Online Annex to Chapter 2 of the October 2025 Regional Economic Outlook: Asia and Pacific

This annex provides documentation of data sources, country coverage, and methodologies used for the results presented in the main text. Section 2.1 summarizes country groupings used in the chapter. Section 2.2 provides more details on the difference-in-difference estimation with a summary of the data sources and country coverage. Section 2.3 elaborates on the quantitative trade model used for scenario analyses of greater trade integration. Section 2.4 offers additional charts.

2.1. Country Groupings

Annex Table 2.1.1. Country Groupings

	Advanced Asia	Emerging Asia
ASEAN-10	Singapore	Brunei Darussalam, Cambodia, Indonesia, Lao PDR, Malaysia, Myanmar, the Philippines, Thailand, Vietnam
East Asia	Hong Kong SAR, Japan, Korea, Macao SAR, Taiwan Province of China	China, Mongolia
Oceania	Australia, New Zealand	Fiji, Kiribati, Marshall Islands, Micronesia, Nauru, Palau, Papua New Guinea, Samoa, Solomon Islands, Timor-Leste, Tonga, Tuvalu, Vanuatu
South Asia		Bangladesh, Bhutan, India, Maldives, Nepal, Sri Lanka

Source: IMF staff compilation.
Notes: ASEAN = Association of Southeast Asian Nations; Emerging Asia = emerging market and developing economies in Asia-Pacific.

2.2. Estimation of 2018-19 US-China Tariff Impacts on Supply Chains

Data and Country Coverage

Main trade-related variables for the analysis are derived from global input-output tables. Among available input-output tables, Asian Development Bank (ADB) Multi-Region Input-Output tables (MRIO) are chosen to allow better coverage of Asia-Pacific economies in recent years. The methodology of Aslam and others (2017) is applied to calculate value-chain related variables, including value-added embedded in exports to the US and backward value-chain linkage with China. Gross intermediate imports from China and total gross exports to the US are also derived from the ADB MRIO. Unless otherwise specified, the sample period covers from 2007 to 2023. Additional variables used in the regression analysis are summarized in Annex Table 2.2.1.

The underlying data used to derive value-added embedded in bilateral trade between economies are available for 62 economies plus one aggregated rest of the world. To ensure the robustness, small economies meeting the following criteria are excluded from the regression analysis: (1) economies whose manufacturing exports to the world in 2016 constituted less than 10 percent of their total exports; and (2) economies in the bottom 5 percentile in terms of total exports to the world in 2016.Countries directly affected by the tariffs (i.e. China and the US) are also excluded to focus

on supply chain shifts. The resulting sample covers 45 economies, including 13 from Asia-Pacific, including Bangladesh, Cambodia, India, Indonesia, Japan, Korea, Malaysia, Philippines, Singapore, Sri Lanka, Taiwan Province of China, Thailand, and Vietnam; 32 economies from outside the region, including Austria, Belgium, Brazil, Bulgaria, Canada, Croatia, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Mexico, Netherlands, Pakistan, Poland, Portugal, Romania, Slovak Republic, Slovenia, Spain, Sweden, Switzerland, Türkiye, Pakistan, and United Kingdom.

The data covers 35 sectors listed in Annex Table 2.2.2. Out of the 35 sectors, 7 sectors that became subject to the US Section 301 tariffs on China in 2018 are considered as "tariff-targeted" sectors. These are: textiles and textile products; chemicals and chemical products; rubber and plastics; basic metals and fabricated metals; machinery, nec; electrical and optical equipment; and transport equipment.

