Federal Reserve Bank of Dallas

A History of U.S. Tariffs: Quantifying Strategic Trade-Offs in Tariff Policy Design

Enrique Martínez García and Michael Sposi

Working Paper 2529 **August 2025**

Research Department

https://doi.org/10.24149/wp2529

A History of U.S. Tariffs: Quantifying Strategic Trade-Offs in Tariff Policy Design*

Enrique Martínez García† and Michael Sposi‡

July 15, 2025

Abstract

U.S. tariff policy has historically balanced competing goals—revenue, protection, and reciprocity. Policy priorities have shifted over time in response to changing economic and political conditions. Using a calibrated general equilibrium model, we illustrate these trade-offs through the lens of tariff Laffer curves. A 70 percent tariff maximizes U.S. revenue only in the absence of retaliation; this optimum falls to 30 percent with reciprocal tariffs. A unilateral 25 percent tariff delivers the largest domestic consumption gains through favorable terms-of-trade effects, though these gains vanish under retaliation. Simulations also show that multilateral retaliatory tariffs can partially offset losses for Mexico and Canada—unless escalation triggers broader trade conflict. The 2018–19 tariff war further illustrates how targeted tariffs distort relative prices and cross-border resource allocation.

JEL Classification: F13, F14, F15, H20, C68, F51

Keywords: Tariff Policy, Terms of Trade, Optimal Tariffs, Tariff Laffer Curve, General Equilibrium Models, U.S. Trade History

*This document has greatly benefited from valuable feedback provided by Kei-Mu Yi, Aaron Flaaen, Marcus Noland, and numerous participants at the April 10, 2025, "Outlook for North American Trade and Immigration" conference organized by the Peterson Institute and the Federal Reserve Bank of Dallas. We are grateful for the outstanding research assistance provided by Valerie Grossman. All remaining errors are solely our responsibility. The views expressed in this paper are our own and do not necessarily reflect those of the Federal Open Market Committee, its principals, or any individuals associated with the Federal Reserve Bank of Dallas or the Federal Reserve System.

†Contacting author: Enrique Martínez García, Federal Reserve Bank of Dallas, 2200 N. Pearl Street, Dallas, TX 75201. Phone: +1 (214) 922-5262. Fax: +1 (214) 922-5194. E-mail: emg.economics@gmail.com, enrique.martinez-garcia@dal.frb.org. Webpage: https://sites.google.com/view/emgeconomics.

‡Michael Sposi, Southern Methodist University, 3300 Dyer Street, Dallas, TX 75275. E-mail: msposi1981@gmail.com. Webpage: https://people.smu.edu/msposi/.

1. Introduction

Tariffs have long been a central instrument of economic policy, serving multiple—and often competing—objectives: raising government revenue, shielding domestic industries from foreign competition, and leveraging market access to promote reciprocal liberalization. However, historical evidence from the U.S. suggests that these goals cannot be fully achieved simultaneously. Policymakers have typically been compelled to prioritize one or two of these objectives, with the balance shifting in response to evolving economic and political conditions (Irwin, 2017).

Understanding how tariffs affect the broader economy is critical for effective policy design. Tariffs have direct implications not only for trade flows and domestic production but also for inflation and monetary policy, government revenue and fiscal balances, and the regional distribution of economic activity. At the core of these macroeconomic effects lies the terms-of-trade mechanism: by shifting demand away from imports, tariffs can improve a country's terms of trade—that is, lower the relative price it pays for foreign goods—and potentially generate welfare gains.

This idea, first articulated by Johnson (1953), explains the enduring appeal of unilateral tariffs for large economies that are not price-takers in international markets. Countries with sufficient market power can use tariffs to influence international relative prices, thereby improving their terms of trade. Yet such gains are inherently conditional. Once trading partners retaliate, global trade patterns adjust, and the risk of mutual welfare losses and lower global trade rises—particularly in the non-cooperative scenario of multilateral tit-for-tat tariff escalation, or a full-scale trade war.

This paper contributes to the literature by highlighting retaliation as the pivotal factor determining whether tariffs enhance or erode welfare. It does so by analyzing the terms-of-trade mechanism within a modern multi-country general equilibrium model of trade, developed by Santacreu *et al.* (2025) and calibrated to U.S. states. This framework allows for a systematic exploration of both unilateral and retaliatory tariff scenarios, capturing effects at both the national and subnational levels. A key contribution of the paper is the quantitative derivation of two distinct tariff Laffer curves for the U.S.—one mapping tariff rate hikes to government revenue, the other to domestic consumption. Together, these dual Laffer curves enable a richer understanding of the fiscal and welfare implications of U.S. tariff policy.

The model shows that in a no-retaliation scenario, U.S. tariff revenue is maximized at a 70 percent universal tariff, while U.S. consumption gains peak at a substantially lower 25 percent—assuming full rebate of tariff revenues to households. This assumption is not without consequence. It highlights a critical dimension of trade policy: the way tariff revenues are used can significantly shape both aggregate and distributional welfare outcomes. Rebating revenues to households tends to yield higher consumption gains, suggesting that these estimates should be viewed as approximating a best-case scenario—or an upper bound—on what tariffs can achieve. In this context, tariffs are not merely taxes on imports; they function as fiscal instruments whose effectiveness depends crucially on how they interact with the broader system of public finance.

Once retaliation is introduced, however, both Laffer curves shift inward. Under multilateral retaliation, the revenue-maximizing tariff falls to 30 percent, while the consumption-maximizing tariff is no higher than the prevailing rate. In this setting, multilateral retaliation eliminates the potential for welfare gains and results in net consumption losses, even when tariff revenues are fully rebated to households.

The analysis distinguishes between unilateral retaliation by individual trading partners and coordinated multilateral responses. Unilateral retaliation—particularly by smaller economies such as Canada or Mexico—tends to be self-defeating due to limited market power in bilateral disputes with the U.S. In contrast, coordinated retaliation across multiple countries can more effectively neutralize the terms-of-trade advantage sought by the U.S. and partially offset the losses faced by retaliating partners—unless escalation results in prohibitively high tariffs and a broader trade war.

This asymmetry in strategic capacity between the U.S. and most of its trading partners is a key insight for understanding the interdependence of tariff policies and the global dynamics they can set in motion. It also suggests that U.S. efforts to implement a universal tariff hike are more likely to deter retaliation and yield favorable outcomes when pursued bilaterally—where trading partners have limited scope for coordination—rather than through multilateral frameworks that enable collective retaliation and risk negating the intended terms-of-trade gains.

The 2018–19 tariff actions vividly illustrated the added complexity introduced by selective, country- and sector-specific tariffs. These measures triggered retaliation and set off price distortions across countries and industries, which rippled through the global economy and created incentives for trade diversion. The episode underscores the challenges that arise when tariffs are imposed outside a rules-based multilateral framework.

