016–2019

	USA	CHN	EU	ROW
USA		-0.06	-0.01	0.04
CHN	1.11		0.51	0.38
EU	0.00	-0.06	0.01	0.00
ROW	0.09	-0.09	0.03	0.05
Change in total inward MP-to-GDP	0.05	-0.08	0.01	0.05

Table 2: Changes in MP

Notes: This table reports the percentage change in the ratio of inward MP to GDP from the source economy (rows) to destination (columns) in different periods.

costs between two countries as

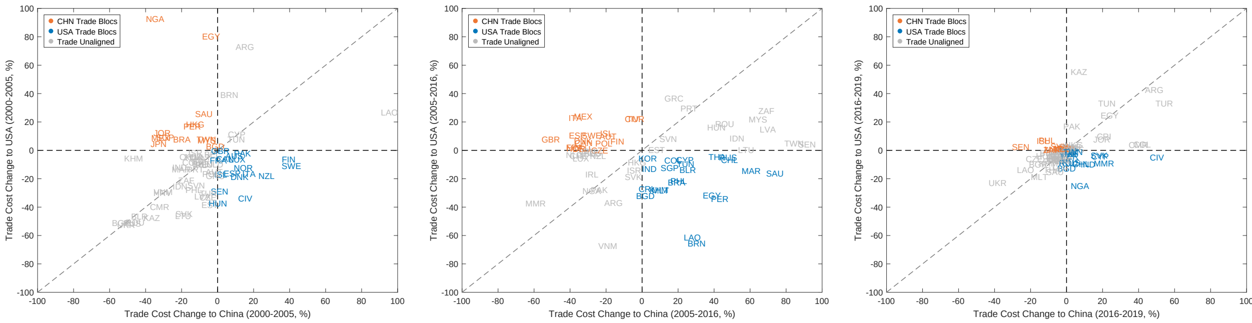
$$\overline{\tau}_{ij,t} = \frac{X^T_{ij,t}}{X^T_{ij,t} + X^T_{ji,t}} \tau_{ij,t} + \frac{X^T_{ji,t}}{X^T_{ij,t} + X^T_{ji,t}} \tau_{ji,t},$$

where X^T_{ij} is i's import from j. We then classify countries into one of the three categories: US trade bloc, China trade bloc or unaligned:

$$i \in \begin{cases} \text{US trade bloc} & \text{if } \Delta\overline{\tau}_{i,CHN} \geq 0 \text{ and } \Delta\overline{\tau}_{i,USA} < 0 \\ \text{China trade bloc} & \text{if } \Delta\overline{\tau}_{i,CHN} < 0 \text{ and } \Delta\overline{\tau}_{i,USA} \geq 0 \\ \text{Unaligned} & \text{otherwise.} \end{cases}$$

While these dimensions are often assumed to move in tandem, our analysis will reveal a far more complex and nuanced landscape. Figures figs. 4 and 5 show changes of each country's trade and MP costs to China and the US. Several key patterns show up.

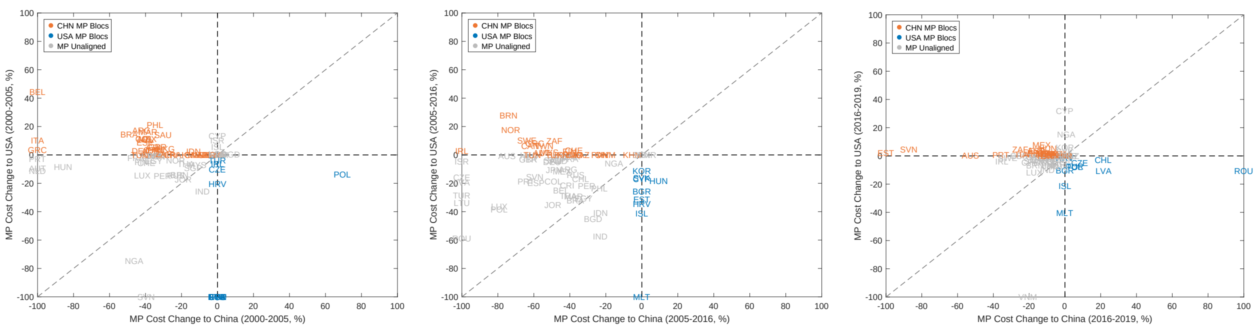
First, countries do not necessarily have the same bloc alignment when we look at changes in MP costs versus in trade costs. Few countries are unaligned in both direction. More often than not, countries may align with one group in MP but unaligned or align



(a) 2000-2005 (b) 2005-2016 (c) 2016-2019

Figure 4: Changes in Trade Costs to China or US

Notes: This figure shows the changes of trade costs between countries in different trade blocs and China or the US in 3 different time periods. Trade costs between two countries are defined as the weighted average of two-way trade costs, weighed by the trade flow.



(a) 2000-2005 (b) 2005-2016 (c) 2016-2019

Figure 5: Changes in MP Costs to China or US

Notes: This figure shows the changes of MP costs between countries in different MP blocs and China or the US in 3 different time periods. MP costs between two countries are defined as the weighted average of two-way MP costs, weighed by the MP flow.

with the other group in trade.

Second, the MP-based classification reveals a more fragmented picture of the world than the trade-based classification. In trade-based classification, the unaligned group is always the largest group, showing that most countries do not have a strong leaning towards either blocs. By contrast, in MP-based classification, in 2000-2005 and in 2016-2019, China blocs have more members than the unaligned group, revealing that MP costs are decreasing for China and partner countries. While in the MP-based classification, the China bloc has more members than the US bloc, the opposite holds when we focus on the trade-based classification.

Third, despite the apparent strength of these economic alignments, the analysis reveals that most countries' positions are surprisingly fluid across time periods. Both MP and trade alignments demonstrate considerable instability, with fewer than half of countries maintaining consistent alignment from one period to the next. Notably, MP alignment shows slightly greater persistence than trade alignment, and direct transitions between opposing blocs are rare in production networks while being more common in trade relationships.

4.1 MP and Trade Alignment

Table 3 provides a summary statistics of a detailed decomposition by country alignment. The data shows that countries take different positions in multinational production and trade networks.

The first pattern is that very few countries remain unaligned in both dimensions simultaneously. Table 3 shows that in all three periods, the number of such countries are fewer than 19, or 25% of the total number in our sample. The rarity of dual non-alignment underscores how economic interdependence has become a fundamental characteristic of the modern international system, with countries actively seeking integration through either trade partnerships or production networks to maintain competitiveness and economic growth.

Second, there exists significant inconsistencies in MP and trade alignment. Countries do not necessarily maintain coherent alignment strategies across both dimensions simultaneously. We can see it by looking at off diagonal entries in table 3. This divergence manifests in various forms: countries may align with one major power in trade relationships while aligning with a different power or remaining unaligned in MP networks. The lack of perfect correlation between MP and trade alignments suggests that these two forms of economic integration might serve distinct functions in countries' economic strategies and are influenced by different sets of factors including technological capabilities, labor costs, market access, and geopolitical considerations.

In tables A.1 to A.3, we list the detailed bloc alignment for each country. Of particular interest are cases where countries align with China in multinational production networks while simultaneously aligning with the USA in trade blocs. In 2000-2005, for example, while it is true that for countries like Brazil, Mexico and Japan are in the China bloc both by MP and by trade standards, there are many other countries with different positions. Countries like Australia, Canada, Spain, the United Kingdom, among others, were in China's MP bloc and the US trade bloc at the same time. In 2005-2016, countries in the China-MP/USA-Trade group are mainly in East Europe and in Asia, like Belarus, Brunei, Kazakhstan, Cambodia, Laos, and Ukraine. In 2016-2019, notably Bangladesh, Indonesia, Italy, and Myanmar are in such a group. Iceland is the only country that is in

(a) 2000-2005

MP/Trade	CHN blocs	USA blocs	unaligned	Total
CHN blocs	6	9	18	33
USA blocs	0	1	11	12
unaligned	8	9	14	31
Total	14	19	43	76

(b) 2005-2016

MP/Trade	CHN blocs	USA blocs	unaligned	Total
CHN blocs	7	7	9	23
USA blocs	1	4	5	10
unaligned	10	14	19	43
Total	18	25	33	76

(c) 2016-2019

MP/Trade	CHN blocs	USA blocs	unaligned	Total
CHN blocs	7	6	20	33
USA blocs	1	3	9	13
unaligned	5	9	16	30
Total	13	18	45	76

Table 3: MP and Trade Bloc Alignment

Notes: Cross-tabulation of countries' MP bloc classification (rows) versus trade bloc classification (columns) for each time period. Diagonal entries show consistent alignment; off-diagonal entries reveal divergent alignment strategies across MP and trade dimensions.

the USA-MP/China-Trade, both in 2005-2016 and in 2016-2019.