Annex Table 2.2.1. Data sources

Variable	Source
Value-added embedded in exports to the United States (abbreviated as "value-added exports to the US")	Derived from Asian Development Bank Multi-Region Input-Output tables, current price, in US dollar
Intermediate imports from China	Derived from Asian Development Bank Multi-Region Input-Output tables, current price, in US dollar
Number of announced FDI projects	Orbis Cross-Border Investment database
Real GDP	World Economic Outlook database
Exchange rate	World Economic Outlook database
COVID-19 stringency index	Hale and others (2021)
Labor cost	Proxied by nominal GDP in US dollar divided by working age population, sourced from World Economic Outlook database
FDI restrictiveness	OECD FDI Regulatory Restrictiveness Index
Political stability	Worldwide Governance Indicator database
Geopolitical alignment	Ideal point estimates based on votes in the United Nations General Assembly (Bailey, Strezhnev, and Voeten (2017); Fjelstul, Hug, and Kilby (2009))
Export exposure to the US	Derived from Asian Development Bank Multi-Region Input-Output tables, current price, in US dollar
Backward value-chain linkage with China	Derived from Asian Development Bank Multi-Region Input-Output tables, current price, in US dollar

Source: IMF staff compilation.

Annex Table 2.2.2. Sector Coverage

Agriculture, hunting, forestry, and fishing	Sale, maintenance, and repair of motor vehicles
Mining and quarrying	Wholesale trade and commission trade
Food, beverages, and tobacco	Retail trade; repair of household goods
Textiles and textile products*	Hotels and restaurants
Leather, leather products, and footwear	Inland transport
Wood and products of wood and cork	Water transport
Pulp, paper, paper products, printing, and publishing	Air transport
Coke, refined petroleum, and nuclear fuel	Other supporting and auxiliary transport activities
Chemicals and chemical products*	Post and telecommunications;
Rubber and plastics*	Financial intermediation
Other nonmetallic minerals	Real estate activities
Basic metals and fabricated metals*	Renting of machinery and other business activities
Machinery, nec*	Public admin and defense; compulsory social security
Electrical and optical equipment*	Education
Transport equipment*	Health and social work
Manufacturing, nec; Recycling	Other community, social, and personal services
Electricity, gas, and water supply	Private households with employed persons
Construction	

Source: IMF staff compilation.
Notes: "*" indicates tariff-targeted sectors.

Difference-in-Difference Approach

Value-Added Exports to the US

The following equation presents the difference-in-differences specification used to estimate the effect of the US-China tariff shocks on value-added embedded in exports to the US:

$$\Delta \ln\left(VAX_{i,s,t}^{US}\right) = \eta_i \cdot Post_t + \beta_i \cdot (Post_t \times Targeted_s) + X'_{i,s,t}\Gamma + \alpha_i + \delta_s + \lambda_t + \epsilon_{i,s,t}$$

where $\Delta \ln\left(VAX_{i,s,t}^{US}\right)$ captures the annual growth of value-added exports to the US from economy i, sector s, in year t. $Post_t$ is an indicator for the post-tariff period that takes a value of one from 2018 and onward (i.e., $Post_t = \mathbf{1}(t \geq 2018)$). $Targeted_s$ is a dummy indicator for tariff-targeted sectors as defined above. $X_{i,s,t}$ represents a set of control variables, including lagged outcomes $\Delta \ln\left(VAX_{i,s,t-1}^{US}\right)$ and additional macroeconomic controls such as real GDP growth, exchange rate growth, and change in COVID-19 stringency index to account for supply chain disruptions related to pandemic-lockdowns. α_i, δ_s and λ_t denote economy, sector, and year fixed effects, respectively. Standard errors are clustered at the economy level.

The main coefficients of interest are the economy-specific β_i. They are reported in Figure 2.5 of the main chapter in percent as relative gains of value-added exports to the US in targeted sectors. The coefficients η_i control for economy-specific post-tariff shifts in non-targeted sectors. Since they allow each economy to have its own general post-tariff trend, the coefficient β_i can be interpreted as measuring the additional growth of value-added exports to the US in tariff-targeted sectors in economy i, relative to that of non-targeted sectors, in the post-tariff period.