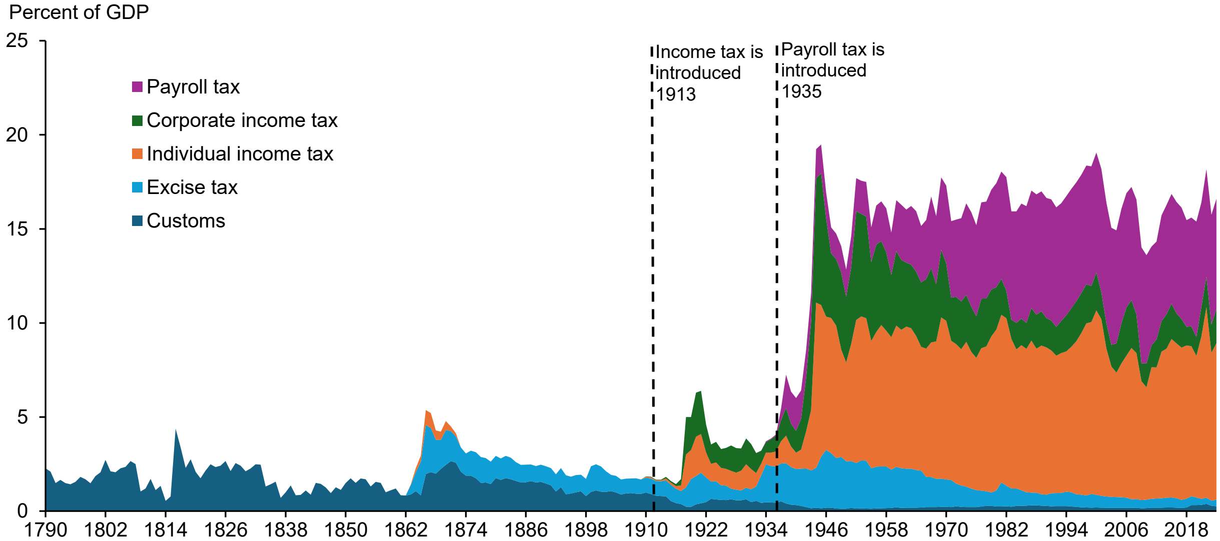
When viewed alongside the simulations in this paper using the Santacreu *et al.* (2025) model, it becomes clear that the effectiveness of U.S. tariff policy depends not only on its domestic design but—crucially—on the responses of foreign trading partners and the reconfiguration of global trade patterns they may provoke.

The remainder of the paper is organized as follows. Section 2 reviews the historical evolution of U.S. tariff policy as a tool for revenue generation, protection, and trade negotiation, and introduces the "impossible trinity" of tariff policy—the idea that it is not feasible to pursue all three objectives simultaneously. Section 3 examines the terms-of-trade externality and presents the dual Laffer curves for U.S. government revenue and U.S. consumption, using the Santacreu *et al.* (2025) model to quantify the effects of universal, flat U.S. tariff scenarios—with and without retaliation—and to assess their distributional consequences across U.S. regions and trading partners.

Section 4 revisits the 2018–19 trade tensions to draw lessons about the policy challenges posed by selective tariffs and the unintended consequences from retaliation and trade diversion. Section 5 expands the discussion to consider how tariffs interact with other macroeconomic domains—including monetary policy, fiscal balances, global demand for dollar-denominated safe assets, and the international architecture of the rules-based international trading system.

The paper concludes by emphasizing the need for coherent tariff strategies that treat retaliation as a central constraint and the terms-of-trade channel as a key mechanism through which tariffs—and the use of tariff revenues—shape economic outcomes. An appendix provides technical details on the calibration and structure of the Santacreu *et al.* (2025) model used in the analysis.

Chart 1
Tariffs as the primary revenue source in early U.S. history



NOTES: The chart shows the declining importance of tariff revenue as a source of U.S. government income over time. The vertical axis represents main government revenue sources as a percentage of nominal GDP. Other sources of government revenue—such as land sales—are not included.
SOURCES: Office of Management and Budget; Congressional Budget Office; Congressional Research Service; United States Census Bureau, *Bicentennial Edition: Historical Statistics of the United States, Colonial Times to 1970*; United States Bureau of Economic Analysis; Haver Analytics; MeasuringWorth; authors' calculations.

2. The three functions of tariffs

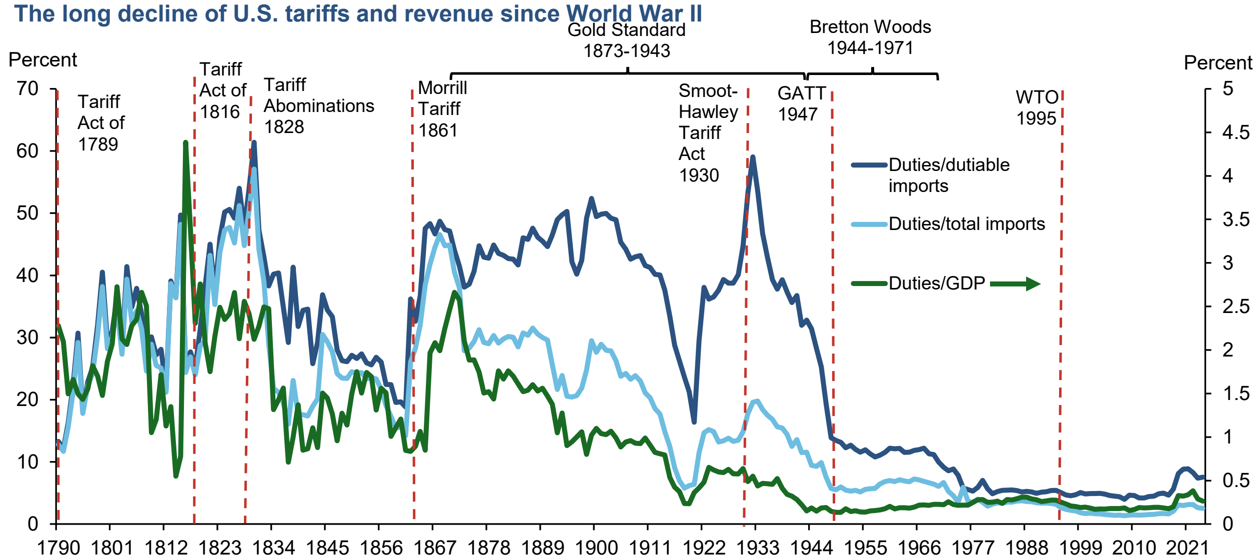
Tariffs have historically served three main purposes—generating government revenue, protecting domestic industries, and facilitating (non-discriminatory) foreign market access—collectively known as the three R's of tariff policy: Revenue, Restriction, and Reciprocity. As Irwin (2017) details, U.S. tariff policy has shifted emphasis among these goals over time.

2.1 Tariffs as a source of government revenue

In the U.S.' formative years, tariffs were the federal government's primary source of income (Chart 1), especially before excise taxes gained greater prominence during the Civil War and well before the establishment of modern income and payroll tax systems in the lead-up to World War I and during the subsequent interwar period. Throughout the 19th and early 20th centuries, customs duties were the primary—or even the dominant—source of federal revenue, largely due to the absence of alternative tax instruments. Tariffs were thus a central pillar of U.S. fiscal policy by necessity.

Efforts to diversify federal revenue began as early as 1862, when the Civil War prompted the introduction of income and excise taxes to finance urgent military expenditures. The constitutional foundation for a permanent federal income tax was laid with the ratification of the 16th Amendment in 1913—the same year the Federal Reserve was established to stabilize and secure the banking and monetary system.

Chart 2
The long decline of U.S. tariffs and revenue since World War II



NOTES: The chart illustrates the substantial decline in U.S. tariff levels in the post–World War II era. The vertical axis shows duties as a percentage of either dutiable imports or total imports. GATT refers to the General Agreement on Tariffs and Trade; WTO stands for the World Trade Organization.
SOURCES: Bureau of Economic Analysis; Census Bureau; Douglas Irwin, "New Estimates of the Average Tariff of the United States, 1790-1820", NBER Working paper No.9616, April 2003; Table Ee424-430 in *Historical Statistics of the United States, Earliest Times to the Present: Millennial Edition*; Haver Analytics; United States International Trade Commission; authors' calculations.