To make sense of the China-MP/USA-Trade alignment, a pattern particularly evident among Asian and East European countries that serve as manufacturing hubs while maintaining strong trade relationships with the United States, a plausible explanation can be that countries may find China's manufacturing and production capabilities essential for their industrial competitiveness, leading them to integrate into China-centered production networks. Simultaneously, these same countries may depend on US markets for exports or seek the institutional benefits of US-led trade agreements. This dual alignment strategy allows countries to leverage China's production advantages while maintaining access to US consumer markets.

The observed patterns raise a provocative question about whether MP and trade relationships function as substitutes rather than complements in countries' economic strategies. The evidence of mismatched alignments and selective non-alignment suggests that countries may indeed view these two forms of economic integration as alternative pathways to achieving economic or political objectives. When countries face constraints or political pressures that limit their options in one dimension, they may compensate by deepening integration in the other. What's more, through the lens of our model where MP integration and trade entail different levels of knowledge spillovers, MP and trade may have very different long-run economic implications, which provides another rationale for countries to pivot differently.

4.2 A More Fragmented World in MP

MP-based classification reveals a different image of the world from the trade-based one. Figure 6 show the numbers of each bloc by different classifications. The right panel shows that, in all periods, classified by changes in trade costs, most countries are unaligned. Their trade costs do not reveal a strong shift to either the China bloc or the US bloc. The US and China trade blocs have similar number of member countries, and the number of countries in the US trade bloc is slightly higher than in the China trade bloc. However, the MP-based classification in the left panel reveals a radically different story. In 2000-2005 and in 2016-2019, the majority of countries are in one of the two blocs rather than unaligned. Also, unlike in the trade-based classification, the China MP bloc consistently have more members than the US MP bloc by a reasonably large margin.

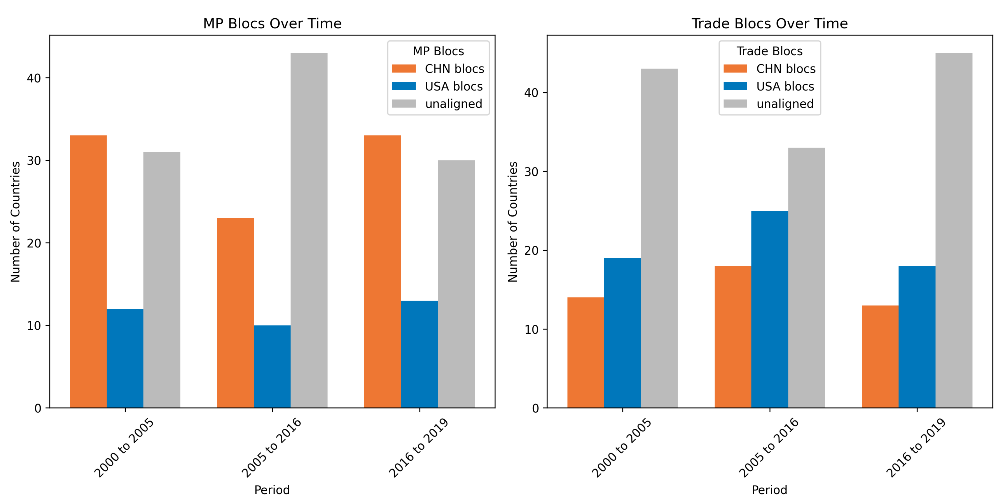


Figure 6: Number of Countries

Notes: Left panel shows MP-based bloc classification; right panel shows trade-based classification across time periods 2000-2005, 2010-2015, and 2016-2019.

One key explanation for the predominance of bloc alignment in MP classification versus trade classification likely stems from the fundamentally different nature of production networks compared to traditional trade relationships. While trade costs can be influenced by relatively symmetric factors such as tariffs, transportation infrastructure, and bilateral agreements that affect both partners similarly, multinational production decisions involve more asymmetric considerations including technology transfer, intellectual property protection, regulatory harmonization, and labor market characteristics. China's larger MP bloc membership may reflect its strategic positioning as the "world's factory," where it has systematically reduced barriers to production integration through industrial parks, special economic zones, and targeted policies to attract foreign direct investment. These production-oriented policies create stronger gravitational pull effects than trade policies alone, as firms making location decisions for production facilities face higher switching costs and longer-term commitments than those simply engaged in goods trade.[7]

The relatively large presence of unaligned countries in trade-based classification but not in MP-based classification suggests that multinational production networks exhibit stronger network effects and path dependencies than trade flows. While it is hard to pinpoint the reason for the difference, we discuss some possible reasons below. Once a country becomes integrated into either the US or China-centered production network, complementarities in infrastructure, supplier ecosystems, and technical standards create self-reinforcing dynamics that are harder to maintain in a neutral position. For instance, countries participating in China's production networks benefit from economies of scale in intermediate goods supply, shared technical standards, and accumulated manufacturing know-how that make neutrality increasingly costly. Similarly, countries in the US production network may be locked into specific technological ecosystems, quality standards, and intellectual property regimes that are difficult to straddle. Deep trade agreements like the TPP may actually be responses to, rather than causes of, these production network alignments, as countries seek to formalize and protect existing production relationships. This would explain why MP-based blocs appear more pronounced—they reflect the underlying economic geography of production that trade agreements subsequently attempt to codify and reinforce. However, these explanations remain open questions that require further empirical examination to determine their relative importance and validity.

[7]The Belt and Road Initiative exemplifies this approach, as it goes beyond trade facilitation to include industrial cooperation agreements, joint ventures, and production capacity cooperation that fundamentally reshape global value chains.

4.3 Is Bloc Alignment Persistent?

In the previous section, we established that the same country may not have consistent MP and trade alignment in the same period. In this section, we ask questions regarding how countries shift across different periods. How persistent is MP bloc alignment for different countries? How about trade alignment?

(a) MP Bloc Transitions

Transition	Total Countries	Stable Countries	Stability Rate
2000-2005 to 2005-2016	76	35	0.461
2005-2016 to 2016-2019	76	33	0.434

(b) Trade Bloc Transitions

Transition	Total Countries	Stable Countries	Stability Rate
2000-2005 to 2005-2016	76	23	0.303
2005-2016 to 2016-2019	76	32	0.421

Table 4: Transition Matrices for Bloc Alignment Persistence

Notes: Transition matrices showing persistence and movement of countries between bloc alignments across consecutive time periods. Diagonal entries indicate countries maintaining the same bloc alignment; off-diagonal entries show transitions between different blocs.

We start by summarizing the number of countries where the MP or trade alignment remains unchanged in table 4. Two characteristics are particularly noteworthy. First, the economic alignments of most countries are fluid, shifting from one period to the next. This pattern is consistent for both MP and trade-based bloc measures, with fewer than half of the countries maintaining their alignment from the preceding period. Second, MP bloc alignment demonstrates slightly more stability than its trade-based counterpart, which echoes the message that production networks are less flexible than trading relationships.

We can also further investigate if bloc alignment for countries in different groups exhibit different persistence. Table 5 provides more detailed information.

Again, MP-based and trade-based bloc transitions show very different patterns. For MP-based classifications, direct transitions from one bloc to the opposing bloc are rare. Most alignment changes occur when countries shift from unaligned to either the China or US bloc, or vice versa. China bloc countries never transition directly to the US bloc, while US bloc to China bloc transitions are possible but not frequent at all.

In contrast, for trade-based classifications, directly moving to opposing blocs are much more common, especially in the earlier period. During the transition from 2000-2005 to

2005-2016, more than half of the countries in the US trade bloc shifted directly to the China bloc, while 42.9% shifted in the opposite direction. In the later period, direct movement to opposite blocs became uncommon, but countries are more likely to shift to the unaligned group.

(a) MP: 2000-2005 to 2005-2016

From/To	CHN blocs	USA blocs	unaligned
CHN blocs	0.394	0.000	0.606
USA blocs	0.083	0.417	0.500
unaligned	0.290	0.161	0.548

(b) MP: 2005-2016 to 2016-2019

From/To	CHN blocs	USA blocs	unaligned
CHN blocs	0.522	0.000	0.478
USA blocs	0.200	0.500	0.300
unaligned	0.442	0.186	0.372

(c) Trade: 2000-2005 to 2005-2016

From/To	CHN blocs	USA blocs	unaligned
CHN blocs	0.143	0.429	0.429
USA blocs	0.579	0.053	0.368
unaligned	0.116	0.419	0.465

(d) Trade: 2005-2016 to 2016-2019

From/To	CHN blocs	USA blocs	unaligned
CHN blocs	0.222	0.222	0.556
USA blocs	0.080	0.320	0.600
unaligned	0.212	0.182	0.606

Table 5: Detailed Transition Matrices for Bloc Alignment

Notes: Detailed transition matrices showing country counts moving between specific bloc alignments across consecutive periods. Numbers are proportion of countries.