FDI from China

An analogous equation is applied to $\Delta \ln\left(FDI_{i,s,t}^{CHN}\right)$, the annual growth of FDI stock from China. The stock of FDI is measured by the cumulative number of announced or completed greenfield projects whose immediate investing companies are from China in economy i, sector s, and year t. The economy-specific coefficients β_i therefore measure

the additional growth of FDI stock from China in tariff-targeted sectors in economy i, relative to that of non-targeted sectors, in the post-tariff period.

Local Projection Difference-in-Differences Approach

Value-Added Exports to the US

The following equation presents the local projection difference-in-differences specification—following Dube and others (2025)—used to estimate the dynamic effects of the US-China tariffs on value-added exports:

$$\begin{aligned}\ln\left(VAX^{US}_{i,s,t+h}\right) - \ln\left(VAX^{US}_{i,s,t-1}\right) &= \kappa_{1,h}\left(Post_t \times Targeted_s \times Top_i\right) + \kappa_{2,h}\left(Post_t \times Targeted_s \times Bottom_i\right) \\ &+ \theta_{1,h}(Post_t \times Top_i) + \theta_{2,h}(Post_t \times Bottom_i) + X'_{i,s,t}\Gamma + \alpha_i + \delta_s + \lambda_t + u_{i,t+h}\end{aligned}$$

where $\ln\left(VAX^{US}_{i,s,t+h}\right)$ is the log level of value-added exports to the US from economy i, sector s, in year $t+h$. $Post_t$ and $Targeted_s$ are same as previously defined. Top_i and $Bottom_i$ indicate whether economy i belongs to the top and bottom quartile of the distribution of the relative value-added gains across economies, respectively. Similar to the baseline difference-in-differences approach, the coefficients $\kappa_{1,h}$ and $\kappa_{2,h}$ measure the additional cumulative growth of value-added exports to the US in economies with the largest and smallest average value-added gains (i.e., in the top- and bottom-quartile), over horizon h, respectively. $\theta_{1,h}$ and $\theta_{2,h}$ absorb the post-tariff shifts in non-targeted sectors of economies in the top- and bottom-quartile, respectively. $X_{i,s,t}$ includes lagged outcomes from period $t-1$ to $t-3$, and additional macroeconomic controls (i.e. real GDP growth, exchange rate growth, and change in COVID-19 stringency index). Standard errors are clustered at the economy level.

Intermediate Goods Imports from China

An analogous equation is applied to the log level of intermediate imports from China. The coefficients $\kappa_{1,h}$ and $\kappa_{2,h}$ in this specification measure the additional cumulative growth of intermediate imports from China in economies with the largest and smallest average value-added gains, over horizon h, respectively.

Determinants of Value-Added Gains

To explore the factors that could explain the heterogeneity in relative value-added gains across 45 economies in the sample, the following equation is estimated by the ordinary least square method:

$$\beta_i = X_i'\Gamma + \epsilon_i$$

where β_i denotes the relative gains in value-added exports to US in targeted sectors for economy i, estimated from the first equation in the difference-in-differences approach. X_i consists of variables measuring country characteristics before the tariff shocks (in 2016 or 2017), including the degree of FDI restrictiveness, labor cost—proxied by nominal GDP per working age population,[1] exports exposure to the US—measured by the share of exports to the US in an economy's total exports, backward global value chain linkage with China—measured by the share of imports from China that is used for exports production in an economy's total imports, political stability, and geopolitical alignment with China.

[1] Labor cost data are not widely available for Asia-Pacific economies in a cross-country comparable way. To fill the gap, nominal GDP per working age population is used to proxy labor cost. This choice is guided by a high correlation between nominal GDP per working age population and labor cost (with correlation coefficient above 0.9) for a European country sample using the labor cost data from International Labour Organization.

2.3. Model Simulation of Deeper Trade Agreements

This section describes the model used to simulate potential gains from strengthening trade integration in non-technical terms. Refer to Cuñat and Zymek (2024) and Wingender and others (2024) for further technical details.