Payroll taxes were added in 1935 under the Federal Insurance Contributions Act (FICA), primarily to fund Social Security and Medicare Part A. As shown in Chart 1, these alternative revenue sources expanded significantly during World War II. Since then, the federal government has come to rely primarily on individual income and payroll taxes, with customs duties playing only a marginal role as a source of fiscal revenue.

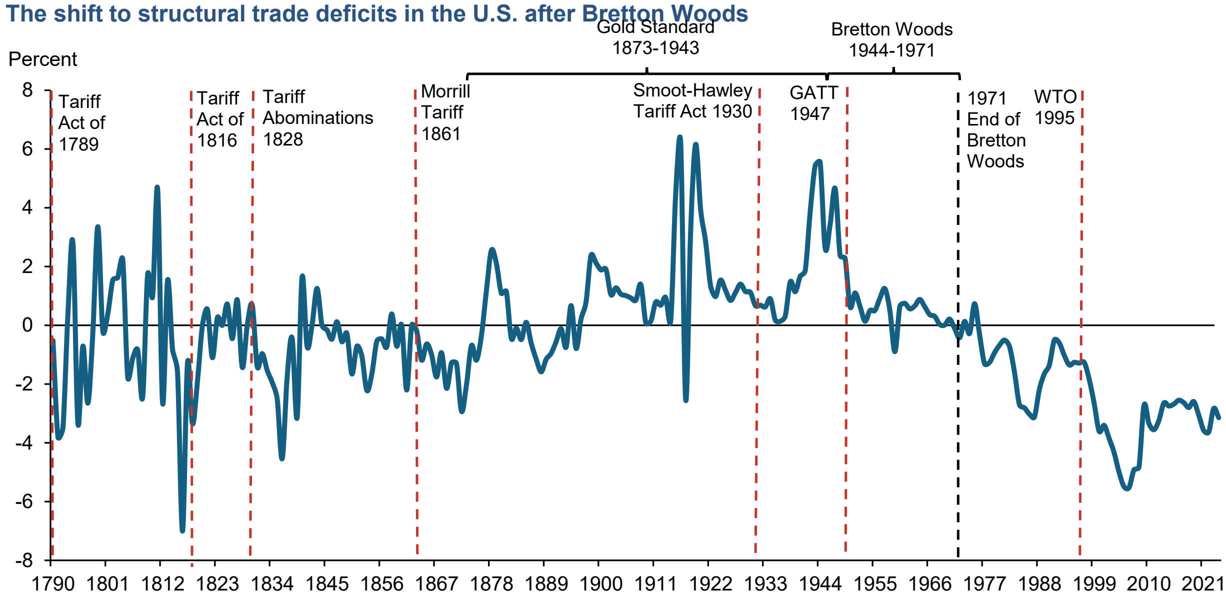
2.2 Tariffs and protectionism

Historically, the Restrictive R of tariff policy has served dual purposes: shielding nascent domestic industries and countering unfair trade practices such as dumping—where firms or countries export goods at artificially low prices to capture market share or undercut competitors. These protective measures were common during periods of economic nationalism and mercantilism, when governments actively defended domestic producers. Over time, however, restrictive tariffs also became strategic tools for securing improved trade conditions and advancing broader international policy objectives.

By the late 19th century, tariffs were being levied on a narrower range of imports, and their importance as a source of federal revenue had begun to decline—particularly after the introduction of universal income taxation in 1913 (Chart 2). Despite occasional protectionist surges—most notably the Smoot-Hawley Act of 1930, which likely deepened the Great Depression (Rustici, 2009; Irwin, 2011; Bond *et al.*, 2013)—the long-term trend toward reduced reliance on tariffs continued.

Following World War II, the U.S. embraced global economic integration, shifting away from high, sector- and country-specific tariffs toward a system of reciprocal trade agreements. This strategic pivot culminated in the creation of the General Agreement on Tariffs and Trade (GATT) and ultimately the establishment of the World Trade Organization (WTO).

Chart 3
The shift to structural trade deficits in the U.S. after Bretton Woods



NOTES: The chart illustrates the emergence of persistent U.S. trade deficits in the post–Bretton Woods era, coinciding with the decline of manufacturing as a share of GDP. The vertical axis shows the trade balance as a percent of nominal GDP. GATT refers to the General Agreement on Tariffs and Trade; WTO denotes the World Trade Organization.

SOURCES: MeasuringWorth; United States Census Bureau, *Bicentennial Edition: Historical Statistics of the United States, Colonial Times to 1970*; United States Bureau of Economic Analysis; Haver Analytics; authors' calculations.

Driving this transition was the belief that trade liberalization would yield substantial shared economic gains—commonly referred to as the "gains from trade"—while promoting global growth and ushering in a new era of globalization. The shift was reinforced by the development of a more predictable, rules-based international trading system and by structural changes such as falling transportation costs (Hummels, 2007), containerization, and other technological innovations that enabled the emergence of global supply chains and deeper economic integration.

Although global tariff rates remain low by historical standards, the U.S. and other countries continue to deploy targeted tariffs in specific sectors or against particular trade partners—whether to address economic concerns or as a negotiating tool. At present, however, most trade frictions stem not from tariffs, but from non-tariff barriers, including national security restrictions, regulatory divergence in consumer protections, language differences, and logistical costs such as shipping times and infrastructure bottlenecks.

2.3 Tariffs and foreign market access

Persistent U.S. trade deficits emerged after the collapse of the Bretton Woods system (Chart 3), driven by two key forces: first, the U.S. dollar and government debt assumed the role of global reserves and sources of safe, liquid assets following the end of the gold anchor; second, a concurrent shift in comparative advantage led to the relocation of low value-added, labor-intensive manufacturing to lower-wage countries (Wen and Reinbold, 2019).

These deficits raise important questions: Do they reflect structural weaknesses in the U.S. economy, or are they a byproduct of economic strength—namely, the ability to attract foreign capital to finance high levels of domestic investment?[1] The role of tariffs adds further complexity to the discussion. Proponents argue that tariffs protect struggling domestic industries, correct trade distortions, and promote reindustrialization and reshoring through import substitution. These arguments often invoke concerns about unfair foreign competition, such as dumping, or frame tariffs as another instrument of industrial policy (Irwin, 2021).

Critics, however, contend that tariffs raise costs for businesses and consumers, disrupt global supply chains, and may hinder domestic investment supported by foreign savings, ultimately dampening economic growth. Historically, tariffs have not proven reliable tools for correcting trade deficits. During the better part of the Gold Standard era and the Bretton Woods period, the U.S. often ran trade surpluses despite significant variation in tariff levels, challenging the notion that tariffs alone can resolve trade deficits (Charts 2 and 3).

Wen and Reinbold (2020) further argue that the U.S. trade balance is closely tied to the stages of U.S. industrialization. As the structure of the economy evolved—altering comparative advantage—and as rising standards of living shifted household preferences toward services, persistent trade deficits emerged. These were sustained in part by the growing global demand for U.S. financial assets as safe, liquid stores of value.

The role of tariffs in U.S. trade and reindustrialization policy cannot be considered in isolation from broader structural transformations—particularly uneven sectoral productivity growth and evolving consumption patterns (Herrendorf *et al.*, 2014).