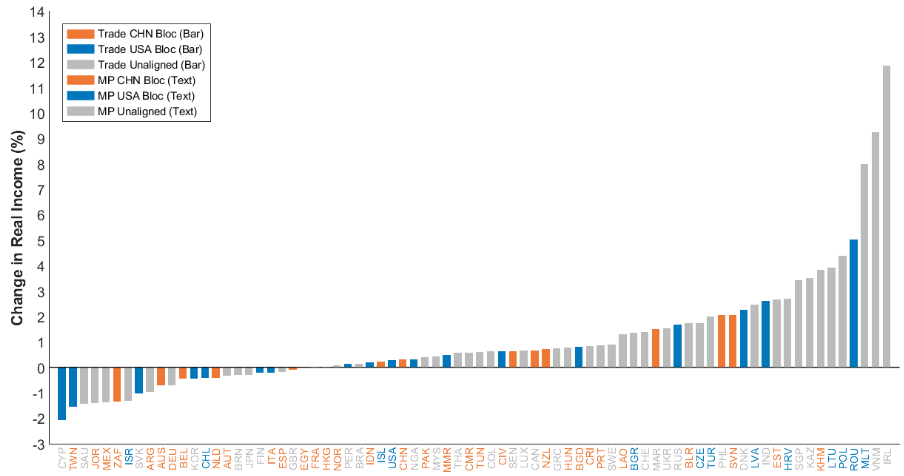
Finally, we also note that the unaligned category plays a notably different role across the two classification schemes. In MP-based networks, unaligned countries maintain relatively stable positions (37.2-54.8% retention), with balanced probabilities of joining either major bloc. For trade classifications, the unaligned category becomes increasingly important over time, with 55.6% of China bloc and 60.0% of US bloc countries transitioning to unaligned status in the later period. This growing trade non-alignment may reflect countries' strategic efforts to diversify economic partnerships and avoid excessive dependence on either major power, particularly as US-China trade tensions intensified after 2016.

5 Counterfactuals

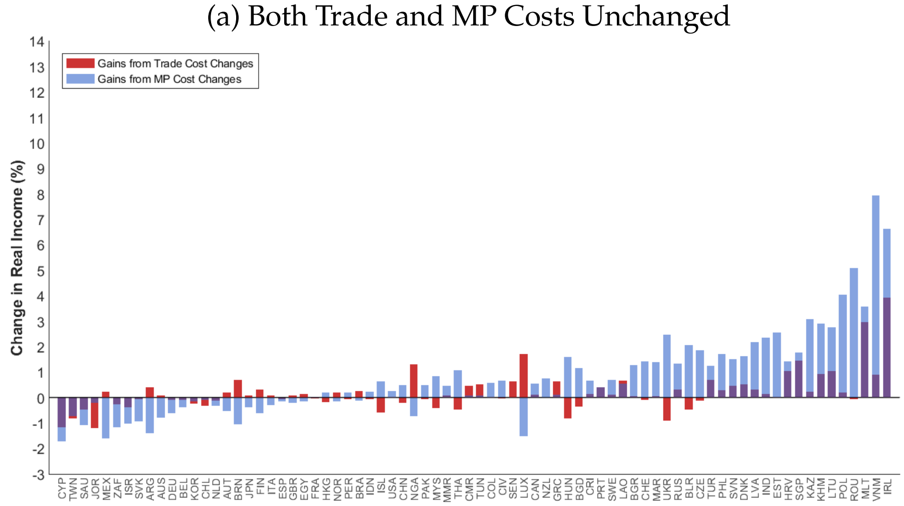
In this section of the paper we try to understand welfare effects of changes in MP and trade costs. We focus on the period from 2016 to 2019.

5.1 Fixing Costs

In this exercise, we evaluate how changes in trade and MP costs between 2016-2019 affected countries' welfare outcomes. For each country, we calculate counterfactual real income and real wages in 2019 while keeping its trade and MP costs fixed at 2016 levels, allowing knowledge stocks to evolve endogenously. We then compare these counterfactual outcomes to 2019 model-implied value.



(a) Both Trade and MP Costs Unchanged



(b) Fix Trade or MP Costs Separately

Figure 7: Counterfactual Change in Real Income (2016-2019)

Notes: The top panel shows the changes in real income from changes in both trade and MP costs for each economy. The bottom panel shows the changes in real income attributed to changes in MP costs or trade costs respectively. Each bar reports the percentage difference between 2019 model-implied value and counterfactual results where trade and/or MP costs are fixed at 2016 levels while knowledge stock evolves endogenously. The change is calculated as: (model-implied - counterfactual) / counterfactual $\times$ 100%.

Figure 7 shows that there is large heterogeneity in gains in real income across countries and blocs. The top panel reports the change in real income where both MP and trade costs were held at 2016 levels. We color code the bars to indicate trade blocs, and the colors of texts of country name indicate MP blocs. Ireland and Vietnam experienced the largest gains over 10%. Both economies were unaligned in trade and MP. Cyprus and Chinese

Bloc	Real Income (%)			Real Wage (%)		
	Median	p25	p75	Median	p25	p75
MP CHN Blocs	0.180	-0.430	0.772	0.238	-0.420	0.836
MP USA Blocs	1.984	0.255	4.046	1.851	0.308	3.941
MP Unaligned	0.646	-0.101	1.682	0.652	-0.175	1.816
Trade CHN Blocs	0.300	-0.430	0.911	0.439	-0.420	0.939
Trade USA Blocs	0.224	-0.430	0.793	0.200	-0.286	0.931
Trade Unaligned	0.752	0.001	2.104	0.718	-0.067	2.050
Overall	0.587	-0.216	1.708	0.577	-0.224	1.750

Table 6: Counterfactual Change (2016-2019)

Notes: This table reports the percentage difference between 2019 model-implied value and counterfactual results where trade and MP costs are fixed at 2016 levels while knowledge stock evolves endogenously. Statistics shown for different country groups classified by MP and trade bloc alignment.

Taipei would have the largest loss around 2%.

The bottom panel reports the results where we fix trade or MP costs respectively. While economies are sorted according to their values in the top panel, the blue bar also exhibits a general ordering of values from low to high, broadly following the the same pattern. Comparing the two counterfactual scenarios reveals that gains from changes in trade costs are generally less than MP costs. For most economies, these two have the same sign, but we also observe economies, especially those ranked in the middle, may have experienced opposite effects from changes in their trade and MP costs.

Table 6 shows distinct patterns in real income and real wage gains across different bloc alignments.[8] Countries in the USA MP bloc experienced the largest median gains, with real income 1.98% and real wages 1.85% higher in 2019 model-implied value compared to the counterfactual scenario with fixed costs. In contrast, China's MP bloc countries saw more modest median gains of 0.18% in real income and 0.24% in real wages. The median country in the USA trade bloc had a slightly smaller gain than its counterpart in China's trade bloc, which is outperformed by the median country in the trade unaligned group. The ranges of gains between the 25th and the 75th percentiles indicate substantial heterogeneity within blocs, with some countries experiencing negative changes while others saw gains exceeding 4%. Overall, the median country experienced gains of approximately 0.58% in both real income and real wages from the cost changes between 2016 and 2019.

[8] Within the same country, the difference between real income and real wage is tariff revenue.

5.2 Consistent Bloc Alignment Counterfactual

Countries do not always align with the same bloc in both trade and MP. Some may join either the China bloc or the U.S. bloc in trade while remaining non-aligned in MP. Others might adopt opposing alignments, such as partnering with the U.S. bloc on trade while aligning with China on MP. Is such approach to trade and MP policy rational?

To answer this question, we perform counterfactual exercises in which we put countries into different blocs and compare their welfare to the baseline. We follow Bonadio et al. (2025) and assume that when a country joins a bloc, the bilateral trade/MP cost between that country and all other countries will change, and these changes in bilateral costs will be similar to those observed among countries in the bloc it joins.

We first need to calculate counterfactual cost changes when considering bloc switching scenarios. We describe how we set counterfactual tariffs as follows. We set our counterfactual trade and MP costs similarly.

Denote the tariff component in trade costs as $\delta_{ij,t} = 1 + t_{ij,t}$ and the change rate from the beginning of the period (t0) to the end (t1) as $\dot{\delta}_{ij} = \frac{\delta_{ij,t1} - \delta_{ij,t0}}{\delta_{ij,t0}}$. For simplicity, time subscripts are suppressed from the following formulas. Specifically, we first calculate the average import and export tariff changes between each country m and a given bloc b. We calculate the average import cost change from country m to bloc b:

$$\dot{\delta}_{bm} = \frac{1}{N_b - \mathbf{1}_{\{m \in b\}}} \sum_{\substack{n \in b \\ n \neq m}} \dot{\delta}_{nm}.$$

And the average export cost change from bloc b to country m:

$$\dot{\delta}_{mb} = \frac{1}{N_b - \mathbf{1}_{\{m \in b\}}} \sum_{\substack{n \in b \\ n \neq m}} \dot{\delta}_{mn}.$$

Thus, we obtain the change rate in trade costs for any given country-bloc pair, reflecting the trade policy applied by a bloc toward a country and vice versa. When assuming a country joins a particular trade bloc and adopts its trade policy, we do not simply apply the bloc's average change rates to that country, as this would ignore the country's own average change rate in trade costs during the period. Instead, we use trade volume weights to calculate an adjustment factor based on the difference between the country's actual average change rate and the hypothetical average under the bloc's policy.