Main Features of the Trade Model

The analysis uses a multi-country multi-sector model with no aggregate uncertainty. Individual agents in each economy supply their fixed human capital inelastically and face a constant probability of dying in each period. Dying agents are replaced by a new-born cohort of the same size to keep the population constant. Agents choose to use life insurance to smooth consumption.

Agents optimize their holdings of capital (accumulated with a country-specific investment efficiency) and a tradeable one-period international bond. The international bond market is cleared by a common interest rate. The rate of time preference varies between economies. The combination of this feature alongside the demographic assumptions above ensures a unique steady state with non-degenerate distribution of international assets and trade balances.

All markets are assumed to be perfectly competitive. In each sector, countries produce differentiated country-specific varieties using Cobb-Douglas technologies, which take in capital, labor and intermediate inputs. Labor and intermediate input shares are country specific. These varieties are tradeable à la Armington, with sector-specific substitution elasticities. Trade is subject to bilateral and sector-specific iceberg costs, which conceptually include—but are not limited to—policy-based non-tariff barriers to trade. In each country, sector-specific bundles are created using a combination of domestic and imported varieties, and these bundles are then used in the production of consumption, investment, and intermediate inputs.

Counterfactual analysis of macro and trade variables is amenable to the “exact hat” algebra approach (Dekle and others, 2008), extended by Cuñat and Zymek (2024) from the standard static setting to a comparison of steady states in a dynamic setting. Specifically for the analysis of the chapter, this approach is used to simulate the impact of reduced non-tariff barriers through the implied change in iceberg costs.

Calibration Strategy

The calibration of the initial steady-state follows Wingender and others (2024). Bilateral trade shares, shares of global GDP, and trade balances are calculated using the OECD Inter-Country Input-Output Tables (2023 release), using the averages for 2016-2019. The final calibration covers 68 economies (plus a rest of the world residual) and 40 sectors spanning both goods and services.[2] The Penn World Tables are used to calibrate country-specific labor shares using 2016-2019 data. Long-run trade elasticities are taken from Fontagné and others (2022) for goods and from Costinot and Rodríguez-Clare (2014) for services. Several other parameters are calibrated based on standard values in the literature.

Measuring Initial Trade Agreement Depth

The country-pair level *depth* indicator counts the total number of areas with legally enforceable provisions in the trade treaties with both countries and then normalizes this tally by the maximum possible number of provisions (52). 14 provisions fall in the World Trade Organization (WTO)’s mandate (referred to as WTO+ provisions) and 38 provisions cover policy areas beyond the WTO mandate (referred to as WTO-X provisions). For country-pairs which are in multiple treaties, a provision is counted towards the tally as long as it is legally enforceable in at least one of the

[2] The list of Asia-Pacific economies covered by the model are Australia, China, Hong Kong SAR, Indonesia, India, Japan, Korea, Lao PDR, Malaysia, New Zealand, the Philippines, Singapore, Thailand, and Taiwan Province of China.

treaties, capturing the idea that firms would be able to appeal to the provisions of various treaties as needed. The information is taken from the World Bank Deep Trade Agreement database.

Formally, let A be any specific trade agreement, i and j denote countries, and $\bar{A}_{ij}$ the set of treaties active between the two countries. Furthermore, let $P_n^{WTO-X},\ n = 1, \dots, 38$ denote the 38 WTO-X provisions, and let $P_n^{WTO+},\ n = 1, \dots, 14$ denote the 14 WTO+ provisions. Then for each agreement A, define $I(P_n^{WTO-X}; A) = 1$ if that WTO-X provision is legally enforceable by that treaty, and 0 if otherwise. Define $I(P_n^{WTO+}; A)$ for WTO+ provisions similarly. An indicator of whether a specific provision is active between the two country pairs $I_{ij}(P_n^{WTO-X})$ can be calculated as:

$$I_{ij}(P_n^{WTO-X}) = \begin{cases} 1 \; if \sum_{A \in \bar{A}_{ij}} I(P_n^{WTO-X}; A) > 0 \\ 0 \; if \sum_{A \in \bar{A}_{ij}} I(P_n^{WTO-X}; A) = 0 \end{cases}, \qquad for\ n = 1, \dots, 38$$