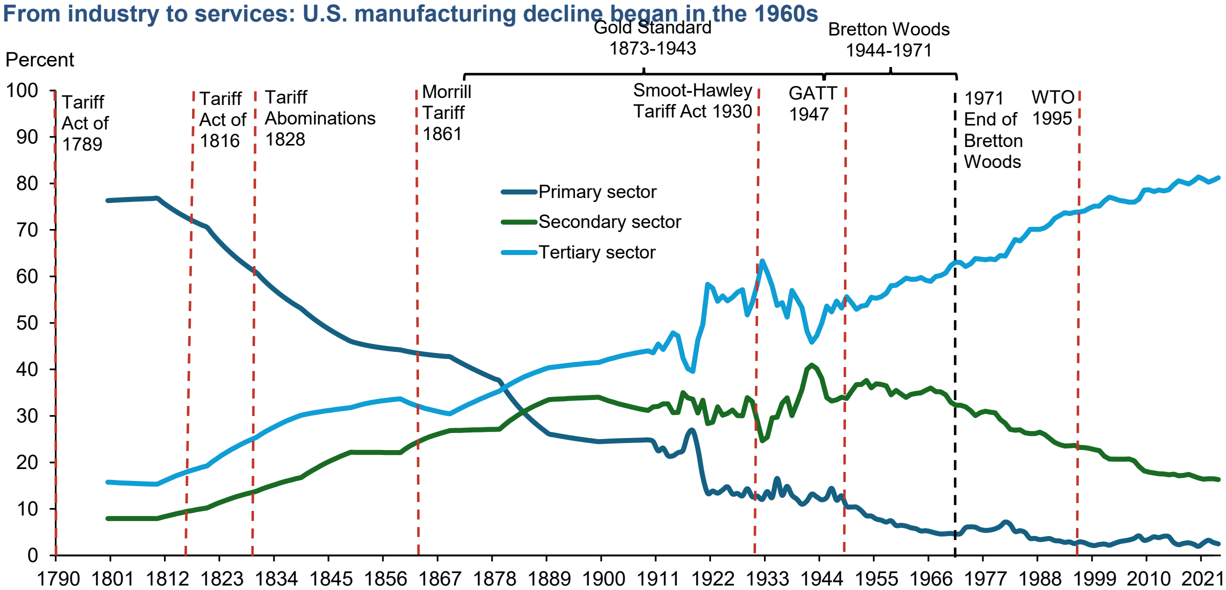
To put this in historical perspective: early on, technological advances in agriculture boosted productivity and savings while freeing labor to shift into manufacturing industries that tended to be more capital-reliant than agriculture. As certain labor-intensive, low-value-added manufacturing activities matured, capital deepening and more recently automation reduced the overall manufacturing sector's labor intensity—pushing the economy up the value chain toward more capital-intensive industries—even as manufacturing output continued to expand.

---

[1] Trade balances can be understood through national accounting identities that link domestic activity to international transactions. National savings (S) is defined as the portion of gross domestic income (GDI), plus net income and transfers from abroad (FI^N), that is not consumed by the private sector (C) or the government (G): $S = GDI + FI^N - C - G$. On the expenditure side, gross domestic product (GDP) is measured as: $GDP = C + G + I + (X - M)$, where I is investment, X exports, and M imports. Since $GDP = GDI + SD$ (with SD denoting the statistical discrepancy), substituting into the savings identity and rearranging yields: $S - I + SD = (X - M) + FI^N = CA$, where the current account (CA) comprises the trade balance ($X - M$) and the primary and secondary balances (net income and transfers, FI^N). By the balance of payments (BOP) identity: $BOP = CA + CFA + Errors\ and\ Omissions = 0$, a current account deficit must be matched by a surplus in the capital and financial account (CFA)—that is, net foreign capital inflows—and vice versa. Hence, when national savings fall short of investment ($S < I$), foreign capital finances the gap; when savings exceed investment ($S > I$), the surplus is used to fund investment abroad.

Rising incomes, meanwhile, shifted household consumption from basic necessities to manufactured goods and, eventually, to services. This progression in demand is consistent with Engel's law, which holds that the share of income spent on food—and increasingly on manufactured goods—declines as income rises.

Chart 4
From industry to services: U.S. manufacturing decline began in the 1960s



NOTES: The chart illustrates the decline of manufacturing as a share of GDP beginning in the 1960s. The vertical axis shows sectoral shares as a percentage of private industries' value added. The primary sector includes agriculture and mining; the secondary sector comprises manufacturing and construction; and the tertiary sector encompasses services and utilities. GATT refers to the General Agreement on Tariffs and Trade, and WTO to the World Trade Organization.
SOURCES: Herrendorf *et al.* (2014); MeasuringWorth; United States Bureau of Economic Analysis; authors' calculations.

Chart 4 illustrates the structural transformation of the U.S. economy over the past two centuries. The long-run shift toward services—a sector typically characterized by slower productivity growth—has contributed to the sustained rise in service-sector output and employment. It has also widened productivity disparities across sectors, further reinforcing the economy's structural evolution.

At the same time, as the U.S. manufacturing base expanded and firms sought access to new markets to realize economies of scale, trade policy evolved in parallel. Initially aimed at shielding domestic producers from foreign competition, U.S. trade policy increasingly prioritized opening foreign markets for American exports and fostering global trade reciprocity. Persistent trade deficits surfaced after manufacturing peaked as a share of GDP in the 1960s, as the economy became more service-oriented and increasingly dependent on imported goods.

Kehoe *et al.* (2018) link the persistence of U.S. trade deficits in the post-Bretton Woods era to deeper structural changes in the U.S. economy. In addition to sectoral productivity differences and shifting consumption patterns, they highlight also the role of sustained foreign borrowing as both a counterpart to trade deficits and a source of financing for domestic investment.

While these capital inflows have supported further capital deepening, they may have also reinforced the long-term shift away from manufacturing toward services by enabling investment and consumption at lower real interest rates than would have been possible relying solely on domestic savings.[2]

However, the findings of Kehoe *et al.* (2018) underscore the central importance of sectoral productivity disparities and suggest that, even if trade deficits were eliminated, employment losses in manufacturing would be unlikely to reverse due to these underlying structural forces.

At the same time, the growing tradability of services presents a new and dynamic frontier for international commerce—one that could reshape not only the scope but also the broader approach to U.S. trade and tariff policy in the years ahead.

2.4 The "impossible trinity" of tariff policy

Navigating the complexities of tariff policy requires managing an inherent policy trilemma among three often-conflicting objectives: the three R's of Revenue, Restriction, and Reciprocity. Advancing one of these goals frequently comes at the expense of the others. For example, setting tariffs high enough to maximize government revenue can undermine efforts to preserve access to foreign markets and secure reciprocal trade concessions. Such tariffs may significantly restrict imports, raise input costs for domestic producers, escalate trade tensions, and trigger retaliatory measures—risks that materialized most acutely in the trade disintegration during the Great Depression (Eichengreen and Irwin, 1995).

Similarly, using tariffs primarily for protection can distort market signals, shelter inefficient industries, and misallocate resources across the economy. At the same time, pursuing broad-based trade reciprocity—by lowering tariffs and promoting openness—can constrain a country's ability to generate revenue through tariffs or shield sensitive sectors from foreign competition and unfair trade practices such as dumping.

This "impossible trinity" of tariff policy underscores the delicate balancing act policymakers face in crafting trade strategies that are both economically sound and politically sustainable.