The import adjustment factor is applied to the trade costs a country faces when importing from other countries, while the export adjustment factor is used for the costs it faces when exporting to other countries. These adjustment factors ensure that the trade-volume-weighted average change rate in the country's trade costs remains consistent. The import adjustment factor and the export adjustment factor when country n joins bloc b are as follows:

$$\dot{\delta}_{n,im}^{b,\text{adj}} = \sum_{m \neq n} \frac{X_{nm}}{\sum_{m \neq n} X_{nm}} \dot{\delta}_{nm} - \sum_{m \neq n} \frac{X_{nm}}{\sum_{m \neq n} X_{nm}} \dot{\delta}_{bm}$$

$$\dot{\delta}_{n,ex}^{b,\text{adj}} = \sum_{m \neq n} \frac{X_{mn}}{\sum_{m \neq n} X_{mn}} \dot{\delta}_{mn} - \sum_{m \neq n} \frac{X_{mn}}{\sum_{m \neq n} X_{mn}} \dot{\delta}_{mb}$$

where X_{nm} represents the trade volume of products that country n purchases from country m at the beginning of the period (t0). We set the counterfactual trade cost change rate when putting country n into bloc b as:

$$\dot{\delta}_{n,m}^{\text{CF},b} = \dot{\delta}_{b,m} + \dot{\delta}_{n,im}^{b,\text{adj}}$$

$$\dot{\delta}_{m,n}^{\text{CF},b} = \dot{\delta}_{m,b} + \dot{\delta}_{n,ex}^{b,\text{adj}}$$

This approach ensures that after country n joins bloc b, the trade-volume-weighted average change rate of its counterfactual import trade costs matches the actual scenario, and the ordering of trade cost change rates applied by n to all partners mirrors that of the average member of bloc b. Similarly, the weighted average change rate of counterfactual export trade costs faced by n is preserved, and the ordering of change rates imposed on n by all other countries aligns with that faced by the average bloc b member.

We also set the counterfactual iceberg trade costs and MP costs in the same way.[9]

This counterfactual examines the impact of adjusting a country's trade or MP cost structure to align with bloc b, while keeping its average cost change constant. Although various combinations of country groups could be tested, we adjust one country at a time, maintaining the trade and MP cost change rates for all other countries at their actual observed values.

We focus on countries where trade and MP are aligned with different blocs. Table 7 presents the welfare effects for two possible bloc switches for countries where trade and MP are each aligned with different blocs: both trade and MP moving fully to the China bloc, and both trade and MP moving fully to the US bloc.

For countries where one of trade or MP is aligned and the other is not, tables 8 to 11 show the counterfactual welfare levels if both trade and MP were to fully align with the aligned bloc.

[9] We use MP flows (X_{mn}^{MP}) instead of trade flows (X_{mn}) to construct the weights for the average change rate in MP costs.

Our counterfactual focuses on the most recent period in our sample (2016–2019) and beyond. We assume that countries in the sample did not join their actual blocs in 2016 but instead joined the counterfactually assigned blocs. After calculating the counterfactual costs in 2019, we run the economy from 2019 onwards, with the 2019 knowledge stock level together with the counterfactual costs. We compare the welfare difference in 2019 between the counterfactual scenario and the actual trade and MP cost scenario to measure the static gains:

$$\text{Static Gains} = \log\left(\frac{C^{\text{CF}}_{i,2019}}{C^{\text{Benchmark}}_{i,2019}}\right),$$

where C_i is the aggregate consumption per worker in country i. We run the economy forward from 2019 with the cost parameters fixed in that year, allowing knowledge stocks to evolve endogenously. The benchmark uses the actual trade and MP costs in 2019, while the counterfactual uses the counterfactual trade and MP costs in 2019. We compare the difference between the counterfactual and the benchmark to quantify the gains from switching blocs, defined as the annual consumption equivalent variation:

$$\text{Welfare} = (1-\beta)\sum_j \beta^j \log\left(\frac{C^{\text{CF}}_{i,2019+j}}{C^{\text{Benchmark}}_{i,2019+j}}\right).$$

5.3 Welfare Effects of Bloc Realignment

We analyze counterfactual scenarios where countries with partial or split alignments achieve full bloc commitment. In this subsection, we calculate welfare implications of bloc realignment by implementing counterfactual MP and trade costs, incorporating both tariff and non-tariff iceberg cost components.

Our analysis examines six distinct groups based on initial alignment configurations.

Figure 8 shows the result compactly. The left panel presents results for economies joining the China bloc. For economies initially in the China MP bloc outside China trade bloc, joining entails switching to the China trade bloc. For economies initially in the China trade bloc but outside the China MP bloc, joining entails switching to the China MP bloc. The right panel presents analogous results for economies joining the US bloc.

When these economies shift from partial to full alignment with either China or the US, three distinct patterns emerge. First, the majority of economies lie in the third quadrant, exhibiting both negative static gains and negative welfare effects. This suggests that partial alignment reflects rational economic decision-making, as full alignment would generate adverse welfare outcomes in both static and long-run terms. Second, for economies

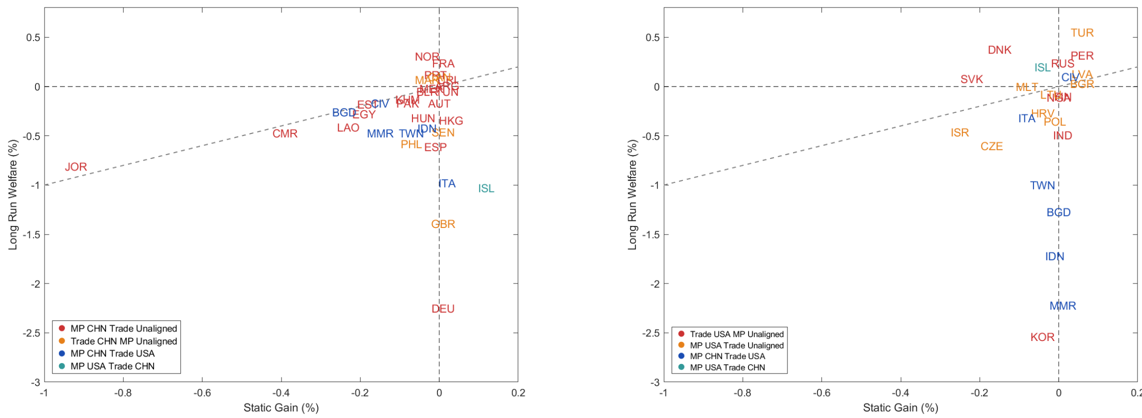


Figure 8: Welfare Effects of Bloc Realignment

Notes: The figure displays static and welfare gains from bloc realignment. The left panel presents results for economies joining the China bloc. For economies initially in the China MP bloc outside China trade bloc, joining entails switching to the China trade bloc. For economies initially in the China trade bloc but outside the China MP bloc, joining entails switching to the China MP bloc. The right panel presents analogous results for economies joining the US bloc. Welfare represents the annual consumption equivalent variation. Static gain measures the change in real consumption level in 2019 relative to the baseline.

switching to full alignment with China, welfare effects are smaller than static effects, indicating negative growth effects. Third, several economies would experience positive static and welfare gains from such realignment: Argentina, Costa Rica, and France when joining the China bloc; Latvia, Turkey, and Peru when joining the US bloc.

We discuss each country group in more details below.

5.3.1 *Split Alignments Between US and China*

Table 7 document results for economies with split alignments. Two patterns emerge from the welfare decomposition. First, apart from rare examples (Côte d'Ivoire, Italy, Myanmar, and Iceland), static gains of aligning trade and MP blocs are predominantly negative, indicating that forcibly consolidating trade and production activities within a single bloc may lead to efficiency losses in the short term.

