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Evaluating Tariff Shock Propagation in an Integrated Demand System–MRIO Framework*

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Abstract

This paper introduces a framework that integrates Quadratic Almost Ideal Demand System (QUAIDS) elasticities with the ADB Multi-Region Input–Output (MRIO) database to evaluate the direct and indirect impacts of tariffs on Value Added at the country-sector level. Using the data on USA tariffs imposed in September 2025, results reveal a broad-based contraction in global value added by –0.52%, with indirect effects roughly twice as large as direct ones. While, direct effects are concentrated in traded manufacturing sectors such as textiles, chemicals, and machinery, the majority of total losses arise from indirect spillovers into services and infrastructure, including transport, telecommunications, finance, and public spending. Losses are widespread, where more than 90% of countries experience declines, with South Asia and North America the most affected, while Europe and East Asia show greater resilience. India (–5.8%) and the United States (–3.2%) face strong contractions, while China's large domestic market cushions much of the shock. These findings highlight the systemic nature of tariff shocks and their asymmetric propagation across countries and sectors that factors in structural dependence across the global economy. By embedding non-linear demand responses within a structural MRIO framework, the study provides a transparent, policy-relevant tool for evaluating shocks to global production networks.

Keywords: Quadratic Almost Ideal Demand System (QUAIDS); Multi-Regional Input–Output (MRIO); Tariffs; Production networks; Indirect impacts

JEL: F13, F14, F17, C67, D12, D57, O47

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1 Introduction

The effects of trade shocks remain a central question in international economics, particularly as global production has become increasingly fragmented across borders and industries. Tariffs and other trade barriers not only affect the directly targeted goods, but also transmit through complex input–output linkages, creating substantial second round effects that alter production, consumption, and value-added across countries and sectors (Johnson, 2014; Los et al., 2015; Antràs & Gortari, 2020). Understanding these propagation mechanisms has become essential for assessing the true incidence and welfare implications of trade policy.

Traditional trade models explain how countries and sectors adjust to policy shocks through substitution elasticities, capturing how trade flows and domestic production respond to changes in relative prices (Hertel, 1996; Anderson & van Wincoop, 2003; Caliendo & Parro, 2015; Yotov et al., 2016). However, these models typically rely on aggregate elasticity parameters that are calibrated from external meta-studies or imposed assumptions rather than estimated from observed behavior. As a result, they often abstract from heterogeneous and non-linear demand responses across income levels, goods, and regions.

In contrast, Input–Output (IO) and Multi-Regional Input–Output (MRIO) frameworks provide a detailed accounting of inter-country and inter-sectoral production linkages that can be used to trace how shocks propagate through global value chains (Miller & Blair, 2009). Yet, such models typically assume fixed technical coefficients and linear relationships, meaning that substitution and demand adjustments are not explicitly modeled. MRIO analyses thus capture the mechanical propagation of shocks through production networks, but not the behavioral mechanisms driving demand shifts.

This paper bridges these two strands of research by integrating an empirically estimated demand system with the structural production network of an MRIO framework. Specifically, we estimate non-linear and non-homothetic demand elasticities using a Quadratic Almost Ideal Demand System (QUAIDS) (Banks et al., 1997; Naqvi, 2025), applied to reshaped data from the Asian Development Bank's Multi-Regional Input–Output (ADB MRIO) database (ADB, 2025). The dataset covers 62 countries plus a Rest of World (RoW) aggregate and provides consistently defined intersectoral flows, trade shares, expenditures, and relative prices for 2007–2023.

The estimated QUAIDS elasticities are used to quantify direct demand adjustments in response to tariff-induced price changes. These demand shifts are then mapped back into the MRIO framework to evaluate the indirect propagation of shocks through intermediate and final demand linkages at the country–sector level. Rather than focusing solely on changes in total output, we assess impacts in terms of Value Added (VA), which aligns with GDP and provides a policy-relevant measure of economic welfare. This integration of demand estimation and network analysis yields a comprehensive view of the full pass-through of tariff shocks—from consumer responses to economy-wide consequences—thus enriching traditional approaches to trade shock assessment.

Our results show that tariffs imposed by the USA in September 2025 are expected to lead to widespread global losses in value added, averaging about half a percent, with over 90% of countries experiencing declines. Although direct effects are concentrated in traded manufacturing sectors such as textiles, chemicals, and machinery, the majority of total losses arise from indirect spillovers into services and infrastructure, including transport, telecommunications, finance, and public spending. Small, open economies like Ireland and Austria experience disproportionate indirect effects, while Germany illustrates how a deeply-integrated manufacturing hub can transmit shocks through European value chains. In Asia, India and Vietnam suffer severe contractions, whereas China's large domestic market and regional demand help buffer the impact. The United States, despite initiating the tariffs, is expected to incur a total value added loss of around 3.2% as higher domestic prices cascade through its economy. These findings demonstrate that the true costs of tariffs extend well beyond targeted sectors and are amplified through global production networks.

The remainder of this paper is structured as follows; Section 2 reviews relevant literature, Section 3 introduces the data, and Section 4 outlines the three-step methodology. Section 5 presents the results, while Section 6 concludes with policy implications.

2 Literature review

Trade models

Trade models focus on estimating substitution behavior in response to policy shocks, often within a gravity model or general equilibrium framework. Gravity models have been foundational for international trade analysis and have undergone substantial methodological advances, including the integration of input–output data (Caliendo & Parro, 2015; Hertel et al., 2007) and improved empirical identification strategies (Anderson & van Wincoop, 2003; Yotov et al., 2016). Two dominant modeling traditions have emerged. The first, following Armington (1969), assumes that goods are differentiated by country of origin, giving rise to the widely used "Armington elasticity". The second, the Eaton–Kortum ("EK") framework, models technology differences and trade costs to explain productivity-driven trade patterns and the welfare effects of policy changes (Eaton & Kortum, 2002; Eaton et al., 2012).

Building on these foundations, Costinot & Rodriguez-Clare (2014) formalize the welfare gains from trade in a world with heterogeneous firms, while empirical work by Robert C. Feenstra & Timmer (2015) and Broda & Weinstein (2006) provides key estimates of trade substitution elasticities. Large-scale multi-sectoral models, such as the Global Trade Analysis Project (GTAP) (Hertel et al., 2007), operationalize these frameworks in a Computable General Equilibrium (CGE) setting, combining trade elasticities with input–output linkages to evaluate the impact of trade and tariff policies. The elasticities in GTAP and related models are often sourced from meta-studies or literature calibrations, rather than estimated directly from data.

A growing empirical literature examines the impacts of tariff shocks directly. Caliendo & Parro (2015) quantify the effects of NAFTA by estimating sectoral elasticities and tracing trade reallocation patterns. Costinot & Rodriguez-Clare (2014) highlight welfare consequences of tariffs in a multi-sector model with firm heterogeneity. At the country level, Fajgelbaum et al. (2020) analyze the U.S.–China trade war, showing that tariffs raised producer prices but reduced the real incomes of consumers. Similarly, Amiti et al. (2019) find that tariff changes significantly affected import prices and firm-level competitiveness. Boehm et al. (2023) distinguish between short- and long-term elasticities when evaluating tariff changes across Most-Favored Nation (MFN) clusters.

Recent research increasingly incorporates supply chain linkages and sectoral detail. Gnocato et al. (2025) study how sector-specific tariff increases propagate through production networks using input–output structures, while Kreuter & Riccaboni (2023) explicitly integrate input linkages into models of tariff incidence. At the micro level, Rosenow et al. (2024) analyze firm-level adoption of green technologies under high tariffs, Fontagné et al. (2022) estimate product-level trade elasticities and their evolution over time, and Soderbery (2018) develop a structural estimator for heterogeneous supply and demand elasticities to explore the distributional effects of optimal tariffs.

Input-Output analysis

The second major strand of literature relies on input–output (IO) and multi-regional input–output (MRIO) analysis to trace inter-sectoral and inter-country relationships within and across economies (Miller & Blair, 2009). MRIO models provide a comprehensive mapping of production interdependencies and have become a cornerstone for analyzing global production networks. Prominent MRIO databases include WIOD (Timmer et al., 2015), EORA (Lenzen et al., 2013), EXIOBASE (Stadler et al., 2018), OECD ICIO (Yamano et al., 2023), and more recently, the ADB MRIO (ADB, 2025).

MRIO frameworks have enabled detailed assessments of international production fragmentation, the transmission of shocks through global value chains, and the sectoral and geographic distribution of changes in output. They are widely used to evaluate the environmental and social footprints of trade and production, and to analyze the exposure of economies to trade disruptions, policy shocks, or crises.

Seminal contributions include Johnson (2014), who emphasize the role of value-added trade in macroeconomic accounting, and Los et al. (2015), who develop new measures of global value chain participation. Subsequent work has expanded these insights to consider the geography of value chains (Antràs & Gortari, 2020), the dynamics of regional upgrading (Boschma, 2024), and the vulnerability of supply chains to shocks such as tariffs, natural disasters or pandemics (Carvalho et al., 2021).

While MRIO approaches excel at capturing propagation and accounting effects, they generally assume fixed-coefficient technologies and linear propagation mechanisms, implying that substitution or behavioral adjustments are absent. Consequently, MRIO analyses describe how shocks spread on the supply side but do not fully explore the demand-side adjustments.

Positioning of this paper

Despite their respective strengths, both trade and MRIO models have notable limitations. Trade models capture substitution behavior, but often rely on externally calibrated elasticities and impose homothetic, often linear, demand structures. MRIO models, in turn, provide detailed mapping of inter-industry linkages but typically assume uniform behavioral responses and fixed production technologies.

This paper bridges these two approaches by integrating a flexible demand system with MRIO analysis, thus combining a more nuanced behavioral response with structural interdependence. Specifically, we employ the Quadratic Almost Ideal Demand System (QUAIDS) (Banks et al., 1997) to estimate non-linear substitution elasticities directly from reshaped MRIO data. Demand system models have evolved substantially—from early Cobb–Douglas and Linear Expenditure System (LES) specifications to more flexible forms such as the Translog and the Almost Ideal Demand System (AIDS) (Pollak & Wales, 1995). QUAIDS extends these by allowing for non-homothetic preferences and curvature in Engel curves, offering a robust framework for analyzing price and income responses.[1]

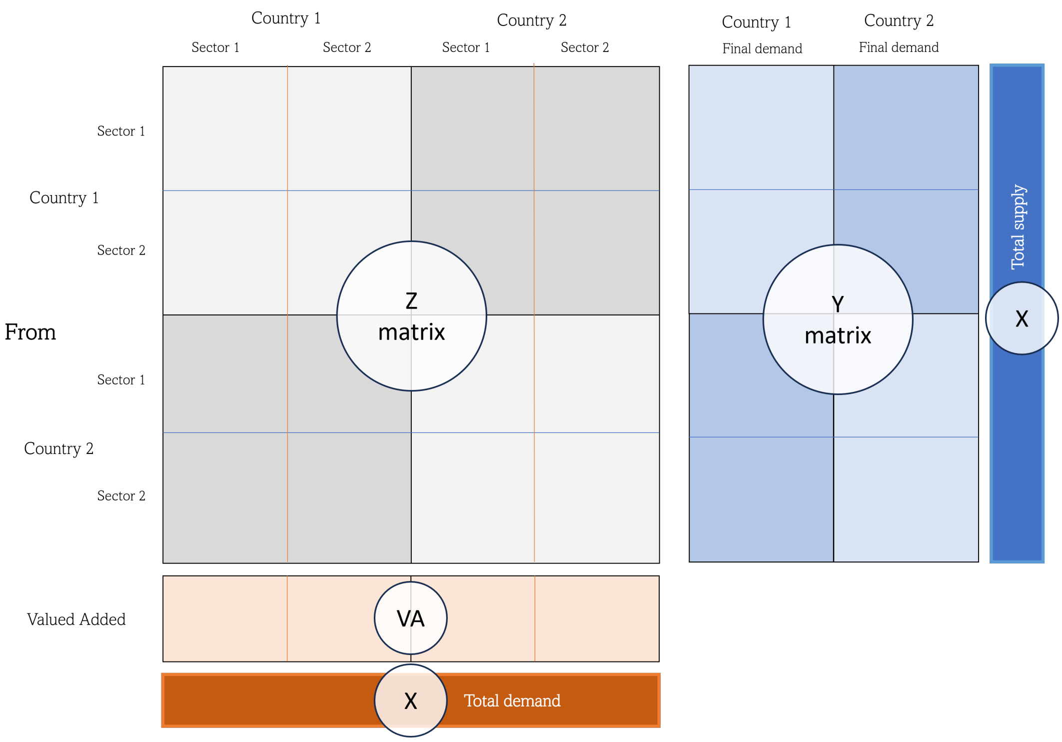
By integrating the ADB MRIO database with the QUAIDS framework, we link household expenditure patterns, regional trade shares, and relative prices to generate empirically grounded elasticity estimates. These elasticities quantify how demand adjusts to tariff-induced price changes and are reintroduced into the MRIO system to simulate direct and indirect effects on output and value added between countries and sectors. This combination enables us to capture the complete pass-through of trade shocks, from consumer-level substitution to global production adjustments, thus complementing structural gravity models and extending MRIO analysis with a flexible, data-driven behavioral component.

[1] See Naqvi (2025) for a detailed review and comparison of various demand system models using the ADB MRIO.

3 Data

Figure 3.1 provides an overview of the structure of a standard multi-regional input–output (MRIO) database. At its core, an MRIO is organized into three main building blocks. The first is the intermediate transaction matrix $\mathbf{Z}$, which records the flows of intermediate goods and services from each country sector to each other country sector. Within this matrix, the diagonal sub-blocks (light grey in Fig. 3.1) represent domestic inter-industry exchanges, while the off-diagonal sub-blocks (dark grey) capture international trade in intermediates. Because every unit of output is allocated as input somewhere in the system, the intermediate block is square by construction, and in the MRIO context it consists of a set of perfectly square country–sector to country-sector sub-matrices (Miller & Blair, 2009).

Figure 3.1: Schematic structure of MRIO data



The second block is the final demand matrix $\mathbf{Y}$, shown in blue in Figure 3.1. This block records all categories of expenditure that are not used as intermediate inputs, including household consumption, government consumption, gross fixed capital formation (investment), and inventory changes. As with intermediate flows, final demand can be decomposed into demand met from domestic sectors (light blue) and demand from foreign sectors (dark blue). By construction, the total output of each country–sector is the sum of its intermediate and final uses $\mathbf{X} = \mathbf{Z} + \mathbf{Y}$.

The third block contains value added where components include items such as imports, compensation of employees, operating surplus, net taxes and subsidies, and trade and transport margins. These entries show how the value added generated in production is allocated across various factors of production. Additionally, the accounting rules of MRIOs dictate that the total supply $(\mathbf{Z} + \mathbf{Y})$ should equal total demand $(\mathbf{Z} + \mathbf{VA})$ to ensure consistency (Miller & Blair, 2009).

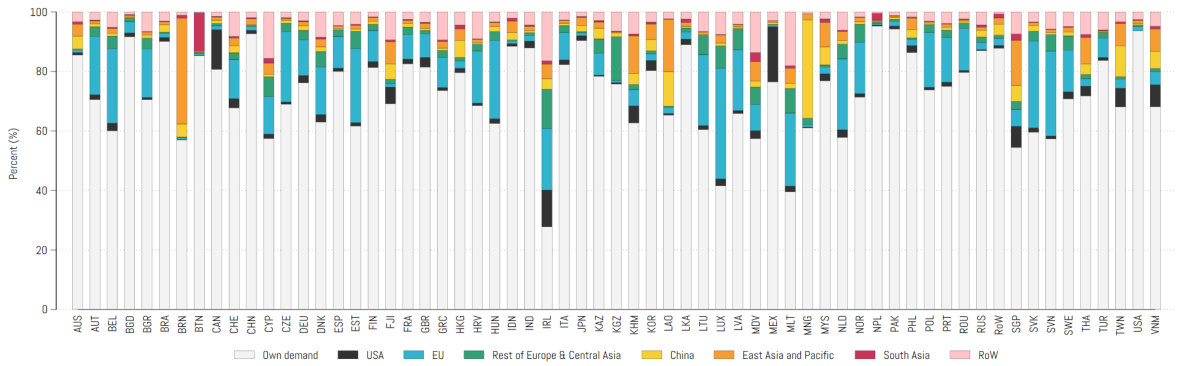
In this paper, we draw on the Asian Development Bank's Multi-Regional Input–Output database (ADB

MRIO), a relatively new addition to the suite of global MRIO datasets (ADB, 2025).[2] The ADB MRIO covers 62 individual economies plus a Rest of the World (RoW) aggregate, with harmonized sectoral and demand classifications. In comparison to other widely-used MRIOs, such as WIOD (Timmer et al., 2015), EORA (Lenzen et al., 2013), EXIOBASE (Stadler et al., 2018), and OECD–ICIO (Yamano et al., 2023), the ADB MRIO offers a distinctive advantage in providing both nominal and real values for recent years currently ranging from 2007–2023.[3] This allows us to compute relative prices (nominal-to-real ratios) and which are then used for estimating income and price elasticities at the detailed country–sector level using a QUAIDS demand system model. These empirically grounded elasticities give us heterogeneous responses to tariff shocks, which can be embedded back into the MRIO framework to trace demand adjustments and supply-chain propagation.