---

[2] In the global financial system that emerged after the collapse of Bretton Woods—unanchored from gold, based on fiat currencies, and marked by increasingly open capital accounts—the U.S. dollar assumed a central role. Within this regime, persistent U.S. trade deficits have functioned not only to attract foreign savings but also as a key mechanism for distributing dollars globally, reinforcing the dollar's role as the dominant international reserve and invoicing currency. By consistently importing more than it exports, the U.S. facilitates the global circulation of dollars, which serve as essential liquidity—acting as the "grease" for international trade and financial transactions. As Goldberg *et al.* (2022) note, while the dollar's share of global reserves has declined modestly, its dominance in global payment systems and foreign exchange markets remains robust. In this context, U.S. trade deficits have supported the expansion of global dollar funding networks and helped entrench the dollar's international position—raising important questions about how the global system would adjust were these deficits to narrow or reverse.

3. Terms-of-trade mechanism and the tariff Laffer curves

3.1 The terms-of-trade externality

Another critical dimension of tariff policy is its effect on a country's terms of trade, defined as the ratio of export prices to import prices. This relative price determines how much a country can consume from abroad for each unit of goods it produces and exports. An improvement in the terms of trade—when export prices rise relative to import prices—allows a country to obtain more imports per unit of exports, effectively increasing national purchasing power and benefiting domestic consumers.

Large economies like the U.S. are typically not price-takers in global markets. As a result, they can influence their terms of trade, including through policy actions such as tariffs. As shown by Costinot and Rodríguez-Clare (2014), U.S. tariffs can shift the relative price of imports to exports, affecting both the competitiveness of U.S. producers abroad and the degree to which import costs are passed on to domestic consumers.

Consider, for example, a 10 percent U.S. tariff on sneakers imported from Mexico, originally priced at $100 duty-free. Facing reduced demand in their largest export market—and under competitive pressure from other suppliers—Mexican producers may lower their pre-tariff price to $95 to maintain market share. This price adjustment could result from wage reductions, tighter margins, or other cost-cutting measures. In addition, weaker demand for Mexican exports may lead to currency depreciation, further lowering the dollar price of Mexican goods and partially offsetting the impact of the tariff.

In this scenario, the final price paid by U.S. consumers rises to $104.50—less than the $110 that would result if the pre-tariff price remained unchanged. Meanwhile, U.S. Customs collects $9.50 in tariff revenue. If this revenue were redistributed—through direct transfers, offsetting tax reductions, or other mechanisms—the net cost to consumers could fall to $95, effectively below the original duty-free price. In such a case, U.S. consumers would experience a net gain, driven by an improvement in the terms of trade.

However, these gains come at a cost to the trading partner. Mexican workers may face wage cuts or job losses as firms in Mexico absorb the burden of adjustment needed to limit the tariff's impact on export volumes. The ability of a large country like the U.S. to shift the terms of trade in its favor thus creates a negative externality for its trading partners—imposing economic costs they did not choose and cannot easily mitigate.

The ultimate effect of a tariff on U.S. consumers depends critically on how the tariff revenue is used. If redistributed efficiently, tariff revenues can offset the inflationary impact on real incomes and potentially enhance both welfare and consumption. However, if revenues are not returned to households—or are used in ways that do not directly support consumption—real income losses from higher post-tariff import prices may outweigh any potential gains. The net effect thus hinges on the balance between the inflationary burden of higher import prices and the fiscal boost to real household incomes from revenue redistribution.

Taken together, the terms-of-trade mechanism highlights that tariffs have implications far beyond trade balances or industrial protection. They introduce complex fiscal and redistributive trade-offs—domestically and internationally—that must be carefully considered in any assessment of trade policy.

3.2 The tariff Laffer curves

The potential for tariffs to raise government revenue—and even generate real consumption gains—depends critically on how import volumes and prices respond to changes in tariff rates. While moderate increases from low initial levels may boost revenue by offsetting only modest declines in import volumes, excessively high tariffs can sharply curtail trade, weaken aggregate demand, and, beyond a certain threshold, reduce private consumption and ultimately lower customs revenue relative to its peak. This nonlinear relationship is captured by the tariff Laffer curve for government revenue, which identifies the rate beyond which further tariff increases result in declining revenue.

Importantly, the revenue-maximizing tariff rate does not necessarily coincide with the rate that maximizes real private consumption or overall welfare. Evaluating the broader welfare implications of tariff policy requires accounting for terms-of-trade effects—how tariffs alter the relative prices of imports and exports—and distinguishing between the sources of real disposable income that finance consumption. This perspective gives rise to a distinct tariff Laffer curve for private consumption, underscoring that fiscal and welfare objectives may diverge. The interaction between tariffs and terms of trade and the resulting trade-off between revenue gains and real factor income losses play a central role in shaping overall welfare outcomes.

A useful starting point for this analysis based on the Santacreu *et al.* (2025) model is the following approximation of the national accounting identity:

$$P_n^c \cdot C_n = F_n + T_n = W_n \cdot E_n + T_n, \tag{1}$$

where P_n^c is the aggregate price level, C_n is real private consumption, $F_n = W_n \cdot E_n$ is labor factor income (with W_n denoting the average wage and E_n employment), and T_n is net government transfers—including tariff revenues rebated to households—in location n. This identity states that nominal private consumption expenditure ($P_n^c \cdot C_n$) must equal nominal disposable income ($W_n \cdot E_n + T_n$), which consists of labor income and government transfers (in a framework that abstracts from capital).

Dividing both sides of equation (1) by the price level P_n^c yields:

$$C_n = \frac{W_n \cdot E_n}{P_n^c} + \frac{T_n}{P_n^c}. \tag{2}$$

This decomposition provides a useful lens for analyzing how tariff policy affects private consumption through the distinct components of real disposable income. Tariffs influence consumption via two primary channels captured in equation (2): the real value of labor income, $\frac{W_n \cdot E_n}{P_n^c}$, and the real value of government transfers, $\frac{T_n}{P_n^c}$. While tariffs can raise government revenue and thereby increase transfers to households, boosting $\frac{T_n}{P_n^c}$, they may simultaneously reduce real labor income $\frac{W_n \cdot E_n}{P_n^c}$ through higher consumer prices or adverse effects on wages and employment.

This simple framework thus enables a transparent decomposition of the consumption effects of tariffs into their fiscal revenue and factor-income components.

The scope for gains in real disposable income—and hence consumption—depends largely on two elasticities. First, the import demand elasticity: if domestic consumers readily substitute away from imports, foreign exporters face stronger incentives to lower prices. Second, the export supply elasticity: if foreign producers lack alternative markets, they are more likely to absorb part of the tariff burden.