Second, overall welfare gains are typically smaller than static gains because bloc consolidation disrupts the accumulation of knowledge stocks. When countries realign their production and trade relationships, they alter the channels through which technology diffuses across borders. The exercise shows that such changes will reduce overall diffusion through which countries can learn from other countries and improve their productivity, generating negative growth effects that compound over time. As a result, the immediate efficiency improvements from realignment are offset by slower economic growth driven

(a) MP CHN Bloc and Trade USA Bloc

	Both Join USA Bloc		Both Join CHN Bloc	
Economy	Welfare (%)	Static Gain (%)	Welfare (%)	Static Gain (%)
Bangladesh	-1.27	-0.00	-0.26	-0.24
Côte d'Ivoire	0.10	0.03	-0.17	-0.15
Indonesia	-1.72	-0.01	-0.42	-0.03
Italy	-0.32	-0.08	-0.98	0.02
Myanmar	-2.22	0.01	-0.47	-0.15
Chinese Taipei	-1.00	-0.04	-0.47	-0.07

(b) MP USA Bloc and Trade CHN Bloc

	Both Join USA Bloc		Both Join CHN Bloc	
Economy	Welfare (%)	Static Gain (%)	Welfare (%)	Static Gain (%)
Iceland	0.20	-0.04	-1.03	0.12

Table 7: Gains from Switching Bloc

Notes: This table presents welfare effects for economies with split alignments between the US and China blocs. Panel (a) list economies that are currently in China's MP bloc but aligned with the US trade bloc. Panel (b) list economies that is in the US MP bloc but aligned with China's trade bloc. The first two columns show the effects of both trade and MP joining the US bloc. The next two columns show the effects of both joining China's bloc. Welfare represents the annual consumption equivalent variation. Static gain measures the change in real consumption level in 2019 relative to the baseline.

by impaired technology diffusion. The mostly negative welfare results suggest that for this group of countries that split their alignment in trade or MP dimension across US and China blocs are likely doing so for good economic reasons. Iceland and Côte d'Ivoire would realize positive welfare gains by fully aligning with the U.S. trade and MP bloc.

5.3.2 *China MP Bloc with Trade Unaligned*

Table 8 shows the effects for economies in China MP bloc but unaligned in the trade dimension. Economies that are integrating into China's production networks show predominantly negative static effects from adding trade alignment, with 14 of 20 countries experiencing negative gains.

5 economies achieve positive overall welfare effects. The overall welfare effects depend on the relative importance between the immediate effects from trade bloc consolidation and long-term growth channels. Similar to what we observe in the previous group of economies, the overall welfare effects tend to be smaller than static gains, turning to negative in three cases (Germany, Hong Kong, Tunisia), while the opposite is true for

Economy	Welfare (%)	Static Gain (%)
Argentina	0.01	0.02
Austria	-0.17	-0.00
Belarus	-0.05	-0.03
Cameroon	-0.47	-0.39
Costa Rica	0.07	0.02
Germany	-2.25	0.01
Egypt	-0.28	-0.19
Spain	-0.61	-0.01
Estonia	-0.18	-0.18
France	0.24	0.01
Hong Kong	-0.34	0.03
Hungary	-0.32	-0.04
Jordan	-0.81	-0.92
Cambodia	-0.13	-0.08
Lao	-0.41	-0.23
Mexico	-0.02	-0.02
Norway	0.31	-0.03
Pakistan	-0.17	-0.08
Portugal	0.12	-0.01
Tunisia	-0.05	0.02

Table 8: Gains from Joining China Trade Bloc

Notes: This table shows welfare effects for economies currently in China's multinational production bloc but unaligned in trade. The counterfactual examines the effects of these economies joining China's trade bloc, thereby achieving full alignment with China. Welfare represents the annual consumption equivalent variation. Static gain measures the change in real consumption level in 2019 relative to the baseline.

Norway. In this group, Argentina, Costa Rica, and France are examples that benefit from full China alignment in both dimensions.

5.3.3 *China Trade Bloc with MP Unaligned*

Table 9 shows that more than half of the countries in the China trade bloc experience welfare losses from adding MP alignment. Meanwhile, more than half of the countries exhibit inconsistent directions between their overall welfare effects and static gains. The United Kingdom faces the most severe welfare losses in this group, despite registering a minimal static gain (0.01%).

This pattern of losses validates these countries' decisions to remain outside China's MP networks despite trade relationships. The results suggest that trade relationships with China do not necessarily imply complementarities in production. The negative static effects

Economy	Welfare (%)	Static Gain (%)
Canada	0.10	0.00
United Kingdom	-1.39	0.01
Morocco	0.07	-0.03
Philippines	-0.58	-0.07
Senegal	-0.46	0.01

Table 9: Gains from Switching Bloc (Trade CHN Bloc and MP Unaligned)

Notes: This table shows welfare effects for countries currently in China's trade bloc but unaligned in multinational production. The counterfactual examines the effects of these countries joining China's multinational production bloc, thereby achieving full alignment with China. Welfare represents the annual consumption equivalent variation. Static gain measures the change in real consumption level in 2019 relative to the baseline.

indicate that reorganizing production toward China would disrupt more efficient existing arrangements, while negative welfare effects suggest that these countries benefit more from their current technology access channels than they would from Chinese production integration.

5.3.4 *US MP Bloc with Trade Unaligned*

Economy	Welfare (%)	Static Gain (%)
Bulgaria	0.03	0.06
Czech Republic	-0.60	-0.17
Croatia	-0.27	-0.04
Israel	-0.46	-0.25
Lithuania	-0.08	-0.02
Latvia	0.13	0.06
Malta	-0.00	-0.08
Poland	-0.35	-0.01
Turkey	0.55	0.06

Table 10: Gains from Switching Bloc (MP USA Bloc and Trade Unaligned)

Notes: This table presents welfare effects for countries currently in the US multinational production bloc but unaligned in trade. The counterfactual analyzes the effects of these countries joining the US trade bloc, thereby achieving full alignment with the United States. Welfare represents the annual consumption equivalent variation. Static gain measures the change in real consumption level in 2019 relative to the baseline.

Table 10 presents results for economies that are aligned with the US in MP but unaligned with either US or China in Trade: while the direction of static gains aligns with welfare changes, the magnitude of welfare changes increases. Among the nine member states in the US multinational production bloc, six would experience welfare losses after joining the US trade agreement, with the magnitude ranging from -0.00% to -0.60%. This result echoes the previous message that the overall welfare from switching into a different alignment would be negative.

5.3.5 *US Trade Bloc with MP Unaligned*

Economy	Welfare (%)	Static Gain (%)
Cyprus	-6.86	-2.03
Denmark	0.38	-0.15
Finland	-0.10	0.01
India	-0.49	0.01
South Korea	-2.54	-0.04
Nigeria	-0.11	0.00
Peru	0.32	0.06
Russia	0.24	0.01
Slovakia	0.08	-0.22

Table 11: Gains from Joining US MP Bloc

Notes: This table presents welfare effects for countries currently in the US trade bloc but unaligned in multinational production. The counterfactual analyzes the effects of these countries joining the US multinational production bloc, thereby achieving full alignment with the United States. Welfare represents the annual consumption equivalent variation. Static gain measures the change in real consumption level in 2019 relative to the baseline.

Table 11 presents results for economies that are aligned with the US in trade but unaligned with either US or China in MP. Approximately half of the economies achieved positive static gains and welfare improvements, though the magnitude of static gains remained generally modest. It is noteworthy that welfare changes exhibited directional inconsistencies with static gains in many economies (Denmark, Finland, India, Nigeria, and Slovakia), while the amplitude of welfare changes would be magnified.

The overall welfare effects are similarly mixed. While Denmark (0.38%), Peru (0.32%), Russia (0.24%), and Slovakia (0.08%) would experience welfare improvements from joining the US MP bloc, the majority of countries face welfare losses, with Cyprus (-6.86%) and South Korea (-2.54%) experiencing particularly substantial declines.

5.3.6 Summary

For countries that do not align with the same bloc in both trade and MP, if they were to switch their bloc alignment such that their trade and MP alignment are in the same direction, we find that the welfare effect for most economies would be negative. This suggests that the current patterns of misalignment may reflect economically rational choices by countries to maintain their existing economic arrangements. However, there are also situations where such realignment can bring positive welfare gains (examples in sections 5.3.2 and 5.3.5). For these countries, the current arrangements may reflect other considerations beyond pure economic reasons.

Second, bloc consolidation also involves trade-offs between static efficiency and dynamic growth effects. For example, adding China trade alignment generates positive static gains for many countries in the China MP bloc but unaligned in trade. However, these static gains are not always fully offset negative growth effects. Among economies in the China MP bloc but unaligned in trade that achieved positive static gain, 3 of 6 experience negative overall welfare despite positive static gains.

5.4 Changing Tariffs Only

In section 5.3, when we consider counterfactuals where countries change in trade bloc alignment, we modify both the tariff and the non-tariff components of the trade costs. In this section, we revisit the question by only changing the tariff component of the trade costs.