In order to estimate demand elasticities, countries are aggregated into seven regional groups summarized in Table 3.1. This regional aggregation serves two purposes. First, it captures broad patterns of substitutability across major world regions, ensuring that substitution effects reflect meaningful economic structures rather than noise at the individual-country level. Second, it provides a level of aggregation at which elasticity estimates remain empirically robust and interpretable, while still preserving the diversity of trade linkages across regions. This is discussed in further detail in Section 4.

Figure 3.2 illustrates the regional supply patterns for each country in the database, including the share of "own" supply and demand. As we observe in the figure, this represents a substantial portion of total demand in most economies, while the rest is trade. This highlights a key advantage of using MRIOs for elasticity estimation compared to bilateral trade datasets. While MRIOs abstract from the highly detailed product classifications available in databases such as COMTRADE or BACI, they provide rich information on the joint structure of supply and demand, that is still disaggregated at the sectoral level. This enables us to, (a) separate domestic supply from foreign supply for each country in the database in a consistent framework, and (b), link countries and sectors through the system of technical coefficients, thereby capturing the full network of inter-industry and cross-border dependencies that are essential for estimating spillover impacts.

Figure 3.2: Total supply share from countries to regions



Similarly to the country groupings, we also define sectoral classifications (Table 3.2) by aggregating the original 35 sectors into 25 categories. This step is motivated by two considerations. First, several sectors, such as public services or energy supply, engage in little or no international trade, producing entire zero blocks in the MRIO. In the context of a non-linear estimation procedure, these zero entries frequently push estimates to the boundaries of the parameter space, leading to spurious results or non-convergence in the QUAIDS model. Second, very small sectors, such as "supporting transport activities" or "community and

[2] https://www.adb.org/what-we-do/data/regional-input-output-tables
[3] See Tarne et al. (2018) for a comparison of MRIO databases.

Table 3.1: Country classifications

ISO3	Country	Region	Tariff (Sep 2025)
USA	United States	USA	-
AUT	Austria	EU	15
BEL	Belgium	EU	15
BGR	Bulgaria	EU	15
HRV	Croatia	EU	15
CYP	Cyprus	EU	15
CZE	Czechia	EU	15
DNK	Denmark	EU	15
EST	Estonia	EU	15
FIN	Finland	EU	15
FRA	France	EU	15
DEU	Germany	EU	15
GRC	Greece	EU	15
HUN	Hungary	EU	15
IRL	Ireland	EU	15
ITA	Italy	EU	15
LVA	Latvia	EU	15
LTU	Lithuania	EU	15
LUX	Luxembourg	EU	15
MLT	Malta	EU	15
NLD	Netherlands	EU	15
POL	Poland	EU	15
PRT	Portugal	EU	15
ROU	Romania	EU	15
SVK	Slovak Republic	EU	15
SVN	Slovenia	EU	15
ESP	Spain	EU	15
SWE	Sweden	EU	15
KAZ	Kazakhstan	Rest of Europe and Central Asia	25
KGZ	Kyrgyz Republic	Rest of Europe and Central Asia	10
NOR	Norway	Rest of Europe and Central Asia	15
RUS	Russian Federation	Rest of Europe and Central Asia	10
CHE	Switzerland	Rest of Europe and Central Asia	39
TUR	Turkiye	Rest of Europe and Central Asia	15
GBR	United Kingdom	Rest of Europe and Central Asia	10
CHN	China	China	30
AUS	Australia	East Asia and Pacific	10
BRN	Brunei Darussalam	East Asia and Pacific	25
KHM	Cambodia	East Asia and Pacific	19
FJI	Fiji	East Asia and Pacific	15
HKG	Hong Kong	East Asia and Pacific	15
IDN	Indonesia	East Asia and Pacific	19
JPN	Japan	East Asia and Pacific	15
KOR	Korea, Rep	East Asia and Pacific	15
LAO	Lao PDR	East Asia and Pacific	15
MYS	Malaysia	East Asia and Pacific	19
MNG	Mongolia	East Asia and Pacific	10
PHL	Philippines	East Asia and Pacific	19
SGP	Singapore	East Asia and Pacific	10
TWN	Taiwan	East Asia and Pacific	20
THA	Thailand	East Asia and Pacific	19
VNM	Viet Nam	East Asia and Pacific	46
BGD	Bangladesh	South Asia	20
BTN	Bhutan	South Asia	10
IND	India	South Asia	26
MDV	Maldives	South Asia	10
NPL	Nepal	South Asia	10
PAK	Pakistan	South Asia	19
LKA	Sri Lanka	South Asia	20
BRA	Brazil	Rest of the World	10
CAN	Canada	Rest of the World	35
MEX	Mexico	Rest of the World	15
RoW	Rest of the World	Rest of the World	10

social work", lack sufficient economic weight for robust elasticity estimation and are therefore collapsed into broader, more meaningful categories. At the same time, large and highly-traded sectors such as agriculture and manufacturing are retained at their original level of detail. The resulting dataset yields a 1575×1575 intermediate transaction matrix $\mathbf{Z}$ ($63 \times 25 = 1575$), which gives us sufficient degrees of freedom to estimate a computationally intensive demand system while still providing meaningful results at the sectoral level.

Table 3.2: Sector classifications

Original sector name	**Orig. ID**	**New sector name**	**New ID**
Agriculture, hunting, forestry, and fishing	c1	Agriculture, hunting, forestry, and fishing	1
Mining and quarrying	c2	Mining and quarrying	2
Food, beverages, and tobacco	c3	Food, beverages, and tobacco	3
Textiles and textile products	c4	Textiles and textile products	4
Leather, leather products, and footwear	c5	Leather, leather products, and footwear	5
Wood and products of wood and cork	c6	Wood and paper products	6-7
Pulp, paper, paper products, printing, and publishing	c7		
Coke, refined petroleum, and nuclear fuel	c8	Coke, refined petroleum, and nuclear fuel	8
Chemicals and chemical products	c9	Chemicals and chemical products	9
Rubber and plastics	c10	Rubber and plastics	10
Other nonmetallic minerals	c11	Other nonmetallic minerals	11
Basic metals and fabricated metal	c12	Basic metals and fabricated metal	12
Machinery, nec	c13	Machinery, nec	13
Electrical and optical equipment	c14	Electrical and optical equipment	14
Transport equipment	c15	Transport equipment	15
Manufacturing, nec; recycling	c16	Manufacturing, nec; recycling	16
Electricity, gas, and water supply	c17	Electricity, gas, and water supply	17
Construction	c18	Construction	18
Sale, maintenance, and repair of motor vehicles and motorcycles; retail sale of fuel	c19	Wholesale and retail trade	19-21
Wholesale trade and commission trade, except of motor vehicles and motorcycles	c20		
Retail trade, except of motor vehicles and motorcycles; repair of household goods	c21		
Hotels and restaurants	c22	Hotels and restaurants	22
Inland transport	c23	Transport	23-26
Water transport	c24		
Air transport	c25		
Other supporting and auxiliary transport activities; activities of travel agencies	c26		
Post and telecommunications	c27	Post and telecommunications	27
Financial intermediation	c28	Financial intermediation	28
Real estate activities	c29	Real estate activities	29
Renting of M&Eq and other business activities	c30	Renting of M&Eq and other business activities	30
Public administration and defense; compulsory social security	c31	Public spending and Private households	31-25
Education	c32		
Health and social work	c33		
Other community, social, and personal services	c34		
Private households with employed persons	c35		
Final consumption expenditure by households	F1	Final demand	F
Final consumption expenditure by non-profit organisations serving households (NPISH)	F2		
Final consumption expenditure by government	F3		
Gross fixed capital formation	F4		
Changes in inventories and valuables	F5		

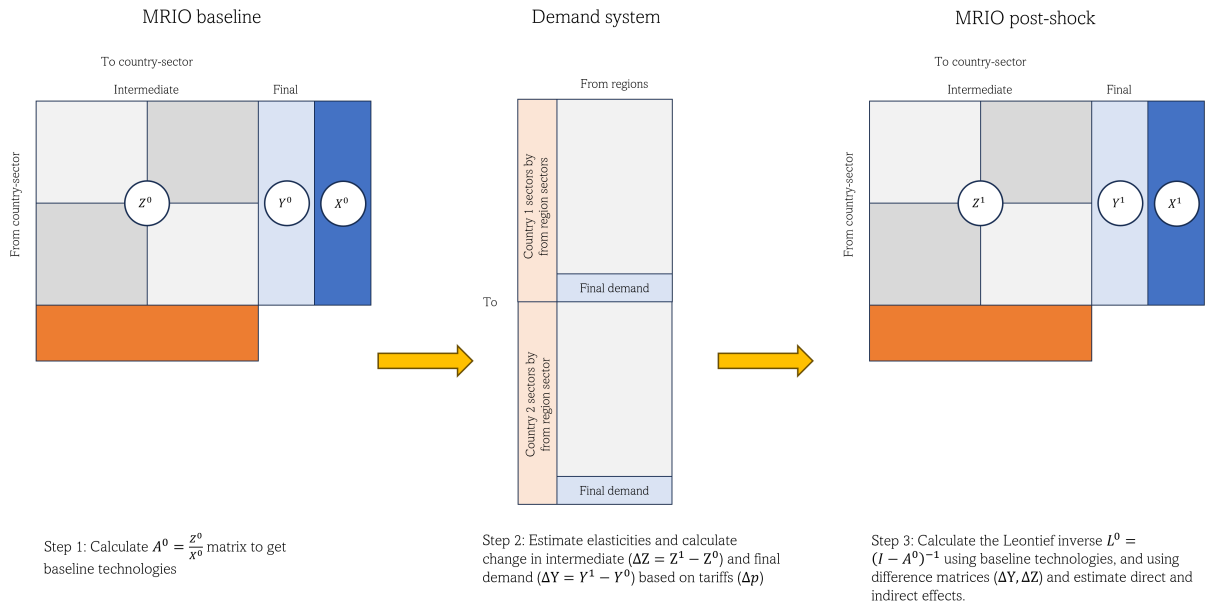
For final demand, all categories are collapsed into a single aggregate sector. While household consumption, government expenditure, and investment differ in composition across countries, consolidating them into one category prevents overextending the estimation procedure of the demand system model with gaining significant insights from tariff shocks where we mostly focus on the production side of the economy. The resulting final demand data is a vector consisting of 1,575 rows (63 countries $\times$ 25 sectors) and one column.

Note that Table 3.1 provides average tariff rates at the country level from September 2025. The model can implement differentiated tariffs at the country-sector level for a more accurate picture, such as 50% tariffs on steel industries, but since the tariff rates change fairly frequently, we leave out the finer differentiation in rates for more policy-oriented near-real-time analysis.

4 Methodology

Figure 4.1 summarizes the three-step estimation strategy used in this paper.

Figure 4.1: Elasticities in an MRIO structure



Step 1 estimates the baseline technical coefficients using standard input–output calculations. In Step 2, the MRIO data are reshaped for demand estimation by collapsing *from-country* into broader *from-region*. The reshaped dataset is then used to estimate substitution price and income elasticities for the receiving *to-country-sectors* from *from-region* using a QUAIDS demand system. Once the elasticities are estimated, we introduce USA tariffs as exogenous price shocks (see Table 3.1), under the assumption that the USA fully bears the resulting increase in prices.[4] From the estimated QUAIDS elasticities, we calculate changes in demand that incorporate both own-price and cross-price substitution effects. In Step 3, the adjusted demand vectors are mapped back into the MRIO structure to generate post-shock intermediate and final demand matrices. The Leontief system is then used to decompose impacts into direct and indirect effects using baseline technical coefficients from Step 1. From this step, changes in value added (VA) are computed.

The three steps are explained in detail below.

Step 1: MRIO and technologies

We begin with the structure of the multi-regional input–output (MRIO) database, which records how industries in different countries and sectors are linked through supply and demand. An MRIO table captures both intermediate use (country-sectors buying from other country-sectors) and final use (output consumed by households, government, investment, and exports).

Formally, let there be C countries and S sectors per country. Each producing unit is identified by a

[4] Extensions could alternatively assume burden-sharing between the tariff-imposing and tariffed country, for example, a 90–10 split.

country–sector pair (c, s), with $c \in \{1, \ldots, C\}$ and $s \in \{1, \ldots, S\}$. The total number of producing units is CS, which we index by $i, j \in \{1, \ldots, CS\}$. In our case, $C = 63$ and $S = 25$, giving us a total of $CS = 1575$ country–sector units.

The intermediate transactions matrix is:

$$\mathbf{Z} \in \mathbb{R}^{CS \times CS}$$

where Z_{ij} is the flow of goods from supplier unit i to user unit j. In block form, the MRIO can be written as:

$$\mathbf{Z} = \left[\mathbf{Z}^{c \to c'}\right]_{c,c'=1}^{C}$$

where each block $\mathbf{Z}^{c \to c'} \in \mathbb{R}^{S \times S}$ contains flows between two countries. Domestic flows appear on the diagonal blocks ($c = c'$), while international trade flows occupy the off-diagonal blocks ($c \neq c'$).

Final demand is represented by:

$$\mathbf{Y} \in \mathbb{R}^{CS \times G}$$

where $Y_{i,g}$ records the use of output from unit i by final demand category $g \in \{1, \ldots, G\}$ which typically has columns; households, government, investment, exports, and inventories. Aggregating over final demand categories gives:

$$\mathbf{y} = \mathbf{Y}\mathbf{1}_G \quad \Longrightarrow \quad y_i = \sum_{g=1}^{G} Y_{i,g}$$

where $\mathbf{1}_G$ is a $G \times 1$ column vector of ones used to sum across the final demand categories. Total output is recovered as:

$$\mathbf{x} = \mathbf{Z}\mathbf{1}_{CS} + \mathbf{y}$$

which simply states that each sector's output equals intermediate plus final demand. From this system we derive the baseline production technology, or the input-coefficient, $\mathbf{A}^0$ matrix:

$$\mathbf{A}^0 = \mathbf{Z}\,\mathrm{diag}(\mathbf{x})^{-1}$$

where each element of $\mathbf{A}^0$, $a_{ij} = (Z_{ij}/x_j)$ represents the input from sector or region i required to produce one unit of output in sector or region j. The residual share that is not used for intermediate inputs, $(1 - \sum_i a_{ij})$, represents Value Added in unit j, capturing the contribution of primary factors such as labor and capital. We utilize the baseline technology matrix in Step 3.

Step 2: Elasticities

To capture behavioral responses to tariff shocks, we estimate a demand system on reshaped MRIO data.

Estimating at the full country–sector resolution is infeasible because many bilateral flows are zero. To address this, we collapse supplying countries into R regions. This reduces dimensionality and ensures that each demanding country–sector unit (c, s) has positive observations of nominal and real expenditures from every supplying region. The resulting dataset is structured with rows defined by (to-country, to-sector, from-sector) and columns defined by supplying regions $r = \{1, \ldots, R\}$.

For each demanding unit (c, s) and supplying region r, expenditure is denoted $D_{(c,s),r}$. Total expenditure is:

$$X_{(c,s)} = \sum_{r=1}^{R} D_{(c,s),r}$$

and import shares are:

$$w_{(c,s),r} = \frac{D_{(c,s),r}}{X_{(c,s)}}$$

Relative prices for each region r are calculated as nominal over real values, extracted directly from the ADB MRIO.