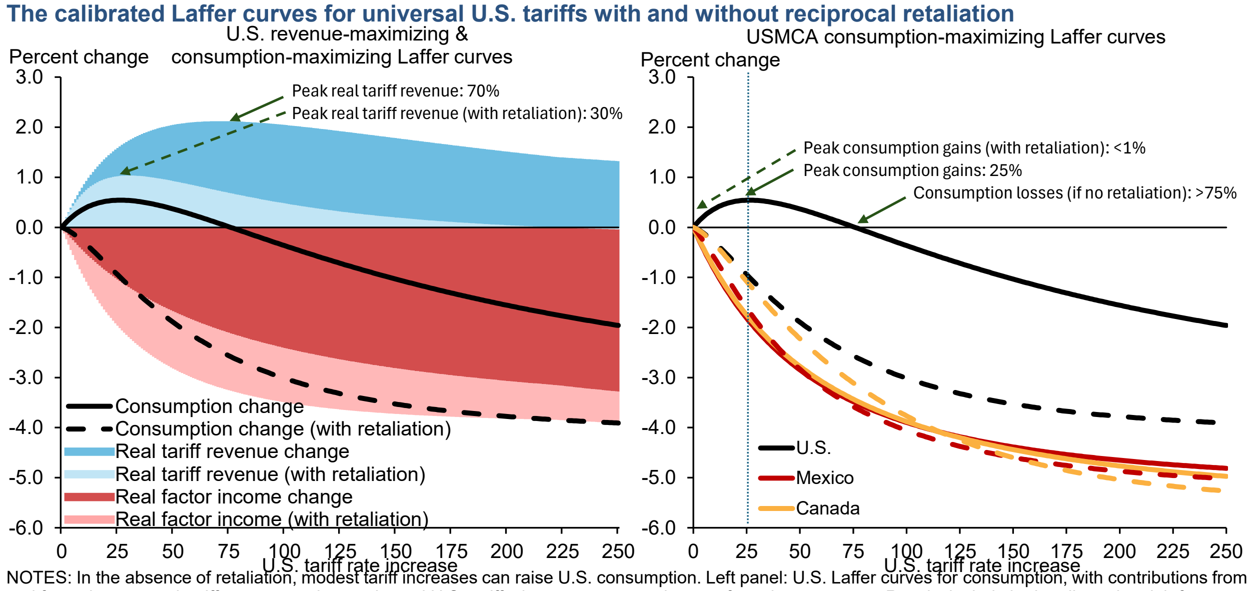
In such cases, as illustrated by the earlier example of Mexican sneaker exporters to the U.S., foreign firms may lower their prices to remain competitive and preserve market share. This results in partial pass-through of the tariff hike to domestic prices, raising real tariff revenue $\left(\frac{T_n}{P_n^c}\right)$ while limiting the contraction in real labor income $\left(\frac{W_n \cdot E_n}{P_n^c}\right)$, even before accounting for any relocation-induced gains. The result can be an increase in real disposable income, as moderate losses in factor income are more than offset by gains from redistributed tariff revenue. This places the economy on the upward-sloping segment of the consumption-based Laffer curve, where rising tariffs still yield net welfare gains.

However, as tariffs rise further, positive fiscal effects begin to taper off while the negative impact on real factor incomes intensifies. Beyond a critical point, further tariff increases reduce real disposable income and private consumption, even if tariff revenue continues to grow. The economy thus moves into the downward-sloping segment of the consumption-based Laffer curve, where welfare gains are gradually eroded and may eventually turn into net losses. Although real tariff revenue may still increase for a time, it too will ultimately decline once tariff rates become prohibitively high.

Under retaliation, the outlook for universal tariffs deteriorates. When trading partners impose reciprocal tariffs, the favorable terms-of-trade effects are largely neutralized. The domestic economy suffers deeper real factor income losses as prices rise further, and tariff revenue declines as trade volumes shrink. With less revenue to redistribute and sharper losses in real factor incomes, the potential for net welfare gains effectively vanishes. In this case, tariffs operate primarily as distortionary taxes or protectionist policy measures—costly in terms of both consumption and aggregate welfare.

While both the revenue-based and consumption-based Laffer curves are robust features of theory and are borne out in empirically calibrated models such as Santacreu *et al.* (2025), the exact outcomes depend on trade elasticities, the scope and nature of retaliation, and the domestic fiscal policy environment. This underscores the importance of evaluating tariff policy within a comprehensive macroeconomic and structural general equilibrium framework—one capable of capturing the full range of interrelated economic effects and international feedback mechanisms at play.

Chart 5
The calibrated Laffer curves for universal U.S. tariffs with and without reciprocal retaliation



NOTES: In the absence of retaliation, modest tariff increases can raise U.S. consumption. Left panel: U.S. Laffer curves for consumption, with contributions from real factor income and tariff revenue under a universal U.S. tariff, shown as percent changes from the status quo. Results include both unilateral and tit-for-tat retaliation scenarios. Right panel: Consumption Laffer curves for the U.S., Canada, and Mexico under a universal U.S. tariff. Solid lines reflect unilateral tariffs; dashed lines reflect tit-for-tat retaliation by all countries.
SOURCES: Authors' calculations based on the model of Santacreu *et al.* (2025).

3.3 The revenue and welfare impacts of U.S. tariffs

The Santacreu *et al.* (2025) model provides a quantitative benchmark for assessing the effects of tariff policy. This calibrated general equilibrium framework incorporates trade in both intermediate and final goods across all 50 U.S. states and the country's seven largest trading partners. Crucially, the model assumes an initial environment of low tariff levels, consistent with prevailing U.S. trade policy in recent decades.

According to the model, the revenue-maximizing universal tariff—absent foreign retaliation—is just over 70 percent (dark blue area, left panel, Chart 5). At its peak, real tariff revenue amounts to approximately 2 percent of private consumption. However, these fiscal gains come at a cost: real factor income declines by nearly 2 percent (dark red area, left panel, Chart 5). Even under the favorable assumption that all tariff revenues are rebated to households, real private consumption sees only negligible gains at the 70 percent rate, and these turn into outright losses beyond a 75 percent tariff (solid black line, left panel, Chart 5). As a result, the consumption-maximizing tariff—the rate that best balances fiscal benefits against real income losses—is significantly lower, around 25 percent, yielding a peak increase of just 0.5 percent in real private consumption.

The model also simulates a reciprocal retaliation scenario, in which all trading partners respond with equivalent tariffs. Under this assumption, tariff revenue peaks at a substantially lower 30 percent rate, generating revenue of only 1.2 percent of private consumption (light blue area, left panel, Chart 5). Real factor income losses become more pronounced (light red area, left panel, Chart 5), and consumption gains vanish entirely. Any tariff increase beyond the prevailing 1–2 percent range leads to rising prices and falling real wages that more than offset the fiscal gains, resulting in mounting consumption losses. These effects are driven by weaker global demand for

U.S. exports and reduced access to foreign markets (dashed black line, left panel, Chart 5). These findings highlight the fragility of welfare gains from unilateral tariffs and the steep economic costs of retaliation and trade wars.

Some economists advocate for high tariffs—well beyond the 25 percent consumption-maximizing level and even past the 70 percent revenue-maximizing point under no retaliation (solid black line, right panel, Chart 5)—as tools of industrial policy aimed at boosting domestic manufacturing through import substitution. In principle, such higher tariffs could yield the same level of revenue as more moderate rates along the upward-sloping segment of the fiscal Laffer curve, while providing stronger protection to domestic industries.

However, this protectionist strategy comes at a cost: according to the U.S. consumption-based Laffer curve, higher tariffs entail a reduction in private consumption relative to lower-rate scenarios that generate equivalent fiscal revenue. In addition, elevated tariffs significantly increase the likelihood of foreign retaliation—raising the risk of escalation into a broader trade war that could further erode U.S. consumer welfare and amplify the economic damage.

Indeed, under retaliation, even modest tariff increases become costly in welfare terms. As shown in Chart 5 (dashed line, right panel), U.S. private consumption begins to decline at tariff levels above the 1–2 percent range—range that broadly aligns with prevailing U.S. tariff rates throughout much of the post–World War II period. By contrast, in the absence of retaliation, limited welfare gains are possible (solid black line, right panel, Chart 5), suggesting that the post–World War II U.S. trade stance—anchored in reciprocity and multilateralism—hovered near the consumption-optimal level under retaliation. This implies that the international trade architecture of the era helped discipline U.S. tariff policy, aligning it more closely with the retaliation-constrained equilibrium than with the unilateral, no-retaliation scenario—thereby reinforcing global trade integration while limiting protectionist tendencies.