Economy	Welfare (%)	Static Gain (%)
Bangladesh	-0.02	-0.02
Côte d'Ivoire	0.00	0.00
Indonesia	-0.00	0.01
Italy	-0.05	-0.00
Myanmar	0.09	0.02
Chinese Taipei	0.00	-0.00
Iceland	0.01	0.00

Table 12: Gains from Switching Bloc

Notes: This table presents welfare effects for economies with split alignments between the US and China blocs. For each country, we change the trade alignment to be consistent with its MP alignment by changing the tariffs only. Welfare represents the annual consumption equivalent variation. Static gain measures the change in real consumption level in 2019 relative to the baseline.

Table 12 shows the result for countries that have split alignments between US and China. For each country, we change the trade alignment to be consistent with its MP alignment by changing the tariffs only.

Economy	Welfare (%)	Static Gain (%)
Argentina	-0.01	-0.00
Austria	-0.02	-0.01
Belarus	0.11	0.08
Cameroon	0.00	-0.00
Costa Rica	0.02	0.01
Germany	-0.08	-0.01
Egypt	0.00	0.01
Spain	-0.03	-0.00
Estonia	-0.01	-0.01
France	-0.02	-0.01
Hong Kong	-0.04	0.01
Hungary	-0.03	-0.01
Jordan	-0.01	0.01
Cambodia	-0.01	-0.02
Lao	0.04	0.02
Mexico	0.01	-0.00
Norway	-0.06	-0.00
Pakistan	0.01	0.00
Portugal	-0.01	-0.01
Tunisia	-0.00	-0.01

Table 13: Gains from Joining China Trade Bloc

Notes: This table shows welfare effects for economies currently in China's multinational production bloc but unaligned in trade. The counterfactual examines the effects of these economies joining China's trade bloc, but changing only the tariffs. Welfare represents the annual consumption equivalent variation. Static gain measures the change in real consumption level in 2019 relative to the baseline.

Table 13 shows the results for economies in China MP bloc but unaligned along the trade dimension. For each country, we calculate the counterfactual welfare where the tariff changes of this country is as if the country switches to the China trade bloc as well. Table 14 show the results for countries in the US MP bloc but unaligned along the trade dimension. We also only change tariffs, leaving the non-tariff components untouched.

The results parallel those in Section 5.3, with more than half of the economies exhibiting negative welfare effects and even exhibiting opposite signs to static gains in some economies. However, a crucial difference emerges: both static gains and welfare effects are an order of magnitude smaller when adjusting tariffs alone. These findings indicate

Economy	Welfare (%)	Static Gain (%)
BGR	0.03	0.02
CZE	0.01	0.01
HRV	0.00	-0.00
ISR	-0.02	-0.00
LTU	0.03	0.02
LVA	0.02	0.01
MLT	-0.00	-0.00
POL	0.01	0.01
TUR	-0.00	0.00

Table 14: Gains from Switching Bloc (MP USA Bloc and Trade Unaligned)

Notes: This table presents welfare effects for countries currently in the US multinational production bloc but unaligned in trade. The counterfactual analyzes the effects of these countries joining the US trade bloc, but changing only the tariffs. Welfare represents the annual consumption equivalent variation. Static gain measures the change in real consumption level in 2019 relative to the baseline.

that the primary drivers of recent trade cost changes are non-tariff components such as transportation costs, non-tariff barrier, and geopolitical tensions (Fan et al., 2025).

6 Concluding Remarks

We recover bilateral MP and trade costs from 2000 to 2019 and classify countries into China blocs, US blocs, or unaligned categories across three periods: 2000-2005, 2005-2016, and 2016-2019. The classification reveals distinct patterns between trade and MP dimensions. In trade-based classification, most countries remain unaligned with balanced US and China bloc membership. In MP-based classification, the majority of countries align with one major power, with China's MP bloc consistently larger than the US bloc while the US maintains more trade bloc members. Direct transitions between opposing blocs occur rarely in MP networks but more frequently in trade, suggesting stronger path dependencies in production relationships.

Counterfactual analysis shows that consolidating split alignments would reduce welfare for most countries, with effects ranging from -6.86% to 0.55%. Among economies with split alignments between US and China, most experience negative welfare outcomes. For countries in China's MP bloc but unaligned in trade, 16 of 20 would face welfare losses from adding trade alignment. Welfare effects frequently diverge from static gains due to disrupted technology diffusion channels: countries like Germany, Hong Kong, and Tunisia experience negative welfare despite positive static gains. While a minority of countries would benefit from consolidation, the predominance of negative welfare effects suggests current alignment patterns reflect economic optimization rather than policy failure. When we restrict counterfactual analysis to tariff changes only, welfare effects diminish by an order of magnitude, indicating that non-tariff barriers and broader economic integration measures drive most welfare implications of bloc alignment.

References

Abeliansky, Ana, and Julian Mayrhuber. 2025. "Geopolitical distance and international trade." *Security through stability.* 51.

Aiyar, Shekhar, Davide Malacrino, and Andrea F Presbitero. 2024. "Investing in friends: The role of geopolitical alignment in fdi flows." *European Journal of Political Economy* 83 102508.

Alesina, Alberto, Enrico Spolaore, and Romain Wacziarg. 2000. "Economic integration and political disintegration." *American Economic Review* 90 (5): 1276–1296.

Alfaro, Laura, and Davin Chor. 2023. "Global Production Networks: The Looming 'Great Reallocation." *Structural Shifts in the Global Economy* 213.

Alvarez, Fernando E, Francisco J Buera, and Robert E Lucas. 2013. "Idea flows, economic growth, and trade." *National Bureau of Economic Research Working Paper*.

Alviarez, Vanessa, Javier Cravino, and Natalia Ramondo. 2023. "Firm-Embedded Productivity and Cross-Country Income Differences." *Journal of Political Economy* 131 (9): 2289–2327.

Amiti, Mary, Stephen J Redding, and David E Weinstein. 2019. "The impact of the 2018 tariffs on prices and welfare." *Journal of Economic perspectives* 33 (4): 187–210.

Antràs, Pol. 2020. "De-globalisation? Global value chains in the post-COVID-19 age."Technical report, National Bureau of Economic Research.

Arkolakis, Costas, Natalia Ramondo, Andrés Rodríguez-Clare, and Stephen Yeaple. 2018. "Innovation and Production in the Global Economy." *American Economic Review* 108 2128–73.

Attinasi, Maria-Grazia, Lukas Boeckelmann, and Baptiste Meunier. 2025. "The economic costs of supply chain decoupling." *The World Economy* 48 (3): 598–627.

Becko, John Sturm, and Daniel O'Connor. 2024. "Strategic (dis) integration."Technical report, Working paper.

Benhabib, Jess, Jesse Perla, and Christopher Tonetti. 2021. "Reconciling Models of Diffusion and Innovation: A Theory of the Productivity Distribution and Technology Frontier." *Econometrica* 89 2261–2301.

Bernard, Andrew B., Jonathan Eaton, J. Bradford Jensen, and Samuel Kortum. 2003. "Plants and Productivity in International Trade." *American Economic Review* 93 1268–1290.

Bonadio, Barthélémy, Zhen Huo, Elliot Kang, Andrei A Levchenko, Nitya Pandalai-Nayar, Hiroshi Toma, and Petia Topalova. 2025. "Playing with blocs: Quantifying decoupling." *Working Paper*.

Buera, Francisco J., and Ezra Oberfield. 2020. "The Global Diffusion of Ideas." *Econometrica* 88 83–114.

Cadestin, Charles, Koen De Backer, Isabelle Desnoyers-James, Sébastien Miroudot, Davide Rigo, and Ming Ye. 2018. "Multinational Enterprises and Global Value Chains: The OECD Analytical AMNE Database." OECD Trade Policy Papers 211, OECD Publishing.

Cai, Jie, Nan Li, and Ana Maria Santacreu. 2022. "Knowledge Diffusion, Trade, and Innovation across Countries and Sectors." *American Economic Journal: Macroeconomics* 14 104–45.

Cai, Sheng, Lorenzo Caliendo, Fernando Parro, and Wei Xiang. 2025. "Mechanics of Spatial Growth." *Working Paper.*

Cai, Sheng, and Wei Xiang. 2025. "Multinational production, technology diffusion, and economic growth." *Journal of International Economics* 104137.

Caliendo, Lorenzo, Maximiliano Dvorkin, and Fernando Parro. 2019. "Trade and Labor Market Dynamics: General Equilibrium Analysis of the China Trade Shock." *Econometrica* 87 741–835.

Caliendo, Lorenzo, Luca David Opromolla, Fernando Parro, and Alessandro Sforza. 2021. "Goods and factor market integration: A quantitative assessment of the EU enlargement." *Journal of Political Economy* 129 (12): 3491–3545.

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

Caliendo, Lorenzo, and Fernando Parro. 2020. "The quantitative effects of trade policy on industrial and labor location." *Yale University and Pennsylvania State University, mimeo*.

Clayton, Christopher, Antonio Coppola, Matteo Maggiori, and Jesse Schreger. 2025a. "Geoeconomic Pressure." *Columbia Business School Research Paper Forthcoming, Stanford University Graduate School of Business Research Paper Forthcoming*.