We then estimate a Quadratic Almost Ideal Demand System (QUAIDS), which generalizes the traditional Almost Ideal Demand System (AIDS) by allowing for flexible, non-linear Engel curves (Banks et al., 1997; Naqvi, 2025). The QUAIDS specification captures how expenditure shares on goods or regions vary with both prices and total expenditure, enabling richer income effects than the linear AIDS formulation.

The budget share equation for region r in country–sector (c, s) is given by:

$$w_{(c,s),r} = \alpha_r + \sum_{r'=1}^{R} \gamma_{rr'} \ln p_{r'} + \beta_r \ln\left(\frac{X_{(c,s)}}{a(\mathbf{p})}\right) + \lambda_r \left[\ln\left(\frac{X_{(c,s)}}{a(\mathbf{p})}\right)\right]^2$$

where $w_{(c,s),r}$ is the budget share of region r in the total expenditure of country–sector (c, s), i.e. the proportion of expenditure allocated to imports from region r. p_r denotes the price index of goods sourced from region r, $X_{(c,s)}$ is the total nominal expenditure by (c, s) across all supplying regions, and $a(\mathbf{p})$ is a Translog (transcendental logarithmic) price aggregator that captures how relative prices affect the real cost of living.

The Translog price index is defined as:

$$\ln a(\mathbf{p}) = \alpha_0 + \sum_{r=1}^{R} \alpha_r \ln p_r + \tfrac{1}{2} \sum_{r=1}^{R} \sum_{r'=1}^{R} \Gamma_{rr'} \ln p_r \ln p_{r'}$$

where α_0 is a constant, α_r captures the average price effect of region r, and $\Gamma_{rr'}$ describes the second-order interaction between the prices of regions r and r'.

The QUAIDS model nests the AIDS model as a special case when $\lambda_r = 0$ for all r. The inclusion of the quadratic term $\lambda_r[\ln(X/a(\mathbf{p}))]^2$ allows the Engel curves to bend, thereby accommodating more realistic income responses, particularly for goods that shift from necessities to luxuries as income rises.

The estimated parameters must satisfy the following standard demand-system restrictions to ensure theoretical consistency. Adding-up conditions: $\sum_r \alpha_r = 1$, $\sum_r \beta_r = 0$, $\sum_r \lambda_r = 0$, and $\sum_r \gamma_{rr'} = 0$, guaranteeing that total budget shares sum to one. Homogeneity conditions: $\sum_{r'} \gamma_{rr'} = 0$, ensuring that demand is homogeneous of degree zero in prices and income. And finally, Symmetry conditions $\gamma_{rr'} = \gamma_{r'r}$, implying consistent cross-price effects between regions.

From the estimated coefficients $(\alpha_r, \beta_r, \lambda_r, \gamma_{rr'})$, we recover the uncompensated (Marshallian) price elasticity matrix $\mathbf{E} \in \mathbb{R}^{R\times R}$, describing the percentage change in demand for region r resulting from a 1% change in the price of region r'. And the income elasticity vector $\boldsymbol{\eta} \in \mathbb{R}^R$, indicating how the demand for each region responds to changes in total expenditure. A detailed derivation of these elasticities within a QUAIDS framework is provided by Naqvi (2025).[5]

To simulate the impact of a tariff shock, we exogenously increase the price of imports from region r to:

$$p'_r = p_r(1 + \tau_r)$$

[5]See also Banks et al. (1997) for the analytical expressions linking estimated coefficients to elasticities.

where τ_r represents the trade tariff rate applied to imports from region r. Because tariffs are imposed at the country level, τ_r is computed as a weighted average across countries within each region, using trade shares in exports to the United States as weights.

Given the elasticity structure, the proportional demand response across all regions is:

$$\mathbf{Q} = \mathbf{E}\,\Delta\mathbf{p} + \boldsymbol{\eta}\,\Delta m$$

where $\Delta\mathbf{p}$ denotes the vector of proportional price changes and Δm the change in total expenditure (set to zero under constant-expenditure simulations). Finally, post-shock expenditures are recovered as:

$$D^1_{(c,s),r} = D^0_{(c,s),r}(1 + Q_r)$$

capturing both own-price and cross-price substitution effects across supplying regions.

Step 3: Post-shock impacts

In the final step, we translate the demand adjustments obtained from the QUAIDS model (Step 2) back into the multi-regional input–output (MRIO) framework. This integration allows us to assess how region-specific changes in demand and prices, originating from tariff shocks, propagate throughout the global production network. While Step 2 isolates the behavioral response on the demand side, Step 3 captures the technological propagation of these shocks through inter-industry and inter-regional linkages.

The initial MRIO database consists of an inter-industry transaction matrix $\mathbf{Z}^0 \in \mathbb{R}^{CS\times CS}$ and a final demand matrix $\mathbf{Y}^0 \in \mathbb{R}^{CS\times G}$, describing intermediate and final uses, respectively. Following the tariff shock, demand adjustments estimated in Step 2 are aggregated by origin and destination, resulting in a change in both intermediate and final demand flows:

$$\mathbf{Z}^1 = \mathbf{Z}^0 + \Delta\mathbf{Z}, \qquad \mathbf{y}^1 = \mathbf{y}^0 + \Delta\mathbf{y}$$

Here, $\Delta\mathbf{Z}$ captures changes in intermediate purchases between sectors and regions, while $\Delta\mathbf{y}$ captures changes in final demand (e.g., household or export demand). Together, they form a counterfactual post-shock MRIO reflecting the new equilibrium pattern of inter-industry linkages.

Total output in each country–sector is determined as the sum of intermediate sales and final demand:

$$\mathbf{x}^1 = \mathbf{Z}^1\mathbf{1}_{CS} + \mathbf{y}^1$$

where $\mathbf{1}_{CS}$ is a summation vector of ones. The change in gross output induced directly by the demand shock, before any production feedbacks occur, is:

$$\Delta\mathbf{x}_{\text{direct}} = \Delta\mathbf{Z}\,\mathbf{1}_{CS} + \Delta\mathbf{y}$$

This first-round or direct impact represents the immediate effect of reduced or increased demand for the outputs of each sector and region.

Assuming that producers continue to use the baseline input coefficients $\mathbf{A}^0$ in the short- to medium-run after the shock, the total output adjustments follow the Leontief system:

$$\Delta\mathbf{x}_{\text{total}} = (\mathbf{I} - \mathbf{A}^0)^{-1}\Delta\mathbf{x}_{\text{direct}}$$

The matrix $(\mathbf{I}-\mathbf{A}^0)^{-1}$ represents the Leontief inverse $\mathbf{L^0}$, which represents the full network interdependencies. It ensures that a change in final demand not only affects the directly targeted countries and sectors but also their upstream suppliers, and suppliers of suppliers, generating indirect effects. Hence, the indirect change in output change can be decomposed as:

$$\Delta\mathbf{x}_{\text{indirect}} = \mathbf{x}_{\text{total}} - \Delta\mathbf{x}_{\text{direct}}$$

The indirect component $\Delta\mathbf{x}_{\text{indirect}}$ reflects the ripple effects across the global value chain—how a tariff on one region's exports alters intermediate demand in other countries and sectors through production interdependencies.

To express output changes in economic value terms, we focus on Value Added (VA), which represents contribution of each sector to gross domestic product (GDP). Let $\mathbf{v}^0$ denote the baseline vector of sectoral Value Added, and define the corresponding Value Added coefficients as:

$$\boldsymbol{\alpha}^0 = \mathbf{v}^0 \oslash \mathbf{x}^0$$

where $\oslash$ indicates element-wise division. Each coefficient $\alpha_i^0 = v_i^0/x_i^0$ represents the share of Value Added in total output for country–sector i. Assuming that production technologies, and therefore VA shares, remain constant, total Value Added can be linked to gross output through:

$$\mathbf{v} = \widehat{\boldsymbol{\alpha}}^0\mathbf{x}$$

where $\widehat{\boldsymbol{\alpha}}^0 = \text{diag}(\boldsymbol{\alpha}^0)$ is the diagonal matrix of Value Added coefficients. This formulation allows Value Added to be expressed and propagated consistently within the MRIO system.

The decomposition of changes in VA mirrors that of output:

$$\Delta\mathbf{v}_{\text{direct}} = \widehat{\boldsymbol{\alpha}}^0\,\Delta\mathbf{x}_{\text{direct}}, \qquad \Delta\mathbf{v}_{\text{indirect}} = \widehat{\boldsymbol{\alpha}}^0\,\Delta\mathbf{x}_{\text{indirect}}$$

The sum of these components gives the total impact on Value Added:

$$\Delta\mathbf{v}_{\text{total}} = \Delta\mathbf{v}_{\text{direct}} + \Delta\mathbf{v}_{\text{indirect}}$$

This final stage completes the analytical loop. Tariff-induced price changes alter regional demand patterns (Step 2), which then feed back into the MRIO system to reshape inter-industry linkages (Step 3). By decomposing the results into direct and indirect effects, we can distinguish between immediate demand reductions in the sectors directly affected by tariffs and the wider network-driven impacts that spread through global supply chains. Together, the QUAIDS–MRIO framework offers a comprehensive view of how trade policy shocks influence production and value creation across an interconnected world economy.

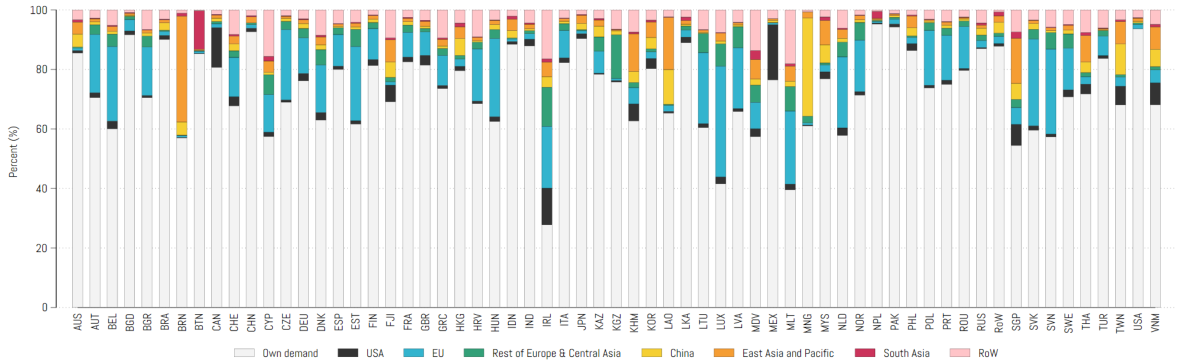
5 Results

Country impacts

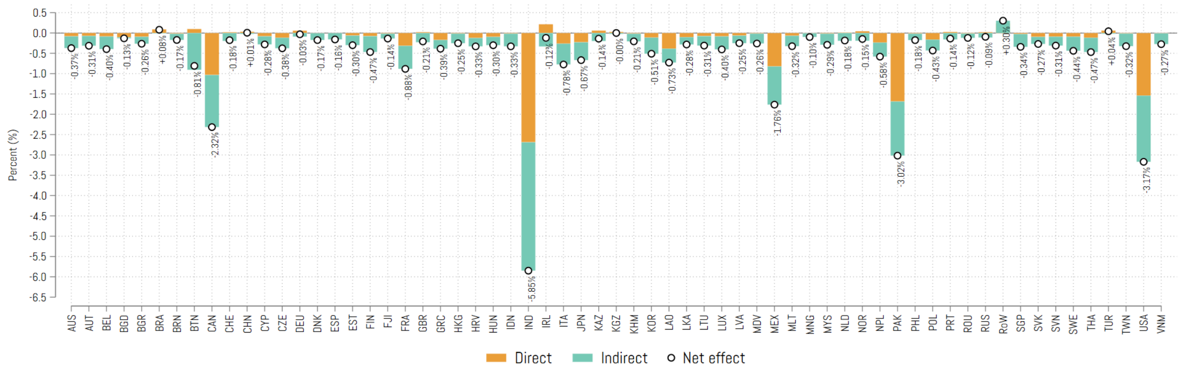
The tariff shock produces broad-based contractions in value added across the global economy. Across the 63 economies in the dataset, the average decline is –0.52%, with a median of –0.29%. Roughly 92% of countries record losses, leaving only a few with very small gains. The largest contraction is observed in

India (–5.8%), while the largest gain, at just +0.3%, is found in the Rest of the World (RoW) aggregate. The complete country-level results are provided in Table A.1.

Figure 5.1: Overall impact of USA tariffs (Sept 2025 rates)



(a) Total supply by regions



(b) Direct and indirect impact on Value Added from tariffs

At the country level, the top most adversely affected economies include both large markets and small open economies. India remains the extreme case, but Ireland (–2.7%), Nepal (–3.1%), Pakistan (–3.2%), and the United States (–3.2%) also appear prominently. Smaller European economies such as Luxembourg (–1.4%) and Malta (–1.2%), as well as open Asian economies such as Vietnam (–2.9%), are heavily exposed through their integration into global production networks, especially the heavy dependence on the USA as an export destination with little substitutability options. In contrast, the few gainers, such as Brazil and Turkey, record positive results of less than half a percentage point, underscoring that net winners are rare and their gains modest compared to the scale of global losses.

Disaggregating the results into direct and indirect effects show a more nuanced picture (Figure 5.1). While direct impacts are estimates from direct changes in demand, the indirect losses reflect the broad input-output dependency structure where first round losses play out in the absence any strong structural change. On average, direct tariff impacts account for –0.17% losses in Value Added, while indirect supply-chain effects are roughly double at –0.35%. The stacked bar chart illustrates a recurring pattern where in most countries, the orange bars (direct effects) are dwarfed by teal bars (indirect effects). For example, India's direct contraction of roughly –2% is magnified by indirect spillovers of –3.8%, producing the largest overall loss in the sample. In Ireland, modest direct losses of –1.0% become a total of –2.7% once indirect effects in services and downstream sectors are included. Some countries, such as Mexico, Canada, Pakistan, and the USA show a balance of both channels, with indirect propagation accounting for at least half of the total decline.

Regional averages also confirm these findings. South Asia (–2.2%) is hardest hit, driven by India, Pakistan, Nepal, and Bhutan. The United States (–3.2%) emerges as the most affected major economy, highlighting that tariff-initiating countries are not shielded from the costs especially if they bear the full costs of imposing the tariffs. By contrast, the EU average contraction is –0.3%, and East Asia & Pacific (–0.4%) show similar moderation, buffered by large internal markets and diversified demand. The Rest of the World aggregate (–1.0%) reflects the vulnerability of smaller economies with fragmented export structures.

The composition of export demand, shown in Figure 3.2 helps explain these differences. For most countries, own-market demand dominates (65–95%), providing partial insulation. However, exposure to the United States, EU or China often determines the scale of the shock. For example, Ireland and other small EU economies rely heavily on intra-EU trade, transmitting tariff shocks quickly within the bloc. East Asian economies are clustered around China and regional partners, where reallocation of demand softens the blow. South Asia, despite its high dependence on domestic demand, sees its externally oriented sectors cut, leading to severe contractions. The scope of tariff coverage also plays a role. A larger number of tariffed countries is systematically associated with larger declines, where correlations are –0.23 for direct, –0.20 for indirect, and –0.22 for total effects.

The United States, as the initiator of tariffs, illustrates the paradox of protectionism under global value-chain integration. By assumption, tariffs raise domestic prices, which reduces domestic purchasing power and increases costs for firms. The total impact is a –3.2% decline in Value Added, nearly evenly split between direct and indirect effects. Despite the dominance of domestic demand in its trade structure (94%), the USA cannot isolate itself from these feedback effects because global inputs are embedded in its production system.

China, by contrast, records a modest contraction of around –0.4%. China's large domestic market and its role as an international hub in East Asia absorb much of the lost demand, keeping the spillovers from the service-sector small. Compared to the USA, where tariffs feed directly into higher prices across the economy, China experiences the shock mainly as reduced external demand, with less severe propagation at home.