$I_{ij}(P_n^{WTO+})$ can be defined similarly. Then the ***depth*** indicator is:

$$Depth_{ij} = \frac{1}{52} * \left(\sum_{n=1}^{14} I_{ij}(P_n^{WTO+}) + \sum_{n=1}^{38} I_{ij}(P_n^{WTO-X}) \right)$$

The ASEAN group's agreements with various regional partners (so called ASEAN-plus agreements that involve ASEAN member states plus one country, such as ASEAN + China or ASEAN + Korea) are treated as a series of bilateral treaties between the non-ASEAN economy and each ASEAN member. Therefore, novel provisions in these treaties which are not in the ASEAN free trade agreement, Regional Comprehensive Economic Partnership (RCEP), or other treaties among ASEAN members count only towards the scores between each ASEAN member and the non-ASEAN partner but do not count towards intra-ASEAN scores. This is a conservative approach to measure the current state of ASEAN integration.

Construction of Counterfactual Shocks to the Model

The counterfactual exercises represent an increase in trade integration and the associated reduction in non-tariff barriers by an increase in the bilateral depth scores.

Define the shock as a change in bilateral depth scores, specifically $\left(Depth_{ij}^{post} - Depth_{ij}^{initial}\right)$. This is then transformed into a change in iceberg costs in the export of country j to country i in sector s following the approach of Dhingra and others (2023), specifically:[3]

$$\hat{\kappa}_{i,j,s} = exp\left\{ -\frac{\tilde{\alpha}}{\theta_s} \left(Depth_{ij}^{post} - Depth_{ij}^{initial} \right) \right\}$$

where $\tilde{\alpha}$ is the estimated long-term effect of increasing depth on exports, as estimated in Dhingra and others (2023), and θ_s are standard sector-specific elasticities of substitution taken from the literature, as discussed above.[4]

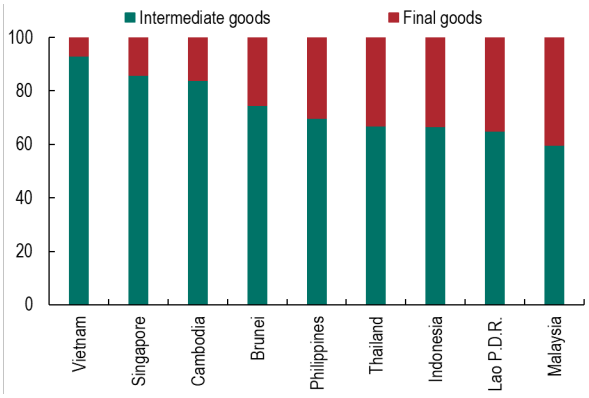
[3] Dhingra and others (2023) normalized their analogous depth score by 40, the maximum in their dataset. Given our normalization by the maximum provision count of 52, we apply a scaling factor to ensure consistent use of their estimates.

[4] Reflecting the focus on medium-term (i.e., new steady state outcomes), the estimated $\tilde{\alpha}$ used in the simulations cumulate the anticipation, contemporaneous, and maturation effects of trade deals. These are reported in Table 3 of Dhingra and others (2023). While suppressed in the notation, we apply separate goods- and services- specific estimates.

2.4. Additional Charts

Annex Figure 2.1. ASEAN: Share of Intermediate Goods in Imports from China, 2023

(Percent)



Sources: Asian Development Bank (ADB) Multiregional Input-Output Tables (MRIO) and IMF staff calculations.

Annex Figure 2.2. ASEAN: Growth in Imports of Intermediate and Final Goods from China, 2017-23

(Average annual percent growth)

Sources: ADB MRIO and IMF staff calculations.

Note: Calculated from nominal values in US dollars in 2017 and 2023. The values for Vietnam are calculated for 2015-23 to avoid a large swing in 2016-17.

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