Clayton, Christopher, Matteo Maggiori, and Jesse Schreger. 2025b. "The political economy of geoeconomic power." In *AEA Papers and Proceedings*, Volume 115. 588–592, American Economic Association 2014 Broadway, Suite 305, Nashville, TN 37203.

Couttenier, Mathieu, Julien Marcoux, Thierry Mayer, and Mathias Thoenig. 2024. "The Gravity of Violence." CEPR Discussion Paper 19527, Centre for Economic Policy Research, Paris and London, https://cepr.org/publications/dp19527.

Dhingra, Swati, and Thomas Sampson. 2022. "Expecting brexit." *Annual Review of Economics* 14 (1): 495–519.

Eaton, Jonathan, and Samuel Kortum. 1999. "International technology diffusion: Theory and measurement." *International Economic Review* 40 (3): 537–570.

Fajgelbaum, Pablo, Pinelopi Goldberg, Patrick Kennedy, Amit Khandelwal, and Daria

Taglioni. 2024. "The US-China trade war and global reallocations." *American Economic Review: Insights* 6 (2): 295–312.

Fan, Jingting. 2025. "Talent, Geography, and Offshore R&D." *Review of Economic Studies* 92 (2): 1022–1060.

Fan, Tianyu, Mai Wo, and Wei Xiang. 2025. "Geopolitical Barriers to Globalization." *arXiv preprint arXiv:2509.12084*.

Feenstra, Robert C., Robert Inklaar, and Marcel P. Timmer. 2015. "The Next Generation of the Penn World Table." *American Economic Review* 105 (10): 3150–3182.

Goldberg, Pinelopi, and Tristan Reed. 2023. "Is the global economy deglobalizing?" *Brookings Papers on Economic Activity Spring* (2): .

Gopinath, Gita, Pierre-Olivier Gourinchas, Andrea F Presbitero, and Petia Topalova. 2025. "Changing global linkages: A new Cold War?" *Journal of International Economics* 153 104042.

Hirschman, Albert O. 1945. *National power and the structure of foreign trade*. Volume 105. Univ of California Press.

Keller, Wolfgang, and Stephen Ross Yeaple. 2013. "The Gravity of Knowledge." *American Economic Review* 103 1414–44.

Kortum, Samuel S. 1997. "Research, Patenting, and Technological Change." *Econometrica* 65 1389–1419.

Li, Haishi. 2023. "Multinational production and global shock propagation during the great recession."

Lind, Nelson, and Natalia Ramondo. 2022. "Global Innovation and Knowledge Diffusion." *National Bureau of Economic Research Working Paper*.

Lu, Dan, Jiaqi Li, and Xiaofeng Li. 2025. "Optimal Policy with Multinational Production and Trade." *Available at SSRN 5293071*.

Lucas, Robert E. 2009. "Ideas and growth." *Economica* 76 (301): 1–19.

Mayer, Thierry, Isabelle Mejean, and Mathias Thoenig. 2025. "The fragmentation paradox: De-risking trade and global safety."Technical report, working paper.

Mohr, Cathrin, and Christoph Trebesch. 2025. "Geoeconomics." *Annual Review of Economics* 17.

OECD. 2025. "OECD Inter-Country Input-Output Tables." OECD Publishing, http://oe.cd/icio.

Pellegrino, Bruno, Enrico Spolaore, and Romain Wacziarg. 2025. "Barriers to global capital allocation." *The Quarterly Journal of Economics* qjaf031.

Perla, Jesse, Christopher Tonetti, and Michael E Waugh. 2021. "Equilibrium Technology Diffusion, Trade, and Growth." *American Economic Review* 111 73–128.

Qiu, Han, Fan Dora Xia, and James Yetman. 2025. *The role of geopolitics in international trade*. Bank for International Settlements, Monetary and Economic Department.

Ramondo, Natalia, and Andrés Rodríguez-Clare. 2013. "Trade, multinational production, and the gains from openness." *Journal of Political Economy* 121 273–322.

Sampson, Thomas. 2017. "Brexit: the economics of international disintegration." *Journal of Economic perspectives* 31 (4): 163–184.

Teti, Feodora A. 2024. "Missing Tariffs." Feodora Teti's Global Tariff Database (v_beta1-2024-12).

Tintelnot, Felix. 2017. "Global Production with Export Platforms." *The Quarterly Journal of Economics* 132 157–209.

Xiang, Wei. 2023. "Clean Growth and Environmental Policies in the Global Economy." *Available at SSRN 4619717*.

Yamano, Norihiko, Ali Alsamawi, Colin Webb, Agnès Cimper, Carmen Zürcher, and Ricardo Chiapin Pechansky. 2023. "Development of the OECD Inter-Country Input-Output Database 2023." OECD Science, Technology and Industry Working Papers 2023/08, OECD Publishing.

A MP and Trade Blocs

In this section we list the bloc alignment for all countries in tables A.1 to A.3.

Economy	MP	Trade	Economy	MP	Trade
BRA	CHN	CHN	IRL	USA	Unaligned
CHN	CHN	CHN	LTU	USA	Unaligned
HKG	CHN	CHN	LVA	USA	Unaligned
JPN	CHN	CHN	POL	USA	Unaligned
MEX	CHN	CHN	ROU	USA	Unaligned
SAU	CHN	CHN	SVK	USA	Unaligned
AUS	CHN	USA	TUR	USA	Unaligned
CAN	CHN	USA	BGD	Unaligned	CHN
CIV	CHN	USA	EGY	Unaligned	CHN
ESP	CHN	USA	JOR	Unaligned	CHN
GBR	CHN	USA	MYS	Unaligned	CHN
ITA	CHN	USA	NGA	Unaligned	CHN
MMR	CHN	USA	PER	Unaligned	CHN
NZL	CHN	USA	SGP	Unaligned	CHN
PAK	CHN	USA	TWN	Unaligned	CHN
ARG	CHN	Unaligned	DNK	Unaligned	USA
BEL	CHN	Unaligned	FIN	Unaligned	USA
BLR	CHN	Unaligned	FRA	Unaligned	USA
CHL	CHN	Unaligned	HUN	Unaligned	USA
CMR	CHN	Unaligned	ISL	Unaligned	USA
COL	CHN	Unaligned	LUX	Unaligned	USA
CRI	CHN	Unaligned	NOR	Unaligned	USA
DEU	CHN	Unaligned	SEN	Unaligned	USA
GRC	CHN	Unaligned	SWE	Unaligned	USA
IDN	CHN	Unaligned	AUT	Unaligned	Unaligned
KAZ	CHN	Unaligned	BRN	Unaligned	Unaligned
KHM	CHN	Unaligned	CHE	Unaligned	Unaligned
LAO	CHN	Unaligned	CYP	Unaligned	Unaligned
MAR	CHN	Unaligned	IND	Unaligned	Unaligned
PHL	CHN	Unaligned	ISR	Unaligned	Unaligned
TUN	CHN	Unaligned	KOR	Unaligned	Unaligned
UKR	CHN	Unaligned	MLT	Unaligned	Unaligned
ZAF	CHN	Unaligned	NLD	Unaligned	Unaligned
USA	USA	USA	PRT	Unaligned	Unaligned
BGR	USA	Unaligned	RUS	Unaligned	Unaligned
CZE	USA	Unaligned	SVN	Unaligned	Unaligned
EST	USA	Unaligned	THA	Unaligned	Unaligned
HRV	USA	Unaligned	VNM	Unaligned	Unaligned