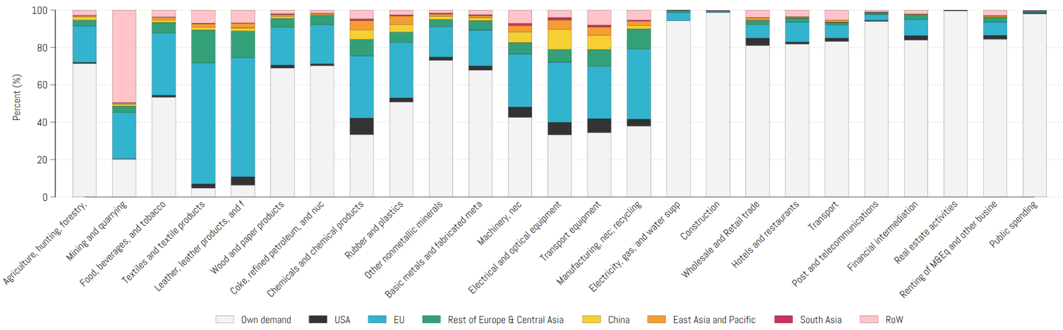
In general, the results underscore three key insights. First, tariffs impose widespread global costs, with nearly all countries losing and the few gainers benefiting only marginally. Second, indirect effects dominate direct ones, underscoring the importance of supply-chain linkages. Third, the initiator of tariffs (the USA in our case) bears larger losses than some of its targets (notably China), as higher domestic prices undermine competitiveness and trigger widespread service-sector contractions.

Country-sector impacts

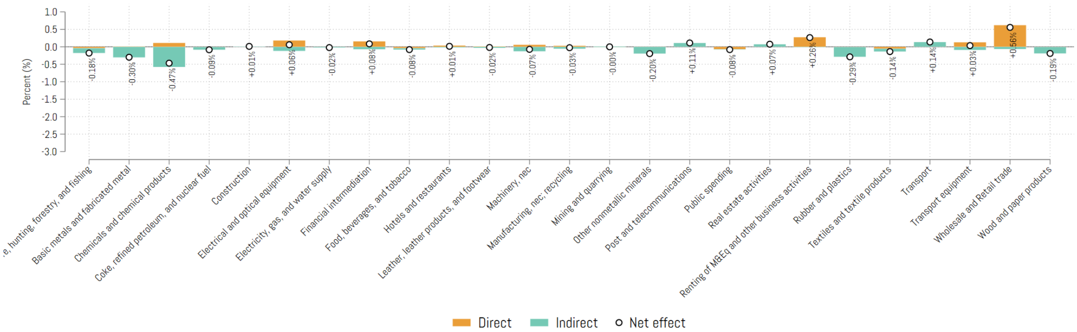
The aggregate results reveal the overall scale of tariff-induced contractions, but the sectoral breakdown is essential for understanding the channels through which shocks are transmitted. The complete set of results for all countries and sectors is presented in Table A.2.

For the selected countries discussed below, we provide two figures. The first illustrates the composition of sectoral exports across destination regions, distinguishing between own demand (light grey bars), exports to the United States (black bars), and exports to other regions grouped by their regional classification (other colors). This breakdown highlights the relative importance of domestic absorption versus external exposure in shaping vulnerability to tariff shocks. The sector-level export shares reveal which industries are most directly exposed to tariffed markets, and help explain why the magnitude of indirect effects varies across countries. The second figure displays the estimated sectoral impacts of tariffs on the Value Added, separating direct effects (orange bars) from indirect spillovers (teal bars), and net effects (circles).

Figure 5.2: Country-sector impacts - Germany



(a) Supply share

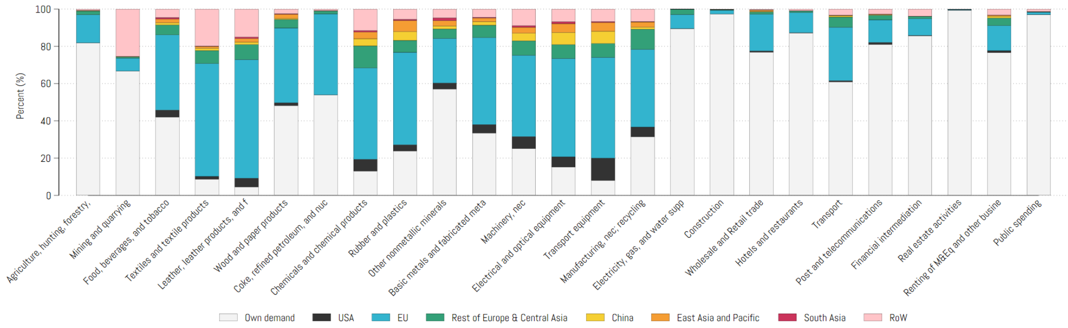


(b) Tariff impact

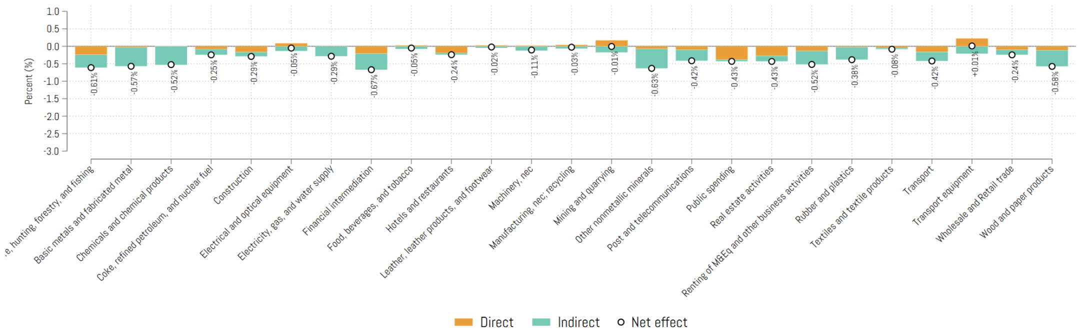
Within the EU, four cases stand out; Germany, Austria, Ireland, and France. In Germany, direct losses are evident in machinery (–0.07%), chemicals (–0.11%), and textiles (–0.05%), sectors at the core of its export profile. Indirect spillovers are more severe, particularly in transport (–0.33%), telecommunications (–0.41%), and retail (–0.18%), reflecting Germany's role as a hub where manufacturing performance underpins downstream services. Austria shows a similar pattern but on a smaller scale where direct effects in wood and paper (–0.11%) and textiles (–0.05%) combine with indirect contractions in financial intermediation (–0.46%) and business services (–0.38%), highlighting the dependence of Austrian services on industrial demand from EU partners. Ireland, by contrast, illustrates the vulnerability of a small, highly open economy where direct losses in food (–0.07%) and textiles (–0.10%) are modest, indirect contractions are very large in telecommunications (–0.61%), business services (–0.22%), and financial intermediation (+0.25%), due to Ireland's role as a multinational hub with heavy dependence on foreign markets. In France, another major European economy, we observe the following patterns; agriculture (–0.41%) and construction (–0.43%) face direct declines, but the strongest effects arise indirectly in real estate (–1.13%) and public spending (–2.31%). This highlights how tariff shocks pass on to fiscal capacity and service provision. Overall, these EU countries show that indirect service-sector losses often outweigh direct goods-sector shocks.

Among Asian economies, India and Vietnam are the most exposed, though in different ways. In India, direct effects on textiles and clothing combine with massive indirect contractions across construction, retail, and business services, explaining the extreme aggregate decline of –5.8%. Vietnam, while smaller, also exhibits steep indirect spillovers where manufacturing exports such as textiles and electronics are

Figure 5.3: Country-sector impacts - Austria

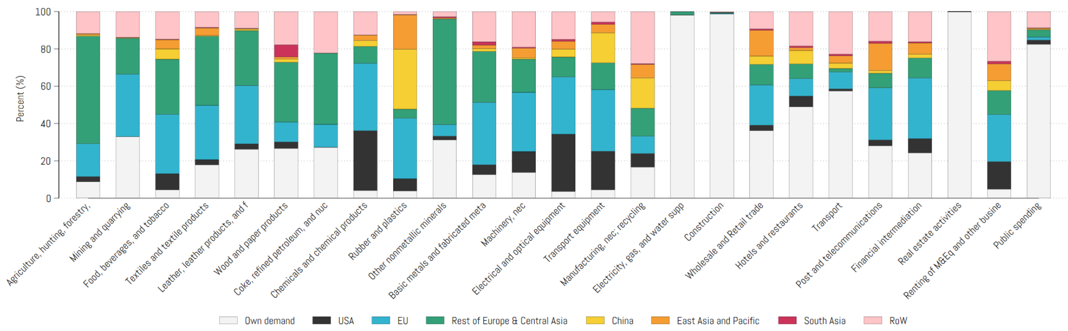


(a) Supply share

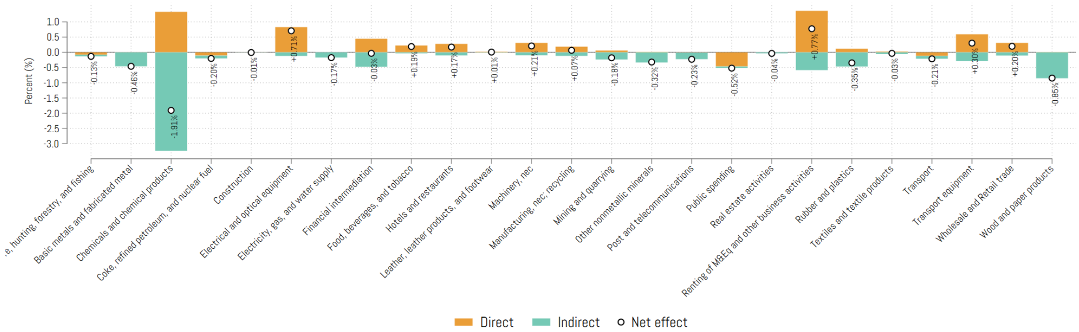


(b) Tariff impact

Figure 5.4: Country-sector impacts - Ireland

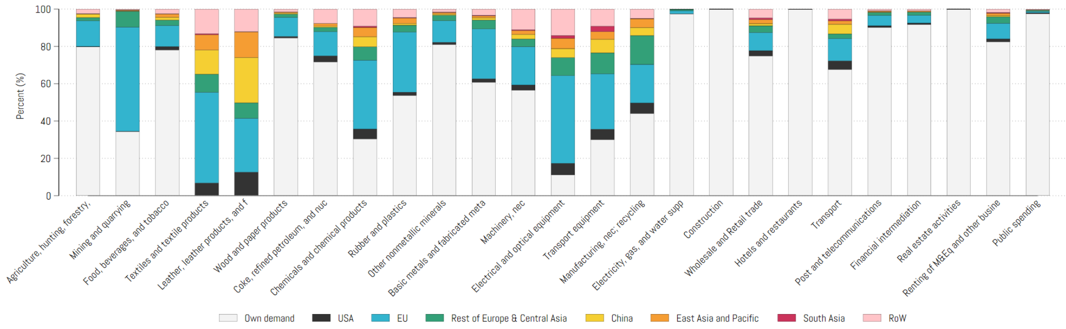


(a) Supply share

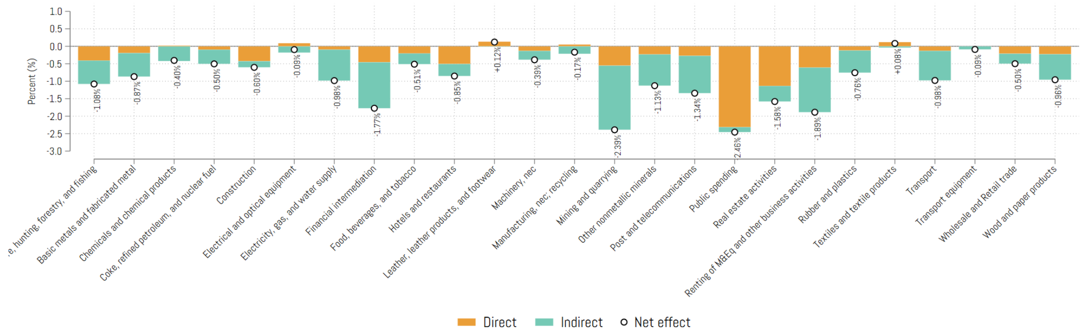


(b) Tariff impact

Figure 5.5: Country-sector impacts - France

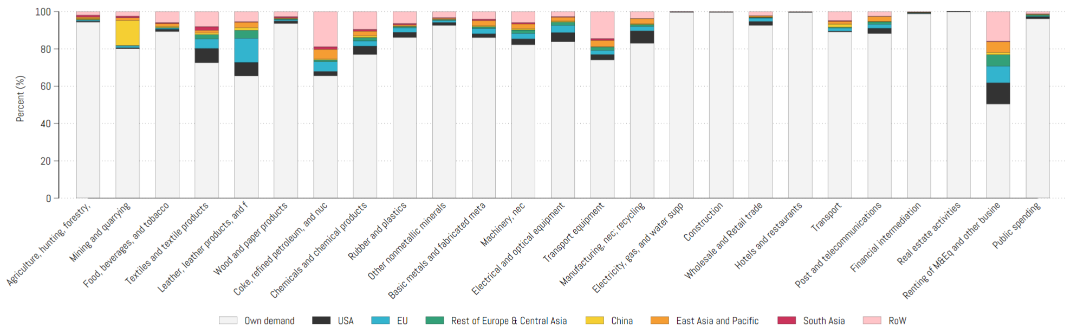


(a) Supply share

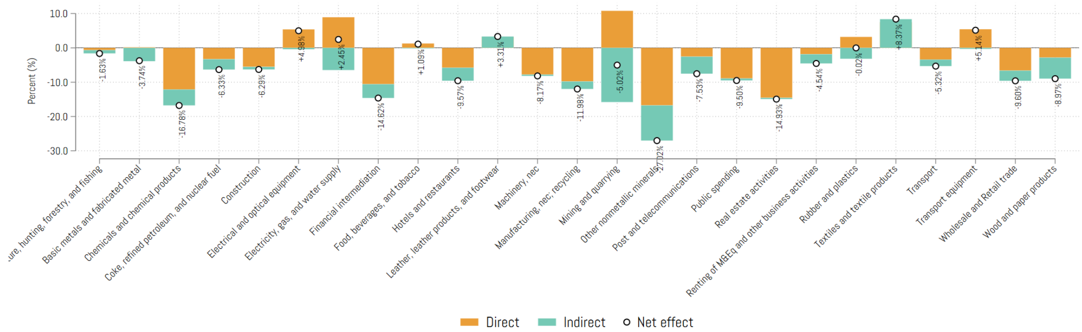


(b) Tariff impact

Figure 5.6: Country-sector impacts - India

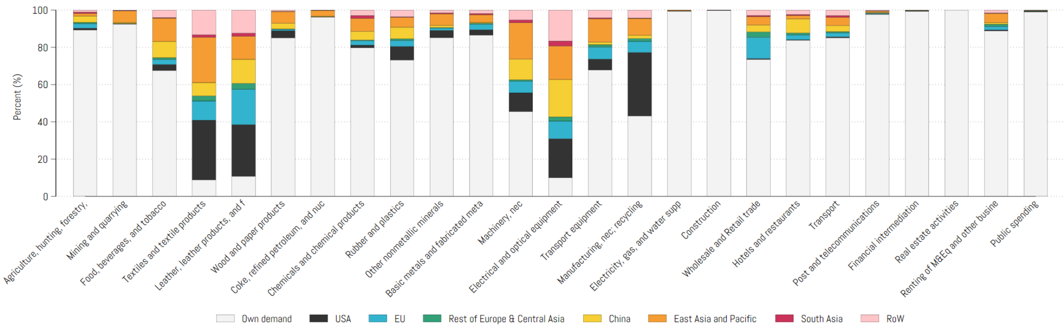


(a) Supply share

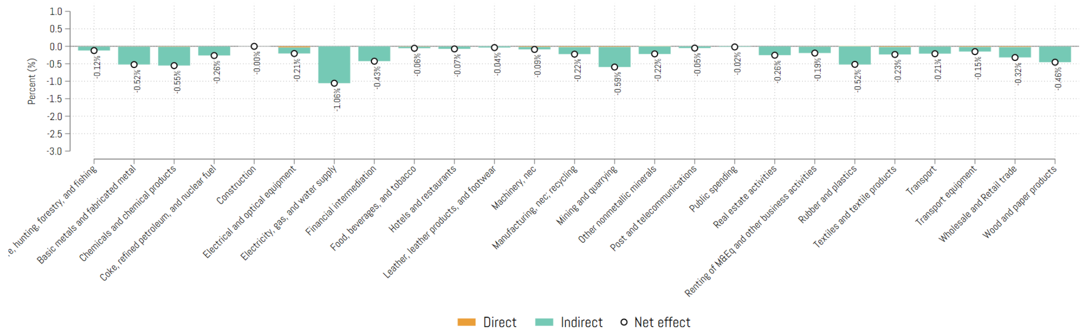


(b) Tariff impact

Figure 5.7: Country-sector impacts - Vietnam



(a) Supply share



(b) Tariff impact

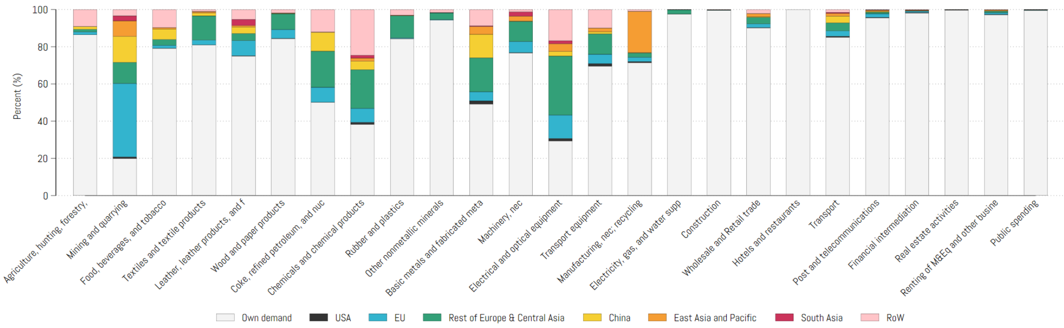
directly hit, but downstream contractions in transport, telecommunications, and finance multiply the effect. These cases show the vulnerability of export-oriented manufacturing economies in Asia, where concentrated sectoral exposure leads to systemic sector-wide losses.