Notably, the model finds that under a 25 percent U.S. tariff and multilateral retaliation, consumption losses for Mexico and Canada are smaller (1.6 percent and 1.1 percent, respectively) than under a unilateral U.S. tariff of the same size without retaliation (1.8 percent for both; dashed vs. solid red and yellow lines, right panel, Chart 5). This counterintuitive result reflects the buffering role of coordinated retaliation. For deeply integrated economies such as those in the United States-Mexico-Canada Agreement (USMCA), joint retaliatory action with other trading partners—though insufficient to eliminate losses—can mitigate some of the adverse effects of universal U.S. tariffs on them.

These findings challenge the conventional view that retaliation is inherently self-defeating for small open economies. In settings characterized by tightly integrated supply chains and coordinated multilateral responses, reciprocal tariffs can offer a degree of strategic insulation. However, this protective effect is not unlimited. As U.S. tariffs rise to prohibitively high levels, retaliation becomes increasingly costly—potentially causing greater harm than non-response. Moreover, effective multilateral retaliation is difficult to achieve without the institutional framework of a rules-based international trade system. When coordination breaks down or retaliation is fragmented, the buffering effect weakens, rendering unilateral responses less effective and often more damaging than a negotiated trade settlement or cooperative accommodation with the U.S.[3]

Ultimately, these results echo historical lessons from the Smoot-Hawley Tariff Act and earlier episodes of protectionism: trade wars are rarely winnable. While theory suggests that optimal tariffs can exploit terms-of-trade externalities, real-world constraints—retaliation, fiscal constraints, supply chain frictions, and political economy realities—severely curtail their usefulness. The U.S. consumption-based Laffer curve, grounded in a simple decomposition of real disposable income, delivers a clear message: the margin for welfare-enhancing tariff policy is narrow, and the risks of escalation and overshooting are substantial for all.

3.4 The distributional impacts of U.S. tariffs

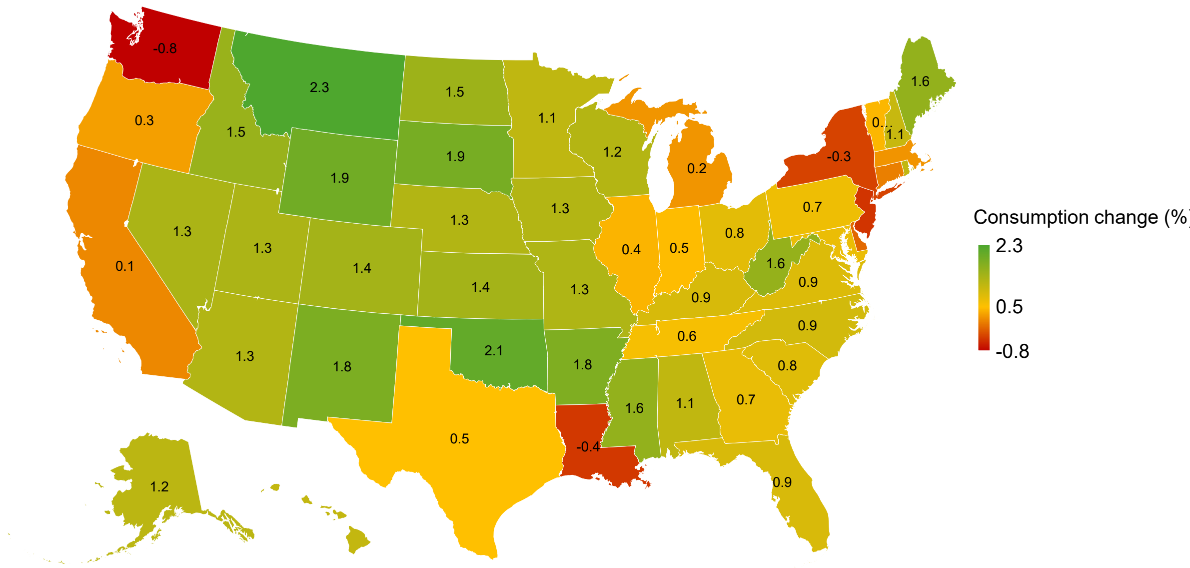
The debate over tariff policy is deeply polarized, reflecting—at least in part—the uneven impact of tariffs across demographic and geographic lines. These effects are shaped by a complex interplay of factors, including educational attainment, labor market attachment, income levels, industrial specialization, and the broader economic structure of individual states. Tariffs can generate benefits for certain sectors while imposing significant costs on others, resulting in divergent outcomes not only across countries but also within the U.S.. Even under the most favorable assumptions for the U.S., unilateral tariff increases with no retaliation produce clear winners and losers, making their distributional consequences a central concern in trade policy discussions.

Given this context, analyzing the distributional consequences of tariffs is essential for understanding their full economic and social implications. While national aggregates offer a broad view of policy impacts, they obscure the substantial variation experienced by households and firms across different states of the U.S. A policy that raises average consumption or output may still leave significant segments of the population worse off—particularly when its costs are highly visible and concentrated, while its benefits appear more diffuse. Identifying which states, in particular, gain or lose from tariff changes is therefore not only a question of economic efficiency, but also one of viability and social cohesion. Without careful attention to these distributional effects, tariff policy risks deepening existing disparities and undermining the long-term sustainability of trade strategies.

---

[3] While a unilateral U.S. tariff hike of 25 percentage points generates a peak consumption gain of 0.5 percent for the U.S. in the absence of retaliation, this gain is reversed under tit-for-tat retaliation by all trading partners, resulting in a U.S. consumption loss of 0.9 percent. For Mexico and Canada, the consumption losses are larger without retaliation—approximately 1.8 percent each—but fall to 1.6 percent and 1.1 percent, respectively, under multilateral retaliation. The rest of the world experiences more modest losses: 0.2 percent without retaliation and just 0.1 percent with multilateral retaliation. Given the relatively small scale of losses for many countries outside North America, the incentive to defect from a multilateral retaliatory strategy may be strong. This raises the likelihood that the global response could drift toward a non-cooperative outcome, undermining the fragile equilibrium required for unified retaliation to mitigate the adverse effects of U.S. tariffs on its trading partners.

Chart 6
Geographical gains and losses from a universal 25 percentage point increase in U.S. tariffs (with no retaliation)



NOTES: The map shows the distributional effects on private consumption across U.S. states from a unilateral and universal 25% universal tariff, assuming no retaliation. It highlights how tariff increases can create both winners and losers at the state level.
SOURCES: Authors' calculations based on the model of Santacreu *et al.* (2025).