Table A.1: Bloc Alignment, 2000-2005

Economy	MP	Trade	Economy	MP	Trade
AUT	CHN	CHN	GBR	Unaligned	CHN
CAN	CHN	CHN	ITA	Unaligned	CHN
CHN	CHN	CHN	MEX	Unaligned	CHN
CIV	CHN	CHN	POL	Unaligned	CHN
FIN	CHN	CHN	TUR	Unaligned	CHN
NOR	CHN	CHN	BGD	Unaligned	USA
SWE	CHN	CHN	BRA	Unaligned	USA
BLR	CHN	USA	CHL	Unaligned	USA
BRN	CHN	USA	COL	Unaligned	USA
KAZ	CHN	USA	CRI	Unaligned	USA
KHM	CHN	USA	EGY	Unaligned	USA
LAO	CHN	USA	IND	Unaligned	USA
TUN	CHN	USA	MAR	Unaligned	USA
UKR	CHN	USA	PER	Unaligned	USA
CHE	CHN	Unaligned	PHL	Unaligned	USA
GRC	CHN	Unaligned	RUS	Unaligned	USA
IRL	CHN	Unaligned	SAU	Unaligned	USA
MMR	CHN	Unaligned	SGP	Unaligned	USA
MYS	CHN	Unaligned	THA	Unaligned	USA
PAK	CHN	Unaligned	ARG	Unaligned	Unaligned
TWN	CHN	Unaligned	AUS	Unaligned	Unaligned
VNM	CHN	Unaligned	BEL	Unaligned	Unaligned
ZAF	CHN	Unaligned	CMR	Unaligned	Unaligned
CYP	USA	USA	HKG	Unaligned	Unaligned
KOR	USA	USA	IDN	Unaligned	Unaligned
MLT	USA	USA	ISR	Unaligned	Unaligned
USA	USA	USA	JOR	Unaligned	Unaligned
ISL	USA	CHN	JPN	Unaligned	Unaligned
BGR	USA	Unaligned	LTU	Unaligned	Unaligned
EST	USA	Unaligned	LUX	Unaligned	Unaligned
HRV	USA	Unaligned	LVA	Unaligned	Unaligned
HUN	USA	Unaligned	NGA	Unaligned	Unaligned
SVK	USA	Unaligned	NLD	Unaligned	Unaligned
CZE	Unaligned	CHN	NZL	Unaligned	Unaligned
DEU	Unaligned	CHN	PRT	Unaligned	Unaligned
DNK	Unaligned	CHN	ROU	Unaligned	Unaligned
ESP	Unaligned	CHN	SEN	Unaligned	Unaligned
FRA	Unaligned	CHN	SVN	Unaligned	Unaligned

Table A.2: Bloc Alignment, 2005-2016

Economy	MP	Trade	Economy	MP	Trade
AUS	CHN	CHN	CZE	USA	Unaligned
BEL	CHN	CHN	HRV	USA	Unaligned
CHN	CHN	CHN	LTU	USA	Unaligned
NLD	CHN	CHN	LVA	USA	Unaligned
NZL	CHN	CHN	MLT	USA	Unaligned
SVN	CHN	CHN	POL	USA	Unaligned
ZAF	CHN	CHN	TUR	USA	Unaligned
BGD	CHN	USA	CAN	Unaligned	CHN
CIV	CHN	USA	GBR	Unaligned	CHN
IDN	CHN	USA	MAR	Unaligned	CHN
ITA	CHN	USA	PHL	Unaligned	CHN
MMR	CHN	USA	SEN	Unaligned	CHN
TWN	CHN	USA	CYP	Unaligned	USA
ARG	CHN	Unaligned	DNK	Unaligned	USA
AUT	CHN	Unaligned	FIN	Unaligned	USA
BLR	CHN	Unaligned	IND	Unaligned	USA
CMR	CHN	Unaligned	KOR	Unaligned	USA
CRI	CHN	Unaligned	NGA	Unaligned	USA
DEU	CHN	Unaligned	PER	Unaligned	USA
EGY	CHN	Unaligned	RUS	Unaligned	USA
ESP	CHN	Unaligned	SVK	Unaligned	USA
EST	CHN	Unaligned	BRA	Unaligned	Unaligned
FRA	CHN	Unaligned	BRN	Unaligned	Unaligned
HKG	CHN	Unaligned	CHE	Unaligned	Unaligned
HUN	CHN	Unaligned	COL	Unaligned	Unaligned
JOR	CHN	Unaligned	GRC	Unaligned	Unaligned
KHM	CHN	Unaligned	IRL	Unaligned	Unaligned
LAO	CHN	Unaligned	JPN	Unaligned	Unaligned
MEX	CHN	Unaligned	KAZ	Unaligned	Unaligned
NOR	CHN	Unaligned	LUX	Unaligned	Unaligned
PAK	CHN	Unaligned	MYS	Unaligned	Unaligned
PRT	CHN	Unaligned	SAU	Unaligned	Unaligned
TUN	CHN	Unaligned	SGP	Unaligned	Unaligned
ISL	USA	CHN	SWE	Unaligned	Unaligned
CHL	USA	USA	THA	Unaligned	Unaligned
ROU	USA	USA	UKR	Unaligned	Unaligned
USA	USA	USA	VNM	Unaligned	Unaligned
BGR	USA	Unaligned			

Table A.3: Bloc Alignment, 2016-2019

B Tariff and Non-Tariff Trade Costs

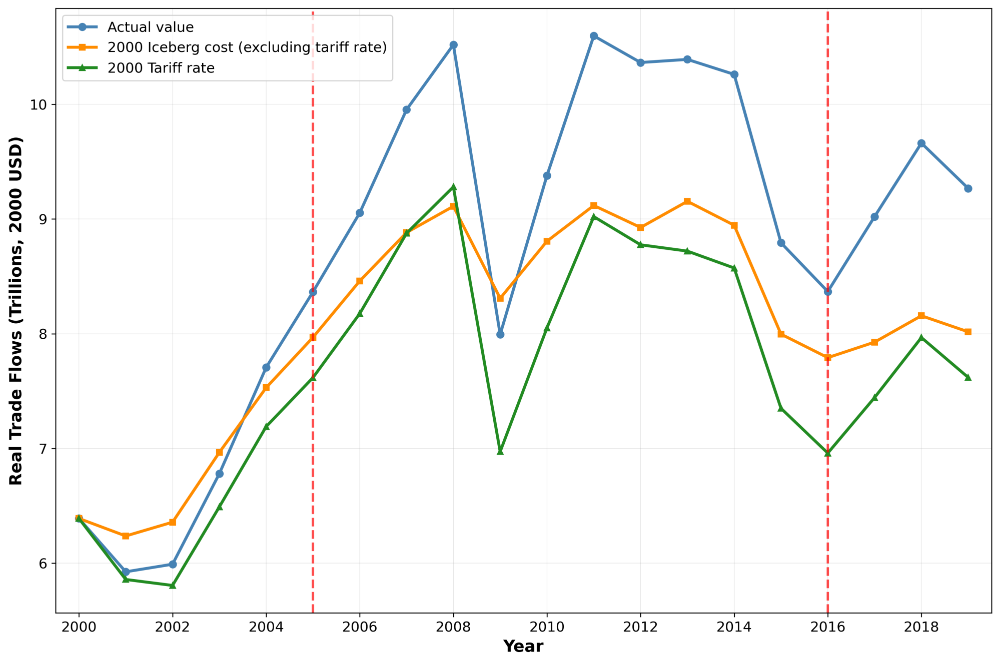


Figure 9: Trade Flows

Notes: This figure shows the time series of aggregate trade flows between countries from 2000 to 2019 under different counterfactuals.

B.1 Change Non-Tariff Trade Costs Only

Figure 10 shows the result compactly for counterfactuals where countries switch trade blocs. The graph is similar to 8, complementing the results in section 5.4 that changes in the non-tariff component of trade costs seem to be more important during the period from 2016 to 2019.

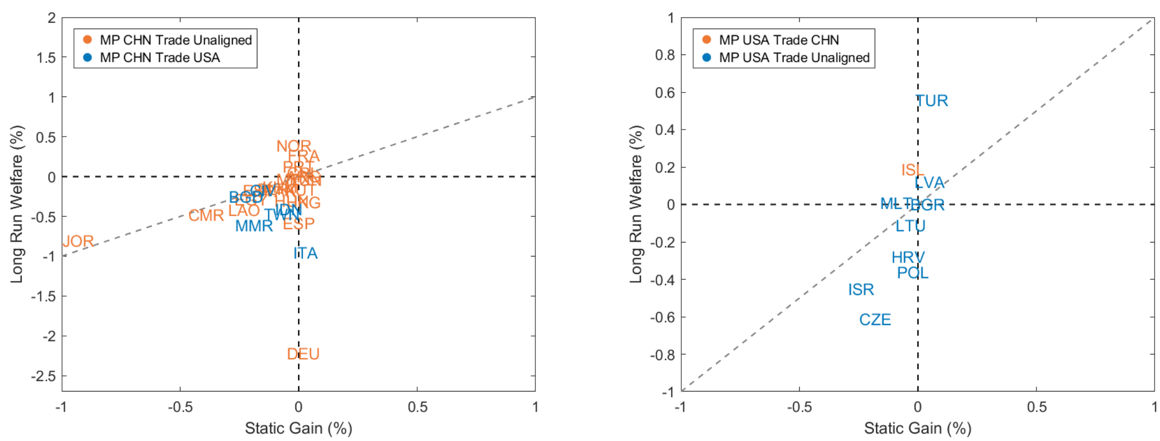


Figure 10: Welfare Effects of Bloc Realignment

Notes: The figure displays static and welfare gains from bloc realignment. The left panel presents results for economies joining the China bloc. For economies initially in the China MP bloc outside China trade bloc, joining entails switching to the China trade bloc. The right panel presents analogous results for economies joining the US bloc. We only change the non-tariff component of trade costs when switching trade blocs. Welfare represents the annual consumption equivalent variation. Static gain measures the change in real consumption level in 2019 relative to the baseline.