Looking at Central Asia, Kazakhstan and Kyrgyzstan stand out. In Kazakhstan, direct tariff impacts are small in traded sectors such as textiles and food, but the second row shows marked indirect effects in mining, construction, and public spending, reflecting its reliance on resource revenues and external demand. Kyrgyzstan shows modest direct losses in manufacturing, but disproportionate contractions in retail, real estate, and business services, consistent with its dependence on re-exports and services linked to regional trade flows. These results show that in Central Asia, the tariff shock is transmitted less through direct exports to USA and more through indirect dependence on regional demand and fiscal revenues.

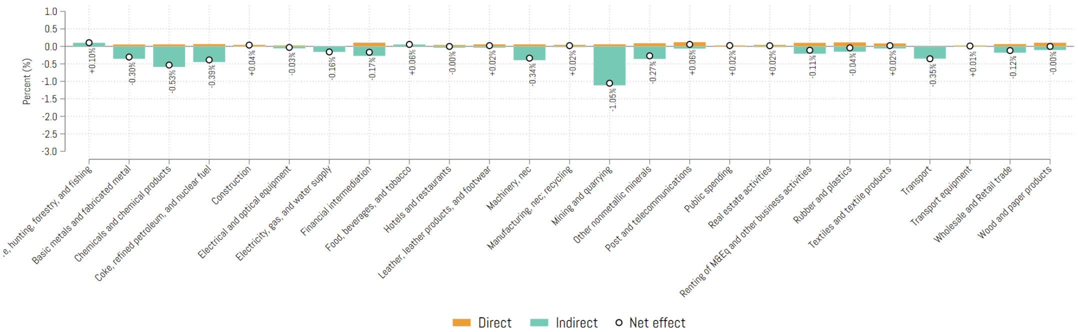
China's results differ sharply from other economies. Direct effects are visible in textiles (–0.07%), wood and paper (–0.29%), and transport equipment (–0.21%), industries explicitly targeted by tariffs. Yet indirect effects remain modest, with retail (+0.03%), construction (+0.00%), and hotels (+0.01%) showing little contraction. This relative insulation stems from China's large domestic market and strong intra-regional trade in East Asia, which absorbs part of the lost USA demand. While China does suffer in targeted manufacturing, the absence of strong indirect spillovers keeps the overall contraction at a moderate –0.4%, far below the USA outcome.

The USA, as the tariff initiator, faces an increase in domestic prices, raising costs for both households and firms. Direct declines appear in agriculture (–0.12%), mining (–0.22%), and food (–0.05%), but the indirect effects are much larger and spread across services such as telecommunications (–0.34%), finance

Figure 5.8: Country-sector impacts - Kazakhstan

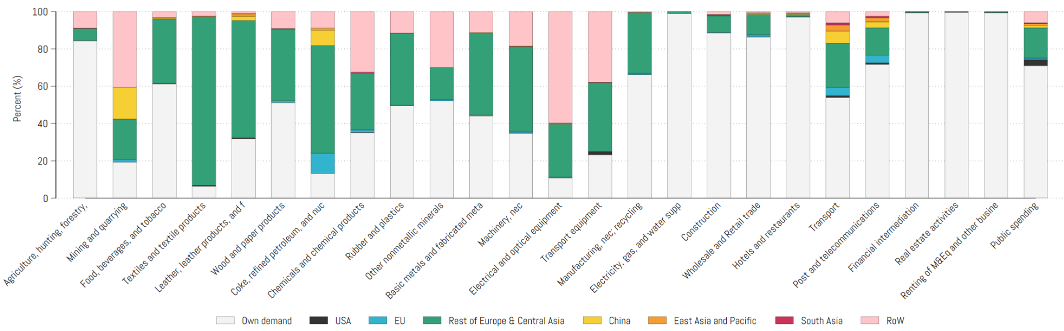


(a) Supply share

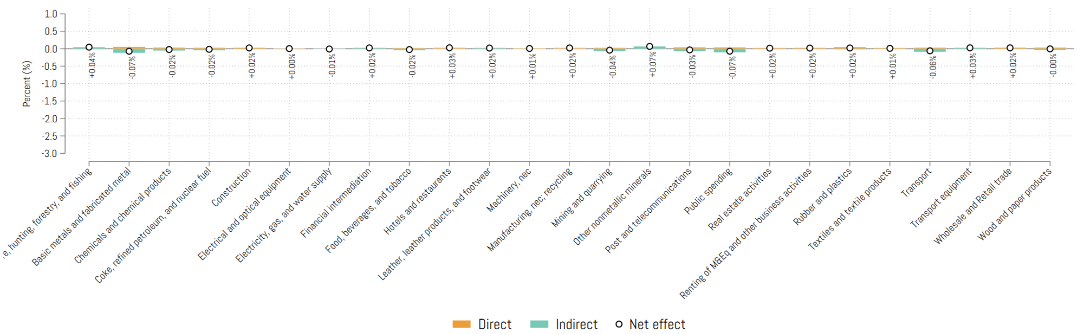


(b) Tariff impact

Figure 5.9: Country-sector impacts - Kyrgyzstan

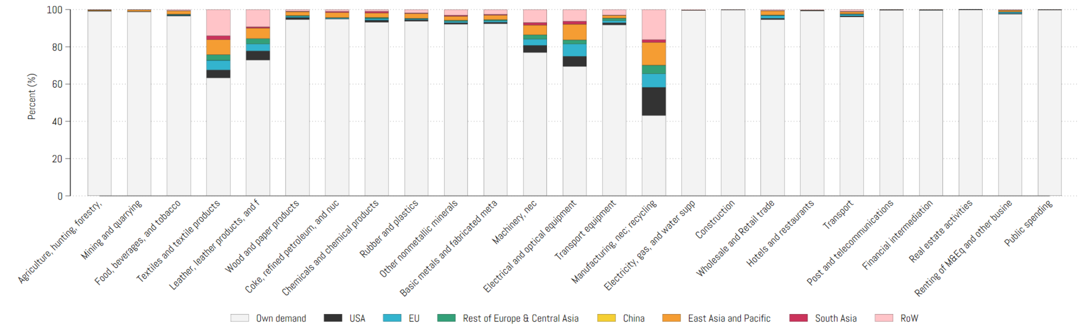


(a) Supply share

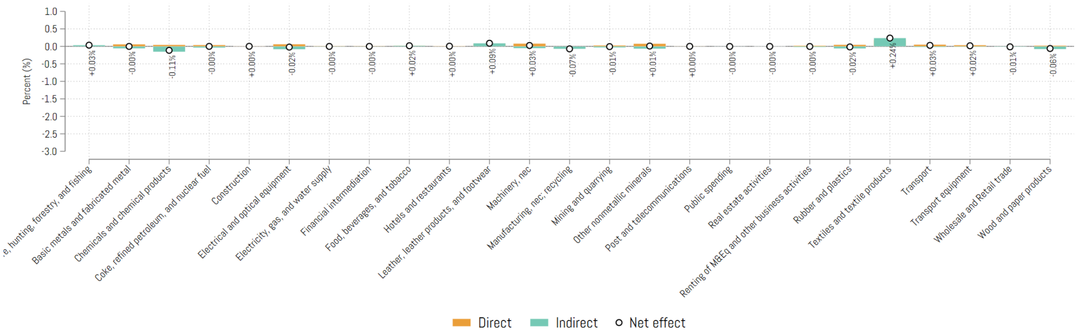


(b) Tariff impact

Figure 5.10: Country-sector impacts - China

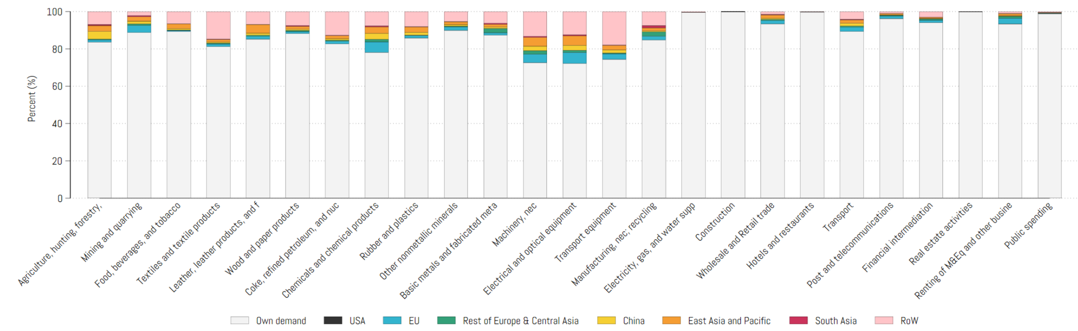


(a) Supply share

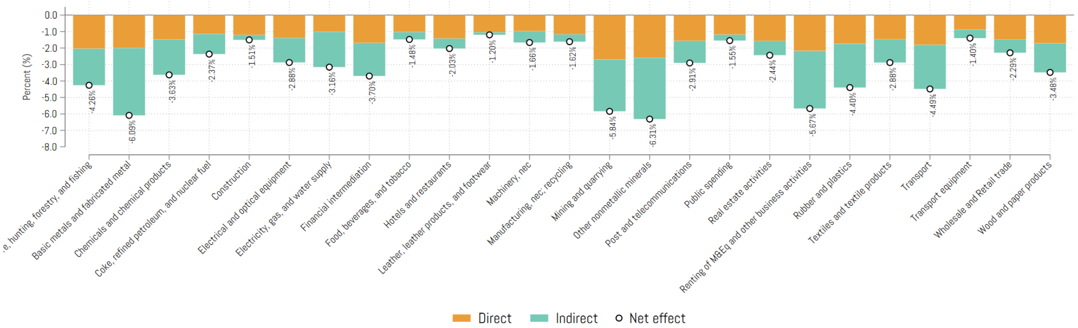


(b) Tariff impact

Figure 5.11: Country-sector impacts - USA



(a) Supply share



(b) Tariff impact

(–0.40%), business services (–0.64%), and retail (–0.18%), which contract as higher costs ripple through production networks. Despite relying on domestic demand for more than 90% of most sectors, the USA shows a total contraction of –3.2%, driven largely by indirect service-sector losses.

In all of these cases, we observe some consistent patterns. Direct impacts fall mainly on traded manufacturing industries, such as textiles, machinery, chemicals, food, while indirect impacts dominate in services and infrastructure, including retail, transport, telecommunications, finance, and public spending. For highly open economies such as Ireland, Austria, and Vietnam, indirect effects amplify modest direct shocks into systemic contractions. For large economies such as the USA and China, the mechanisms differ. USA losses are driven by higher domestic prices cascading into services, while China's large internal market and regional and even global ties cushion against broad spillovers. For Central Asia, tariff shocks reduce external demand and fiscal revenues, with consequences for construction and public services. Taken together, the disaggregated evidence underscores that tariffs reshape economies not only through directly affected industries but through the hidden transmission of costs into services and government budgets, often doubling or tripling the aggregate effect.

6 Conclusions

This paper presents a framework that integrates demand system estimation with multi-regional input–output (MRIO) analysis to examine the direct and indirect effects of tariffs and related policy shocks. By estimating price and expenditure elasticities using a Quadratic Almost Ideal Demand System (QUAIDS) model (Banks et al., 1997; Naqvi, 2025) applied to reshaped MRIO data, we establish an empirically grounded link between consumer demand behavior and global production structures. Embedding these elasticities within the MRIO framework enables us to trace how tariff-induced price changes propagate across countries and sectors, complementing traditional trade models such as the Armington framework (Armington, 1969; Anderson & van Wincoop, 2003), gravity models (Yotov et al., 2016), computable general equilibrium (CGE) approaches (Hertel et al., 2007; Costinot & Rodriguez-Clare, 2014), and MRIO-based analyses of global value chains (Los et al., 2015; Timmer et al., 2021).

In this study, we evaluate tariff shocks in terms of changes in Value Added that represents the net contribution of factors of production. Value Added serves as a direct measure of economic welfare and a policy-relevant indicator to assess the distribution of economic impacts between countries, sectors, and regions. Using data for the USA tariffs implemented in September 2025, we find a broad-based contraction in global value added of –0.52%, with indirect effects roughly twice as large as direct ones. While direct effects are concentrated in traded manufacturing sectors such as textiles, chemicals, and machinery, most total losses stem from indirect spillovers into services and infrastructure, including transport, telecommunications, finance, and public spending. Losses are widespread, where more than 90% of countries experience declines, with South Asia most affected, while Europe and East Asia exhibit greater resilience due to their diversified production bases and strong internal demand linkages. In smaller open economies such as Ireland and Austria, modest direct shocks cascade into economy-wide contractions, whereas in the United States, higher domestic prices drive service-sector losses that account for most of the aggregate decline.

The disaggregated country–sector results reveal further patterns. Within Europe, highly integrated economies such as Germany and Austria are vulnerable to indirect shocks transmitted through intra-EU supply chains, while smaller open economies such as Ireland face disproportionate service-sector impacts due to their reliance on external markets. In Asia, India and Vietnam demonstrate how dependence on export-oriented manufacturing can trigger systemic contractions in downstream services, whereas

China's large domestic market and regional trade integration provide a degree of insulation. In Central Asia, countries such as Kazakhstan and Kyrgyzstan experience indirect VA losses through reduced fiscal revenues, construction activity, and public spending, despite their relatively modest direct exposure to tariffed sectors. These findings underscore how the geography of global value chains determines the economic costs of tariffs.

From a policy perspective, the results emphasize the importance of international coordination and diversification to mitigate the unintended global costs of trade barriers. Strengthening regional demand, improving supply-chain resilience, and reducing over dependence on specific trading partners can help buffer economies against cascading value-chain shocks. Furthermore, integrating empirically estimated behavioral elasticities into trade modeling offers a more realistic basis for anticipating welfare and competitiveness outcomes, supporting evidence-based policymaking in an increasingly interconnected global economy.

Beyond the analysis of tariff shocks, the proposed framework can be extended to capture a wider range of economic adjustments. Incorporating investment dynamics would make it possible to examine how trade and policy shocks influence capital formation, productivity, and long-term growth. Linking the MRIO structure with employment coefficients would allow the quantification of job impacts across countries, sectors, and skill groups, offering insights into labor market vulnerabilities and structural reallocation. Integrating environmental and social satellite accounts, such as emissions and resource use, would allow for evaluating the sustainability implications of economic change. Taken together, these extensions would transform the QUAIDS–MRIO framework into a comprehensive and flexible analytical toolkit capable of addressing a wide spectrum of policy-relevant questions that also offers an integrated perspective on how global economies adjust to both domestic and international shocks.

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A Key tables

Table A.1: Country-level results

		Share (%) of output supplied to									**Impact of Tariffs on VA**		
ISO3	**Country**	**Self**	**USA**	**EU**	**Rest of Europe & Central Asia**	**China**	**East Asia & the Pacific**	**South Asia**	**RoW**	**Tariffs (%) (Sep 2025)**	**Direct**	**Indrect**	**Total**
AUS	Australia	85.520	0.811	0.811	0.400	4.351	4.010	0.776	3.320	10	-0.083	-0.289	-0.372
AUT	Austria	70.541	1.618	19.606	3.240	1.006	0.971	0.202	2.816	15	-0.070	-0.243	-0.313
BEL	Belgium	60.078	2.544	25.079	4.180	0.919	1.623	0.331	5.246	15	-0.085	-0.313	-0.397
BGD	Bangladesh	91.683	1.237	3.846	1.057	0.365	0.659	0.287	0.867	20	-0.105	-0.027	-0.131
BGR	Bulgaria	70.515	0.708	16.299	3.687	1.076	0.915	0.219	6.581	15	-0.093	-0.172	-0.264
BRA	Brazil	90.090	1.343	1.341	0.385	2.516	0.989	0.249	3.087	10	0.092	-0.013	0.079
BRN	Brunei Darussalam	57.026	0.126	0.634	0.106	4.460	35.552	0.977	1.119	25	-0.019	-0.152	-0.172
BTN	Bhutan	85.284	0.112	0.680	0.219	0.061	0.444	12.875	0.325	10	0.097	-0.907	-0.810
CAN	Canada	80.733	13.322	1.303	0.752	1.064	1.060	0.301	1.466	35	-1.033	-1.283	-2.316
CHE	Switzerland	67.799	3.038	13.192	2.219	2.309	2.613	0.583	8.246	39	0.019	-0.196	-0.177
CHN	China	92.693	1.146	1.208	0.586	-	2.062	0.346	1.958	30	0.033	-0.027	0.006
CYP	Cyprus	57.483	1.408	12.691	6.613	0.875	3.757	1.558	15.615	15	-0.083	-0.199	-0.281
CZE	Czechia	69.021	0.752	23.625	2.751	1.017	0.668	0.183	1.985	15	-0.116	-0.261	-0.376
DEU	Germany	76.172	2.482	11.974	3.125	1.633	1.337	0.263	3.013	15	0.057	-0.089	-0.032
DNK	Denmark	62.988	2.534	15.979	5.155	1.620	2.626	0.598	8.500	15	-0.005	-0.169	-0.174
ESP	Spain	80.013	1.084	10.630	2.275	0.467	0.761	0.181	4.588	15	-0.003	-0.156	-0.159
EST	Estonia	61.644	1.107	24.949	5.763	0.841	1.243	0.282	4.170	15	-0.064	-0.236	-0.300
FIN	Finland	81.358	1.964	10.416	2.021	1.126	1.204	0.252	1.659	15	-0.078	-0.391	-0.469
FJI	Fiji	69.178	5.527	1.175	1.436	5.221	7.410	0.683	9.370	15	-0.014	-0.123	-0.137
FRA	France	82.597	1.548	8.328	2.434	1.154	1.100	0.357	2.482	15	-0.316	-0.567	-0.883
GBR	United Kingdom	81.443	3.269	7.892	1.170	0.741	1.648	0.369	3.467	10	0.020	-0.229	-0.209
GRC	Greece	73.582	1.032	10.088	2.330	0.818	2.238	0.509	9.402	15	-0.172	-0.215	-0.387
HKG	Hong Kong	79.598	1.418	2.458	1.215	5.686	3.956	1.227	4.442	15	-0.014	-0.238	-0.251
HRV	Croatia	68.503	0.858	17.517	2.274	0.504	1.106	0.176	9.062	15	-0.124	-0.206	-0.330
HUN	Hungary	62.534	1.585	26.284	2.987	1.686	1.378	0.141	3.405	15	-0.096	-0.205	-0.301
IDN	Indonesia	88.473	0.917	0.863	0.342	2.470	3.813	1.032	2.089	19	-0.015	-0.314	-0.329
IND	India	87.905	2.196	1.894	1.029	0.645	1.495	0.447	4.389	26	-2.689	-3.159	-5.848
IRL	Ireland	27.785	12.305	20.807	13.140	3.509	4.900	1.120	16.434	15	0.213	-0.334	-0.120
ITA	Italy	82.291	1.574	9.242	2.283	0.770	0.908	0.196	2.737	15	-0.262	-0.513	-0.775
JPN	Japan	90.356	1.662	0.959	0.373	2.112	2.720	0.270	1.549	15	-0.230	-0.438	-0.668
KAZ	Kazakhstan	78.368	0.374	7.379	4.795	3.620	2.060	0.524	2.880	25	0.059	-0.200	-0.140
KGZ	Kyrgyz Republic	75.764	0.509	0.679	14.713	1.294	0.391	0.175	6.475	10	0.025	-0.025	0.000
KHM	Cambodia	62.723	5.683	5.490	1.711	3.714	12.622	0.591	7.466	19	-0.017	-0.189	-0.206
KOR	Korea, Rep	80.284	3.363	2.249	1.012	3.820	5.219	0.625	3.429	15	-0.113	-0.397	-0.511
LAO	Lao PDR	65.342	0.555	2.004	0.342	11.713	17.538	0.156	2.349	15	-0.385	-0.343	-0.729
LKA	Sri Lanka	88.993	1.868	2.411	1.302	0.579	1.284	1.146	2.417	20	-0.102	-0.181	-0.283
LTU	Lithuania	60.487	1.286	23.880	6.455	0.345	0.784	0.172	6.591	15	-0.077	-0.233	-0.310
LUX	Luxembourg	41.569	2.311	37.228	7.503	0.896	2.669	0.258	7.568	15	-0.083	-0.322	-0.405
LVA	Latvia	65.864	0.969	20.451	7.082	0.582	0.770	0.124	4.158	15	-0.065	-0.186	-0.251
MDV	Maldives	57.450	2.640	8.866	5.772	2.032	6.599	2.960	13.681	10	-0.013	-0.246	-0.260
MEX	Mexico	76.510	18.515	0.620	0.106	0.724	0.535	0.058	2.932	15	-0.823	-0.940	-1.763
MLT	Malta	39.572	1.885	24.553	8.253	1.809	5.032	0.804	18.091	15	-0.069	-0.256	-0.325
MNG	Mongolia	61.050	0.256	0.752	2.222	32.985	2.018	0.039	0.677	10	-0.006	-0.094	-0.100
MYS	Malaysia	76.879	2.313	2.297	0.704	6.076	8.193	1.144	2.393	19	-0.016	-0.275	-0.292
NLD	Netherlands	57.858	2.490	23.881	4.947	1.289	2.992	0.421	6.122	15	0.009	-0.194	-0.185
NOR	Norway	71.362	1.150	17.355	5.901	0.923	1.403	0.216	1.690	15	0.044	-0.192	-0.147
NPL	Nepal	95.240	0.339	0.565	0.305	0.282	0.428	2.331	0.509	10	-0.234	-0.348	-0.582
PAK	Pakistan	94.254	1.013	1.644	0.629	0.526	0.544	0.134	1.259	19	-1.684	-1.334	-3.018
PHL	Philippines	86.379	2.286	2.083	0.530	2.721	3.966	0.328	1.707	19	-0.015	-0.161	-0.176
POL	Poland	73.796	0.883	18.437	2.613	0.499	0.495	0.163	3.114	15	-0.162	-0.270	-0.432
PRT	Portugal	74.980	1.362	15.141	2.397	1.010	1.040	0.179	3.890	15	0.023	-0.161	-0.137
ROU	Romania	79.698	0.638	14.094	1.843	0.694	0.464	0.155	2.413	15	-0.012	-0.110	-0.122
RUS	Russian Federation	87.025	0.331	2.369	1.814	2.359	0.998	0.672	4.431	10	0.020	-0.113	-0.093
RoW	Rest of the World	87.833	0.840	2.418	1.100	3.639	2.157	1.325	0.688	10	0.231	0.071	0.302
SGP	Singapore	54.473	7.058	5.654	2.719	5.391	15.181	2.112	7.412	10	-0.025	-0.316	-0.341
SVK	Slovak Republic	59.566	1.498	29.183	3.238	1.949	1.039	0.105	3.422	15	-0.096	-0.174	-0.271
SVN	Slovenia	57.337	0.936	28.565	5.539	0.717	0.911	0.207	5.788	15	-0.089	-0.221	-0.310
SWE	Sweden	70.823	2.308	14.014	4.787	1.279	1.583	0.326	4.881	15	-0.089	-0.349	-0.438
THA	Thailand	71.797	3.265	2.487	1.385	3.575	8.893	1.023	7.575	19	-0.116	-0.354	-0.470
TUR	Turkiye	83.695	0.934	6.553	1.869	0.259	0.416	0.198	6.077	15	0.063	-0.021	0.042
TWN	Taiwan	68.102	6.219	3.151	0.768	10.292	7.575	0.551	3.342	20	-0.011	-0.312	-0.324
USA	United States	93.669	-	1.438	0.517	0.533	1.048	0.172	2.624	-	-1.540	-1.630	-3.170
VNM	Viet Nam	68.146	7.359	4.341	1.106	5.832	7.525	0.830	4.861	46	-0.009	-0.266	-0.275

Table A.2: Country-sector results

		1	2	3	4	5	6-7	8	9	10	11	12	13	14	15	16	17	18	19-21	22	23-26	27	28	29	30	31-25
ISO3	**Country**	**Agriculture, hunting, forestry, and fishing**	**Mining and quarrying**	**Food, beverages, and tobacco**	**Textiles and textile products**	**Leather, leather products, and footwear**	**Wood and paper products**	**Coke, refined petroleum, and nuclear fuel**	**Chemicals and chemical products**	**Rubber and plastics**	**Other non-metallic minerals**	**Basic metals and fabricated metal**	**Machinery, nec**	**Electrical and optical equipment**	**Transport equipment**	**Manufacturing, nec; recycling**	**Electricity, gas, and water supply**	**Construction**	**Wholesale and Retail trade**	**Hotels and restaurants**	**Transport**	**Post and telecommunications**	**Financial intermediation**	**Real estate activities**	**Renting of M&Eq and other business activities**	**Public spending**
AUS	Australia	-0.117	-0.221	-0.047	-0.073	-0.060	-0.100	-0.079	-0.058	-0.108	-0.108	-0.070	-0.065	-0.071	-0.062	-0.070	-0.025	-0.047	-0.072	-0.072	-0.092	-0.123	-0.110	-0.064	-0.126	-0.036
		-0.264	-1.351	-0.072	-0.103	-0.044	-0.290	-0.316	-0.452	-0.261	-0.301	-0.645	-0.194	-0.143	-0.164	-0.097	-0.261	-0.108	-0.183	-0.132	-0.311	-0.339	-0.400	-0.116	-0.641	-0.045
AUT	Austria	-0.243	0.171	0.026	-0.051	0.026	-0.114	-0.079	0.006	-0.021	-0.076	-0.032	0.019	0.084	0.222	0.039	-0.001	-0.169	-0.102	-0.191	-0.165	-0.100	-0.212	-0.270	-0.136	-0.386
		-0.368	-0.176	-0.077	-0.033	-0.048	-0.463	-0.166	-0.531	-0.363	-0.555	-0.541	-0.125	-0.135	-0.212	-0.066	-0.284	-0.122	-0.142	-0.050	-0.256	-0.315	-0.458	-0.163	-0.384	-0.046
BEL	Belgium	-0.161	-0.266	-0.116	-0.033	-0.048	-0.107	-0.092	0.136	-0.043	-0.135	-0.058	-0.008	0.005	0.047	0.063	-0.082	-0.308	0.116	-0.152	-0.092	-0.093	-0.085	-0.333	0.258	-0.527
		-0.206	-1.326	-0.109	-0.041	-0.052	-0.495	-0.073	-0.791	-0.368	-0.537	-0.524	-0.122	-0.150	-0.047	-0.341	-0.192	-0.192	-0.180	-0.118	-0.327	-0.414	-0.418	-0.145	-0.571	-0.080
BGD	Bangladesh	-0.001	0.003	-0.158	0.719	-2.207	-0.123	0.000	-0.331	0.246	0.001	-0.003	-0.160	-0.820	-0.011	0.473	0.000	-0.005	0.000	-0.019	0.000	-0.131	-0.022	0.000	-0.067	0.000
		-0.009	-0.004	-0.007	0.150	-0.180	0.011	0.034	-0.051	-0.035	0.014	-0.011	-0.002	-0.105	-0.002	0.000	0.067	0.002	0.028	0.008	-0.003	-0.613	0.251	0.007	-0.222	0.005
BGR	Bulgaria	-0.131	-0.180	-0.091	-0.075	-0.080	-0.082	-0.138	-0.088	-0.058	-0.084	-0.149	-0.139	0.039	-0.085	0.151	-0.099	-0.013	-0.149	-0.095	-0.116	-0.037	-0.181	-0.153	0.016	-0.300
		-0.182	-0.239	-0.075	-0.075	-0.041	-0.183	-0.049	-0.171	-0.196	-0.165	-0.369	-0.054	-0.107	-0.039	-0.074	-0.188	-0.137	-0.203	-0.008	-0.204	-0.172	-0.746	-0.149	-0.394	-0.076
BRA	Brazil	0.332	0.063	0.110	0.166	0.047	0.069	0.139	0.146	0.226	-0.418	-0.156	-0.014	0.109	0.061	-0.223	0.000	0.129	0.227	0.131	0.230	0.154	0.194	0.199	0.233	0.153
		0.087	-0.255	-0.032	0.032	-0.018	-0.049	0.064	0.034	0.063	-0.056	-0.634	-0.038	0.018	0.000	-0.048	0.065	0.013	0.049	0.010	0.070	0.058	0.069	0.038	0.125	0.016
BRN	Brunei Darussalam	-0.002	-0.304	-0.005	-0.021		-0.002	-0.043	-0.009	-0.003	-0.001	0.002	0.000	-0.003	-0.034	-0.003	-0.004	-0.002	-0.003	-0.006	-0.012	-0.003	-0.003	0.000	0.000	0.000
		-0.015	-1.263	-0.034	-0.029		-0.071	-0.342	-0.280	-0.103	-0.078	-0.171	-0.021	-0.040	-0.031	-0.050	-0.073	-0.009	-0.065	-0.144	-0.179	-0.205	-0.126	-0.004	-0.316	-0.010
BTN	Bhutan	-0.062	3.748	0.147	0.004	-0.005	-0.266		-2.575	-0.902	-3.264	5.081	-0.003	0.010	0.005	1.062	2.646	-0.036	-0.591	-1.193	-0.467	-0.678	-0.116	-0.045	-0.139	-0.030
		-0.256	-3.138	-0.043	-0.006	-0.006	-0.271		-1.620	-1.236	-2.604	-2.941	-0.003	-0.001	0.000	-0.187	-6.389	-0.015	-0.131	-0.591	-0.477	-0.806	-0.181	-0.432	-0.419	-0.007
CAN	Canada	-0.006	-3.185	-0.581	-2.750	-2.334	-2.165	-0.569	-2.622	-5.069	-0.684	-2.937	-2.668	-2.425	-2.565	-1.691	0.536	0.576	0.553	0.541	0.475	0.639	0.746	0.742	1.052	0.577
		-1.144	-3.488	-0.291	-0.791	-0.331	-2.093	-1.153	-2.310	-3.825	-1.966	-3.033	-0.795	-0.554	-0.575	-0.200	-2.958	-0.066	-0.860	-0.276	-1.495	-0.556	-1.269	-0.060	-1.907	-0.080
CHE	Switzerland	0.002	0.001	0.012	0.021	0.023	0.008	0.013	0.044	0.025	0.013	0.041	0.028	0.029	0.050	0.091	0.001	0.000	0.009	0.006	0.014	0.006	0.025	0.000	0.018	0.001
		-0.083	-0.290	-0.044	-0.059	-0.077	-0.247	-0.122	-0.696	-0.314	-0.282	-0.914	-0.127	-0.054	-0.057	-0.090	-0.239	-0.023	-0.172	-0.088	-0.221	-0.180	-0.210	-0.013	-0.264	-0.036
CHN	China	0.011	0.025	0.017	0.177	0.069	0.019	0.036	0.042	0.046	0.076	0.057	0.078	0.062	0.032	-0.003	0.004	0.001	-0.001	0.006	0.048	0.002	0.003	0.000	0.017	-0.001
		0.024	-0.032	0.001	0.060	0.021	-0.079	-0.036	-0.156	-0.061	-0.067	-0.058	-0.052	-0.082	-0.014	-0.068	-0.006	0.000	-0.012	-0.001	-0.020	-0.001	-0.003	-0.001	-0.020	-0.001
CYP	Cyprus	-0.357	-0.038	-0.054	-0.002	0.023	-0.108	-0.081	-0.237	-0.025	-0.075	-0.102	-0.193	0.012	-0.135	-0.022	-0.022	-0.016	-0.202	-0.105	-0.027	0.193	-0.056	-0.106	-0.039	-0.289
		-0.128	-0.244	-0.065	-0.014	-0.011	-1.164	-0.252	-0.192	-0.309	0.003	-0.379	-0.167	-0.165	-0.036	-0.078	-0.318	-0.096	-0.139	-0.071	-0.189	-0.280	-0.231	-0.125	-0.267	-0.049
CZE	Czechia	-0.149	-0.215	-0.146	-0.044	-0.032	-0.112	-0.052	-0.026	-0.044	-0.088	-0.135	-0.036	-0.005	-0.094	-0.014	0.000	-0.172	-0.255	-0.140	-0.181	-0.104	-0.147	-0.207	-0.159	-0.336
		-0.259	-0.372	-0.114	-0.065	-0.021	-0.486	-0.303	-0.203	-0.318	-0.402	-0.395	-0.166	-0.083	-0.073	-0.064	-0.202	-0.162	-0.422	-0.078	-0.382	-0.445	-0.560	-0.223	-0.653	-0.070
DEU	Germany	-0.041	-0.012	-0.042	-0.056	0.013	-0.005	-0.005	0.110	-0.006	0.001	0.007	0.056	0.178	0.127	0.030	-0.001	-0.001	0.620	0.034	0.049	0.010	0.155	0.003	0.274	-0.071
		-0.139	0.011	-0.039	-0.081	-0.033	-0.185	-0.080	-0.578	-0.282	-0.196	-0.305	-0.129	-0.120	-0.093	-0.056	-0.021	0.013	-0.064	-0.020	0.089	0.100	-0.072	0.071	-0.011	-0.010
DNK	Denmark	-0.150	-0.416	-0.084	-0.035	-0.032	-0.036	-0.006	-0.090	-0.006	-0.057	-0.069	-0.089	0.181	-0.002	-0.005	-0.009	0.022	0.003	0.002	0.373	0.025	0.038	0.000	0.393	-0.076
		-0.186	-0.621	-0.038	-0.045	-0.022	-0.199	-0.134	-0.435	-0.424	-0.225	-0.404	-0.060	-0.091	-0.082	-0.047	-0.078	-0.038	-0.094	-0.019	-0.482	-0.068	-0.140	-0.020	-0.264	-0.022
ESP	Spain	-0.060	-0.091	0.007	-0.089	0.000	-0.024	-0.004	-0.014	-0.029	0.018	-0.044	-0.058	0.093	-0.047	0.029	-0.003	-0.003	0.164	0.000	-0.031	0.011	0.089	0.001	0.096	-0.094
		-0.034	-0.920	-0.037	-0.052	-0.038	-0.279	-0.105	-0.273	-0.273	-0.392	-0.333	-0.092	-0.112	-0.059	-0.051	-0.145	-0.013	-0.076	-0.022	-0.156	-0.083	-0.136	-0.014	-0.173	-0.033
EST	Estonia	-0.135	0.038	-0.126	-0.040	0.001	-0.064	-0.146	-0.019	-0.039	-0.082	-0.089	-0.074	0.087	-0.105	0.091	-0.003	-0.108	-0.103	-0.060	-0.136	0.047	-0.010	-0.110	-0.062	-0.367
		-0.330	-0.293	-0.065	-0.034	-0.014	-0.548	-0.086	-0.367	-0.357	-0.419	-0.330	-0.094	-0.061	-0.034	-0.084	-0.285	-0.152	-0.194	-0.164	-0.325	-0.441	-0.526	-0.203	-0.409	-0.079
FIN	Finland	-0.294	-0.181	-0.122	-0.002	-0.014	-0.076	0.201	0.044	-0.071	-0.117	-0.121	-0.097	0.146	0.575	-0.043	-0.040	-0.187	-0.206	-0.152	-0.158	-0.104	-0.175	-0.271	-0.121	-0.363
		-0.852	-0.772	-0.271	-0.125	-0.078	-0.606	-0.425	-0.775	-0.781	-0.477	-0.491	-0.336	-0.151	-0.135	-0.183	-0.575	-0.128	-0.250	-0.121	-0.533	-0.500	-0.397	-0.148	-0.579	-0.081
FJI	Fiji	-0.004	-0.012	-0.011	-0.018	-0.002	-0.036		-0.012	-0.008	-0.011	-0.013	-0.007		-0.004	-0.007	-0.002	-0.007	-0.020	-0.061	-0.043	-0.010	-0.008	-0.001	-0.023	-0.010
		-0.154	0.033	-0.062	-0.070	-0.029	-0.177		-0.025	-0.070	-0.021	-0.130	-0.072		-0.028	-0.063	-0.137	-0.026	-0.020	-0.291	-0.496	-0.301	-0.226	-0.167	-0.236	-0.051
FRA	France	-0.407	-0.554	-0.203	0.119	0.130	-0.228	-0.095	0.018	-0.121	-0.232	-0.194	-0.132	0.087	0.000	0.049	-0.093	-0.426	-0.212	-0.506	-0.130	-0.272	-0.455	-1.134	-0.607	-2.312
		-0.672	-1.835	-0.310	-0.039	-0.010	-0.729	-0.408	-0.423	-0.635	-0.895	-0.674	-0.254	-0.182	-0.089	-0.217	-0.889	-0.177	-0.286	-0.346	-0.847	-1.070	-1.317	-0.446	-1.280	-0.144
GBR	United Kingdom	0.008	0.017	0.007	0.032	0.020	0.011	0.013	0.048	0.023	0.010	0.019	0.028	0.047	0.032	0.047	0.000	0.000	0.011	0.003	0.010	0.017	0.053	0.000	0.036	0.008
		-0.055	-0.516	-0.047	-0.091	-0.072	-0.308	-0.125	-0.610	-0.339	-0.246	-0.727	-0.174	-0.141	-0.159	-0.086	-0.081	-0.044	-0.082	-0.043	-0.206	-0.325	-0.543	-0.014	-0.631	-0.055
GRC	Greece	-0.279	-0.216	-0.101	-0.101	-0.047	-0.099	-0.129	-0.100	-0.071	-0.072	-0.123	-0.073	-0.074	0.023	-0.014	-0.005	-0.422	-0.141	-0.237	-0.104	-0.111	-0.225	-0.613	-0.179	-0.786
		-0.095	-0.279	-0.031	-0.035	-0.008	-0.216	-0.047	-0.160	-0.381	-0.602	-0.400	-0.123	-0.171	-0.094	-0.047	-0.188	-0.080	-0.186	-0.041	-0.343	-0.185	-0.698	-0.378	-0.530	-0.052
HKG	Hong Kong	-0.005		-0.002	-0.007	-0.010	-0.043	-0.023	-0.041	-0.013	-0.008	-0.030	-0.012	-0.026	-0.025	-0.002	0.000	-0.001	-0.028	0.000	-0.013	-0.007	-0.010	0.000	-0.019	-0.002
		-0.058		-0.044	-0.017	-0.023	-1.100	-0.330	-1.155	-0.148	-0.085	-0.667	-0.024	-0.134	-0.099	-0.081	-0.093	-0.025	-0.115	-0.013	-0.363	-0.235	-0.221	-0.069	-0.578	-0.029
HRV	Croatia	-0.309	-0.121	-0.237	-0.131	-0.038	-0.141	-0.143	-0.012	-0.087	-0.149	-0.195	0.009	-0.015	-0.117	-0.055	-0.081	-0.174	0.024	-0.162	-0.169	-0.041	-0.093	-0.179	-0.055	-0.415
		-0.206	-0.457	-0.020	-0.035	-0.013	-0.259	-0.024	-0.433	-0.128	-0.197	-0.268	-0.110	-0.063	-0.083	-0.042	-0.342	-0.060	-0.430	-0.049	-0.237	-0.455	-0.316	-0.278	-0.592	-0.057
HUN	Hungary	-0.201	-0.503	-0.118	-0.065	-0.045	-0.105	-0.106	-0.097	-0.044	-0.050	-0.113	-0.052	0.051	0.075	-0.020	-0.023	-0.160	0.195	-0.167	-0.157	-0.089	-0.057	-0.233	0.006	-0.324
		-0.416	-0.175	-0.100	-0.052	-0.016	-0.313	-0.195	-0.316	-0.258	-0.527	-0.318	-0.117	-0.135	-0.116	-0.064	-0.182	-0.074	-0.138	-0.038	-0.267	-0.196	-0.396	-0.132	-0.512	-0.068
IDN	Indonesia	-0.011	-0.128	-0.007	-0.014	-0.020	-0.026	-0.005	-0.014	-0.002	-0.007	-0.013	-0.018	-0.016	-0.015	-0.033	0.000	0.000	-0.001	-0.006	-0.003	-0.001	-0.004	0.000	-0.022	-0.004
		-0.237	-3.323	-0.098	-0.013	-0.044	-0.520	-0.300	-0.397	-0.293	-0.145	-0.254	-0.281	-0.110	-0.076	-0.072	-0.089	-0.036	-0.179	-0.053	-0.149	-0.124	-0.345	-0.030	-0.641	-0.045
IND	India	-0.666	10.779	1.262	7.445	3.186	-2.838	-3.301	-12.112	3.184	-16.757	0.150	-7.778	5.379	5.446	-9.776	8.934	-5.538	-6.621	-5.762	-3.410	-2.561	-10.572	-14.556	-1.849	-8.894
		-0.968	-15.798	-0.173	0.920	0.127	-6.130	-3.028	-4.665	-3.201	-10.262	-3.893	-0.390	-0.394	-0.311	-2.200	-6.481	-0.749	-2.980	-3.806	-1.909	-4.966	-4.044	-0.377	-2.691	-0.602
IRL	Ireland	-0.077	0.058	0.224	0.024	0.019	0.008	-0.107	1.330	0.121	0.016	0.002	0.308	0.829	0.592	0.184	0.000	-0.002	0.308	0.276	-0.119	-0.010	0.446	0.000	1.362	-0.464
		-0.056	-0.238	-0.035	-0.058	-0.011	-0.855	-0.095	-3.238	-0.467	-0.336	-0.461	-0.099	-0.122	-0.289	-0.118	-0.174	-0.004	-0.109	-0.104	-0.095	-0.218	-0.477	-0.035	-0.588	-0.056
ITA	Italy	-0.365	0.028	-0.091	0.011	0.070	-0.186	-0.067	0.039	-0.124	-0.116	-0.219	-0.063	0.017	0.110	0.083	-0.094	-0.624	-0.716	-0.593	-0.454	-0.191	-0.492	-0.779	-0.588	-1.158
		-0.457	-0.265	-0.181	-0.115	-0.069	-0.859	-0.411	-0.532	-0.530	-0.797	-0.628	-0.247	-0.268	-0.215	-0.247	-0.738	-0.258	-0.325	-0.169	-0.884	-0.736	-1.725	-0.386	-1.606	-0.167
JPN	Japan	-0.414	-0.524	-0.131	-0.286	-0.349	-0.416	-0.199	-0.142	-0.458	-0.441	-0.175	-0.094	-0.094	-0.090	-0.264	-0.099	-0.063	-0.169	-0.182	-0.169	-0.162	-0.379	-0.081	-0.319	-0.051
		-0.397	-1.091	-0.106	-0.509	-0.542	-0.890	-0.384	-1.037	-0.865	-0.753	-0.776	-0.153	-0.329	-0.197	-0.310	-0.381	-0.026	-0.201	-0.140	-0.342	-0.347	-0.508	-0.025	-0.609	-0.034
KAZ	Kazakhstan	0.069	0.062	0.037	0.083	0.060	0.106	0.064	0.058	0.113	0.090	0.053	0.061	0.028	0.025	0.044	0.000	0.043	0.064	0.038	-0.009	0.120	0.107	0.042	0.101	0.027
		0.035	-1.115	0.019	-0.062	-0.039	-0.107	-0.451	-0.590	-0.154	-0.360	-0.358	-0.397	-0.059	-0.015	-0.023	-0.159	-0.007	-0.184	-0.040	-0.345	-0.065	-0.275	-0.023	-0.211	-0.004
KGZ	Kyrgyz Republic	0.028	0.023	0.018	0.019	0.019	0.031	0.028	0.031	0.042	0.026	0.049	0.015	0.007	0.020	0.021	0.000	0.027	0.030	0.027	0.031	0.036	0.021	0.019	0.022	0.034
		0.016	-0.065	-0.043	-0.008	0.000	-0.035	-0.046	-0.054	-0.021	0.041	-0.121	-0.008	-0.004	0.006	0.000	-0.008	-0.004	-0.005	0.000	-0.091	-0.070	0.002	-0.003	-0.003	-0.105
KHM	Cambodia	-0.015	-0.002	-0.008	-0.038		0.043	-0.032	-0.012	0.023	0.006	-0.004	-0.009	-0.067	-0.102	-0.020	-0.001	-0.001	-0.040	-0.065	-0.023	-0.019	-0.010	-0.002	-0.006	-0.007
		-0.099	-0.028	-0.087	-0.061		-1.793	-0.247	-0.291	-0.531	-0.111	-0.120	-0.042	-0.006	-0.051	-0.086	-0.026	-0.009	-0.044	-0.181	-0.216	-0.200	-0.092	-0.035	-0.116	-0.062
KOR	Korea, Rep	-0.186	-0.234	-0.073	-0.092	-0.083	-0.226	-0.063	-0.098	-0.193	-0.180	-0.119	-0.089	-0.057	-0.064	-0.118	-0.031	-0.034	-0.119	-0.105	-0.119	-0.181	-0.118	-0.090	-0.125	-0.038
		-0.213	-1.130	-0.119	-0.177	-0.076	-0.958	-0.409	-0.867	-0.553	-0.505	-0.944	-0.317	-0.550	-0.121	-0.145	-0.423	-0.008	-0.252	-0.159	-0.540	-0.635	-0.254	-0.123	-0.429	-0.024
LAO	Lao PDR	-0.515	-0.013	-0.170	-0.099	-0.116	-0.162	-0.444	-0.706	-0.377	-0.694	-0.351	-0.256	-0.326	-0.341	-0.406	-0.037	-0.332	-0.423	-0.423	-0.466	-0.740	-0.495	-0.451	-0.999	-0.291
		-0.308	-0.151	-0.061	-0.075	-0.114	-0.356	-0.495	-0.754	-0.421	-0.832	-0.248	-0.053	-0.108	-0.200	-0.224	-0.727	-0.043	-0.335	-0.051	-0.586	-0.380	-0.602	-0.147	-1.291	-0.018
LKA	Sri Lanka	-0.043	0.043	-0.205	1.747	-0.340	-0.199	-3.306	-1.466	2.569	-0.045	-1.060	0.435	-2.675	-0.807	-0.817	-0.001	-0.009	0.992	0.227	0.036	0.178	0.034	0.000	2.081	0.074
		-0.142	-0.064	-0.077	0.497	-0.081	-0.385	-0.466	-0.718	-0.804	-0.165	-0.594	-0.483	-0.378	-0.033	-0.035	0.099	0.000	-0.152	-0.135	-0.059	-0.064	0.280	0.042	-0.624	0.013
LTU	Lithuania	-0.275	-0.058	-0.123	-0.066	-0.074	-0.081	0.028	0.058	-0.027	-0.080	-0.049	-0.089	0.042	-0.145	0.112	-0.001	-0.014	-0.195	-0.024	-0.194	-0.040	-0.103	-0.119	-0.107	-0.298
		-0.099	-0.310	-0.027	-0.033	-0.008	-0.343	-0.223	-0.538	-0.300	-0.173	-0.494	-0.130	-0.109	-0.042	-0.059	-0.257	-0.205	-0.152	-0.137	-0.330	-0.445	-0.534	-0.276	-0.535	-0.068
LUX	Luxembourg	-0.103	-0.019	-0.096	-0.009		-0.117		-0.080	-0.061	-0.070	0.012	-0.053	-0.015	-0.056	-0.047	-0.004	-0.154	-0.112	-0.096	-0.074	-0.043	-0.063	-0.214	0.021	-0.459
		-0.211	-0.899	-0.112	-0.245		-0.610		-0.234	-0.275	-0.465	-0.761	-0.138	-0.137	-0.091	-0.121	-0.377	-0.154	-0.358	-0.237	-0.286	-0.328	-0.427	-0.516	-0.335	-0.081
LVA	Latvia	-0.187	0.002	-0.117	-0.085	-0.039	-0.011	-0.103	-0.102	-0.060	-0.021	-0.089	-0.065	0.057	-0.074	0.018	-0.001	-0.008	-0.149	-0.066	-0.143	-0.022	0.114	-0.116	0.005	-0.353
		-0.283	-0.325	-0.027	-0.041	-0.010	-0.454	-0.081	-0.373	-0.179	-0.400	-0.316	-0.107	-0.095	-0.059	-0.047	-0.173	-0.067	-0.131	-0.037	-0.324	-0.156	-0.399	-0.083	-0.455	-0.038
MDV	Maldives	0.356		-0.760	-0.055		-0.002				-0.066	0.411			0.707	-0.149	0.000	-0.057	0.035	0.121	-0.570	-0.114	-0.104	-0.006	-0.227	0.242
		-0.509		-0.047	-0.157		-0.191				-0.237	-0.204			-0.004	-0.030	-0.149	0.002	-0.046	-0.197	-0.335	-0.654	-0.851	-0.143	-0.581	-0.101
MEX	Mexico	-1.017	1.158	0.169	-3.378	-0.951	-0.416	0.383	-0.591	-3.123	-1.895	-3.451	-2.221	-3.420	-2.249	-3.752	-0.016	0.488	0.829	0.581	0.424	0.654	0.574		1.044	0.417
		-0.291	-2.036	-0.058	-0.287	-0.427	-1.772	-0.551	-1.416	-2.422	-1.636	-4.253	-0.577	-0.521	-0.565	-1.098	-1.912	0.049	-1.296	-0.082	-0.398	0.015	-0.181		-0.840	0.002
MLT	Malta	-0.126	-0.023	-0.211	-0.009	0.016	-0.116	-0.181	-0.120	0.086	-0.031	-0.102	-0.028	0.097	-0.034	-0.018	-0.002	-0.070	-0.106	-0.068	-0.150	-0.063	-0.043	-0.062	0.251	-0.613
		-0.051	-0.857	-0.031	-0.222	-0.070	-0.078	0.051	-1.258	-0.470	-0.318	-0.303	-0.146	-0.237	-0.083	-0.043	-0.199	-0.167	-0.208	-0.037	-0.388	-0.225	-0.300	-0.181	-0.466	-0.111
MNG	Mongolia	-0.001	-0.004	-0.001	-0.012	-0.020	-0.003	-0.004	-0.002	-0.004	-0.004	-0.007	-0.011	0.000	-0.002	-0.005	0.000	-0.001	-0.015	-0.005	-0.011	-0.003	-0.005	-0.010	-0.027	-0.001
		-0.002	-0.051	-0.006	-0.018	-0.015	-0.054	-0.102	-0.206	-0.087	-0.060	-0.471	-0.123	-0.078	-0.081	-0.041	-0.109	-0.018	-0.100	-0.047	-0.095	-0.101	-0.173	-0.086	-0.214	-0.010
MYS	Malaysia	-0.006	-0.154	-0.013	-0.011	-0.009	-0.008	-0.003	-0.024	-0.014	-0.016	-0.015	-0.014	-0.017	-0.004	-0.029	0.000	-0.001	-0.015	-0.008	-0.015	-0.002	-0.008	-0.001	-0.024	-0.001
		-0.248	-1.211	-0.194	-0.049	-0.057	-0.195	-0.273	-0.714	-0.339	-0.435	-0.451	-0.226	-0.350	-0.172	-0.061	-0.364	-0.048	-0.311	-0.040	-0.265	-0.083	-0.325	-0.032	-0.420	-0.013
NLD	Netherlands	-0.117	-0.487	-0.039	-0.061	-0.035	-0.023	0.005	-0.025	-0.003	-0.031	-0.005	0.016	0.064	0.019	0.012	-0.023	0.041	0.143	0.001	0.112	0.038	0.392	0.004	0.439	-0.215
		-0.127	-0.979	-0.062	-0.057	-0.038	-0.274	-0.179	-0.485	-0.363	-0.253	-0.478	-0.080	-0.064	-0.051	-0.025	-0.148	-0.095	-0.128	0.006	-0.319	-0.140	-0.199	-0.006	-0.255	-0.044
NOR	Norway	0.036	0.055	0.031	0.048	0.035	0.056	0.039	0.042	0.058	0.055	0.059	0.040	0.040	0.029	0.045	0.000	0.033	0.049	0.045	0.050	0.073	0.078	0.041	0.052	0.020
		-0.023	-1.020	-0.017	-0.048	-0.033	-0.153	-0.182	-0.710	-0.259	-0.183	-0.710	-0.189	-0.099	-0.084	-0.052	-0.103	0.001	-0.090	-0.026	-0.236	-0.124	-0.219	-0.021	-0.195	-0.021
NPL	Nepal	-0.011	0.004	-0.426	0.394	-0.548	-1.101	-0.842	-1.106	-0.993	-0.192	0.710	-1.019	0.103	-0.799	0.386	0.000	0.000	-0.043	-0.003	-0.214	-0.118	0.000	-0.008	-0.026	-0.002
		-0.098	-0.898	-0.393	0.189	0.046	-1.060	-1.026	-0.697	-1.157	-0.811	-0.373	-0.195	-0.017	-0.151	-0.067	-0.150	-0.001	-0.113	-0.013	-0.272	-0.297	-0.503	-0.024	-0.581	-0.036
PAK	Pakistan	-3.928	-6.412	-0.896	0.968	-1.504	-0.787	-0.481	-1.403	-0.771	-1.218	-0.917	-1.180	-1.173	-0.978	-1.027	0.002	-0.897	-9.289	-1.671	-0.039	0.437	0.349	-0.345	-7.497	-1.443
		-2.575	-2.777	-0.202	-0.126	-0.127	-1.399	-0.401	-2.303	-0.976	-1.256	-1.185	-0.936	-0.946	-0.988	-2.645	-0.478	-0.242	-1.214	-0.121	-0.534	-1.293	-3.612	-4.785	-1.907	-0.331
PHL	Philippines	-0.003	-0.029	-0.007	-0.009	0.006	-0.014	0.000	-0.003	-0.008	-0.033	-0.018	-0.034	-0.038	-0.024	-0.016	0.000	0.000	-0.004	-0.018	-0.007	-0.004	-0.002	-0.045	-0.059	-0.003
		-0.055	-0.335	-0.062	-0.031	-0.011	-0.120	-0.109	-0.107	-0.190	-0.327	-0.243	-0.099	-0.305	-0.137	-0.090	-0.124	-0.002	-0.081	-0.082	-0.069	-0.092	-0.070	-0.520	-0.733	-0.030
POL	Poland	-0.254	-0.521	-0.173	-0.065	-0.042	-0.140	-0.145	-0.099	-0.118	-0.143	-0.135	-0.070	0.025	-0.083	-0.022	-0.001	-0.032	-0.193	-0.214	-0.272	-0.135	-0.239	-0.305	-0.112	-0.556
		-0.288	-0.772	-0.099	-0.060	-0.029	-0.387	-0.380	-0.213	-0.328	-0.355	-0.346	-0.217	-0.196	-0.122	-0.104	-0.365	-0.177	-0.259	-0.119	-0.409	-0.313	-0.378	-0.108	-0.639	-0.089
PRT	Portugal	-0.045	-0.050	-0.025	0.104	0.029	0.004	0.139	0.217	0.044	0.004	-0.002	-0.007	0.080	-0.079	0.030	0.000	-0.009	0.118	0.014	0.005	0.016	0.002	0.001	0.062	-0.066
		-0.081	-0.289	-0.021	-0.056	-0.033	-0.405	-0.142	-0.651	-0.419	-0.217	-0.340	-0.073	-0.097	-0.039	-0.095	-0.097	-0.028	-0.122	-0.021	-0.224	-0.108	-0.165	-0.024	-0.235	-0.031
ROU	Romania	-0.054	-0.006	-0.014	-0.032	-0.074	-0.030	-0.040	-0.039	-0.019	-0.012	-0.015	-0.061	0.017	-0.053	0.000	-0.007	-0.003	-0.005	0.083	-0.012	0.030	0.035	0.000	0.102	-0.091
		-0.064	-0.133	-0.018	-0.032	-0.033	-0.187	-0.039	-0.089	-0.336	-0.092	-0.384	-0.099	-0.097	-0.041	-0.077	-0.083	-0.029	-0.144	-0.113	-0.117	-0.075	-0.186	-0.019	-0.235	-0.024
RUS	Russian Federation	0.021	0.052	0.008	0.013	0.016	0.029	0.030	0.024	0.026	0.026	0.028	0.012	0.020	0.012	0.018	0.000	0.006	0.018	0.019	0.020	0.036	0.020	0.014	0.019	0.008
		-0.010	-0.444	-0.020	0.001	0.003	-0.204	-0.305	-0.479	-0.077	-0.030	-0.375	-0.032	-0.059	-0.020	-0.049	-0.176	-0.004	-0.102	-0.016	-0.116	-0.080	-0.065	-0.029	-0.115	-0.026
RoW	Rest of the World	0.205	0.322	0.134	0.114	0.236	0.322	0.227	0.278	0.295	0.388	0.214	0.278	0.208	0.249	0.040	0.313	0.207	0.257	0.228	0.203	0.222	0.192	0.218	0.276	0.153
		0.081	-0.555	-0.007	0.066	0.082	0.129	-0.081	-0.115	0.204	0.407	-0.190	0.117	0.276	0.170	-0.233	0.384	0.132	0.102	0.041	0.079	0.130	0.177	0.095	0.249	0.023
SGP	Singapore	-0.014		-0.026	-0.025	-0.057	-0.035	-0.011	-0.028	-0.017	-0.017	-0.013	-0.019	-0.037	-0.054	-0.023	0.000	-0.001	-0.082	-0.011	-0.033	-0.013	-0.035	-0.002	-0.033	-0.009
		-0.189		-0.139	-0.129	-0.085	-0.504	-0.421	-1.255	-0.611	-0.285	-0.576	-0.222	-0.171	-0.184	-0.123	-0.375	-0.027	-0.364	-0.096	-0.453	-0.229	-0.494	-0.152	-0.432	-0.081
SVK	Slovak Republic	-0.141	-0.248	-0.140	-0.095	-0.026	-0.110	-0.087	-0.116	-0.017	-0.068	-0.180	-0.061	-0.062	0.119	-0.041	-0.007	-0.205	-0.152	-0.088	-0.165	-0.007	-0.089	0.023	-0.113	-0.332
		-0.234	-0.258	-0.027	-0.038	-0.007	-0.248	-0.149	-0.181	-0.338	-0.279	-0.307	-0.160	-0.098	-0.026	-0.065	-0.098	-0.226	-0.226	-0.084	-0.281	-0.220	-0.191	-0.224	-0.344	-0.053
SVN	Slovenia	-0.166	-0.125	-0.115	-0.045	-0.037	-0.111	-0.071	-0.062	-0.064	-0.059	-0.129	-0.064	-0.014	-0.079	0.109	-0.075	-0.124	-0.101	-0.094	-0.209	-0.036	-0.058	-0.148	-0.022	-0.333
		-0.103	-0.485	-0.045	-0.083	-0.003	-0.316	-0.482	-0.619	-0.241	-0.419	-0.344	-0.103	-0.109	-0.042	-0.078	-0.344	-0.149	-0.159	-0.052	-0.336	-0.189	-0.277	-0.090	-0.395	-0.054
SWE	Sweden	-0.279	-0.275	-0.085	-0.014	-0.022	-0.041	0.036	0.137	-0.005	-0.108	-0.040	-0.046	0.131	0.229	0.040	-0.141	-0.251	-0.090	-0.236	-0.205	-0.119	-0.043	-0.310	0.007	-0.502
		-0.781	-0.958	-0.117	-0.073	-0.074	-0.762	-0.235	-0.776	-0.442	-0.471	-0.603	-0.166	-0.098	-0.139	-0.085	-0.310	-0.138	-0.135	-0.123	-0.352	-0.511	-0.604	-0.228	-0.444	-0.100
THA	Thailand	-0.250	-0.171	-0.069	-0.085	-0.032	-0.180	-0.120	-0.079	-0.089	-0.117	-0.104	-0.054	-0.006	-0.065	-0.067	-0.041	-0.082	-0.145	-0.079	-0.100	-0.288	-0.231	-0.151	-0.214	-0.078
		-0.404	-0.617	-0.136	-0.067	-0.049	-0.856	-0.291	-0.932	-0.833	-0.256	-0.392	-0.293	-0.320	-0.140	-0.228	-0.341	-0.014	-0.247	-0.037	-0.225	-0.800	-0.497	-0.143	-0.666	-0.077
TUR	Turkiye	0.075	0.085	0.019	0.033	0.038	0.049	0.027	0.029	0.044	0.057	0.032	0.021	0.027	0.014	0.033	0.000	0.021	0.061	0.184	0.057	0.088	0.148	0.139	0.243	0.051
		0.032	-0.354	0.013	-0.001	0.008	0.032	-0.017	-0.045	-0.060	-0.171	-0.160	-0.035	-0.037	-0.030	-0.015	0.001	0.000	0.001	0.012	0.007	0.074	0.047	0.032	0.135	0.005
TWN	Taiwan	-0.002	-0.004	-0.006	-0.021	-0.007	-0.002	-0.020	-0.026	-0.030	0.007	-0.014	-0.016	-0.035	-0.027	-0.032	0.000	-0.001	-0.013	-0.012	-0.009	-0.004	-0.002	0.000	-0.012	0.000
		-0.059	-0.926	-0.029	-0.211	-0.088	-0.396	-0.430	-1.001	-0.462	-0.467	-0.997	-0.152	-0.484	-0.499	-0.057	-0.391	-0.023	-0.260	-0.040	-0.210	-0.146	-0.172	-0.034	-0.239	-0.033
USA	United States	-2.041	-2.701	-1.032	-1.463	-1.042	-1.711	-1.147	-1.488	-1.748	-2.590	-2.002	-0.966	-1.395	-0.891	-1.167	-1.027	-1.201	-1.468	-1.427	-1.807	-1.560	-1.691	-1.564	-2.173	-1.192
		-2.221	-3.143	-0.449	-1.419	-0.157	-1.768	-1.223	-2.143	-2.652	-3.724	-4.087	-0.698	-1.485	-0.508	-0.449	-2.132	-0.307	-0.821	-0.604	-2.680	-1.347	-2.012	-0.876	-3.500	-0.357
VNM	Viet Nam	-0.006	-0.019	-0.012	-0.020	-0.001	-0.004	-0.004	-0.014	0.006	0.006	-0.009	-0.019	-0.033	-0.018	-0.023	0.000	0.000	-0.023	-0.005	-0.008	-0.001	-0.001	0.000	-0.009	-0.001
		-0.117	-0.575	-0.045	-0.215	-0.036	-0.451	-0.261	-0.538	-0.524	-0.222	-0.515	-0.070	-0.174	-0.135	-0.202	-1.057	-0.002	-0.298	-0.070	-0.205	-0.051	-0.427	-0.255	-0.185	-0.018
Global average		-0.211	-0.297	-0.090	0.039	-0.107	-0.206	-0.216	-0.392	-0.381	-0.765	-0.136	-0.272	-0.161	-0.045	-0.272	0.164	-0.172	-0.279	-0.191	-0.142	-0.084	-0.206	-0.349	-0.125	-0.356
		-0.305	-1.372	-0.095	-0.092	-0.064	-0.659	-0.384	-0.870	-0.653	-0.734	-0.834	-0.210	-0.215	-0.141	-0.225	-0.659	-0.090	-0.308	-0.176	-0.419	-0.414	-0.545	-0.230	-0.629	-0.071