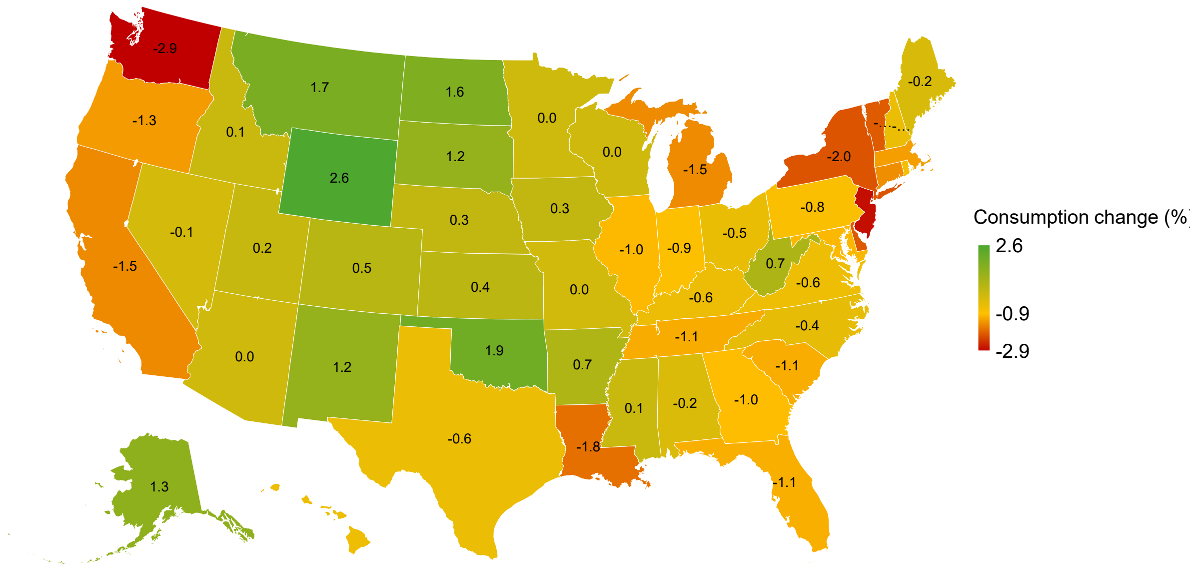
For example, a hypothetical unilateral 25 percentage point tariff on all sectors and trading partners—absent retaliation—would significantly shift U.S. consumption patterns. Across states, real private consumption would range from a 0.8 percent decline to a 2.3 percent increase, with an average national gain exceeding 0.5 percent (Chart 6). States with large import-competing sectors, such as mining, would benefit from reduced foreign competition, which boosts local market share and consumption. In contrast, states with export-oriented industries—particularly in the Northeast, East Coast, and Midwest—would likely experience consumption losses due to weaker external demand and rising input costs.

The observed correlation between state-level consumption gains and structural characteristics—such as exposure to import competition or specialization in tariff-sensitive industries—suggests that support for protectionist policies is closely tied to the economic geography of the U.S. Even when average national effects are positive in the absence of retaliation, the benefits of tariff policy are often geographically concentrated, helping to explain regional variation in receptiveness to protectionist trade agendas.[4] While political economy considerations lie beyond the scope of the model, the distribution of economic gains provides a plausible mechanism for understanding why

[4] As a crude proxy, using the state-level share of votes for the U.S. administration elected in the November 2024 election, the correlation between vote share and state-level consumption gains under the unilateral tariff scenario is 0.53.

support for tariffs may emerge and persist—regardless of whether aggregate national outcomes are favorable, as in the optimal unilateral tariff case, or less so.

Chart 7
Geographical gains and losses from a universal 25 percentage point increase in U.S. tariffs (with retaliation)



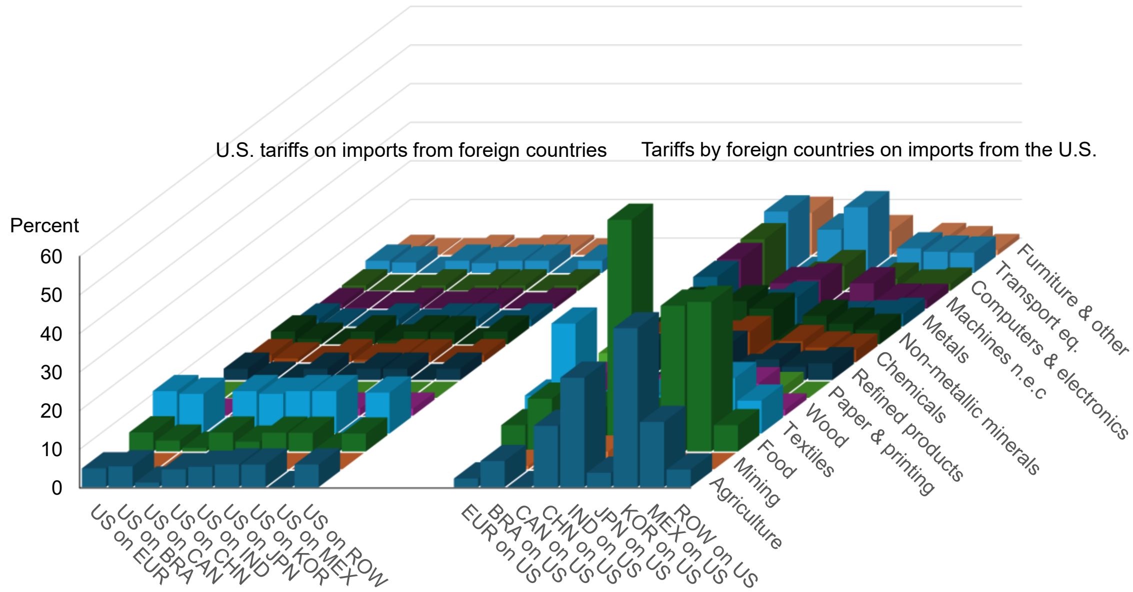
NOTE: The map illustrates the distributional effects on private consumption across U.S. states from a universal 25% tariff under a tit-for-tat retaliation scenario. It highlights how tariff increases, when met with retaliation, still generate both winners and losers at the state level.
SOURCES: Authors' calculations based on the model of Santacreu *et al.* (2025).

When retaliatory tariffs are introduced, trade dynamics become more complex. A multilateral tit-for-tat response reduces overall U.S. consumption by nearly 1 percent (Chart 7), with considerable variation across states. Export-reliant states experience the steepest declines, with real consumption falling by as much as 3 percent. Still, even under retaliation, some states post consumption gains of up to 2.6 percent, depending on their industrial structure and exposure to global trade.[5]

Texas, for instance, experiences a 0.5 percent increase in consumption under the unilateral, no-retaliation scenario—closely tracking the national average. Under retaliation, the state's strong base in mining, oil, gas, and other sectors that benefit from reduced foreign competition helps contain the decline to just 0.6 percent, compared with a 0.9 percent drop nationally.

[5] Using state-level vote shares for the U.S. administration elected in November 2024 as a proxy, the correlation with state-level consumption gains under the retaliation scenario is 0.61. While not implying causality, this association reinforces the notion that certain regions may consistently benefit from tariffs, helping to account for the persistence of support for protectionist policies even when aggregate national outcomes are negative.

Chart 8
Unequal tariff treatment: U.S. exports vs. foreign imports in 2017



NOTES: Tariff rates are as of 2017, expressed as percentages. Prior to the 2018–19 trade war, U.S. exports faced higher average tariffs abroad than foreign exports faced in U.S. markets.
SOURCES: Authors' calculations based on data from Santacreu *et al.* (2025).

Even more striking, Wyoming—another commodity-heavy state—emerges as one of the biggest winners. It registers a 1.9 percent consumption gain without retaliation, which rises to 2.6 percent under multilateral tit-for-tat retaliation. This counterintuitive result illustrates that retaliation is not uniformly harmful and can, under specific conditions, further tilt the balance of tariff effects in favor of certain states.

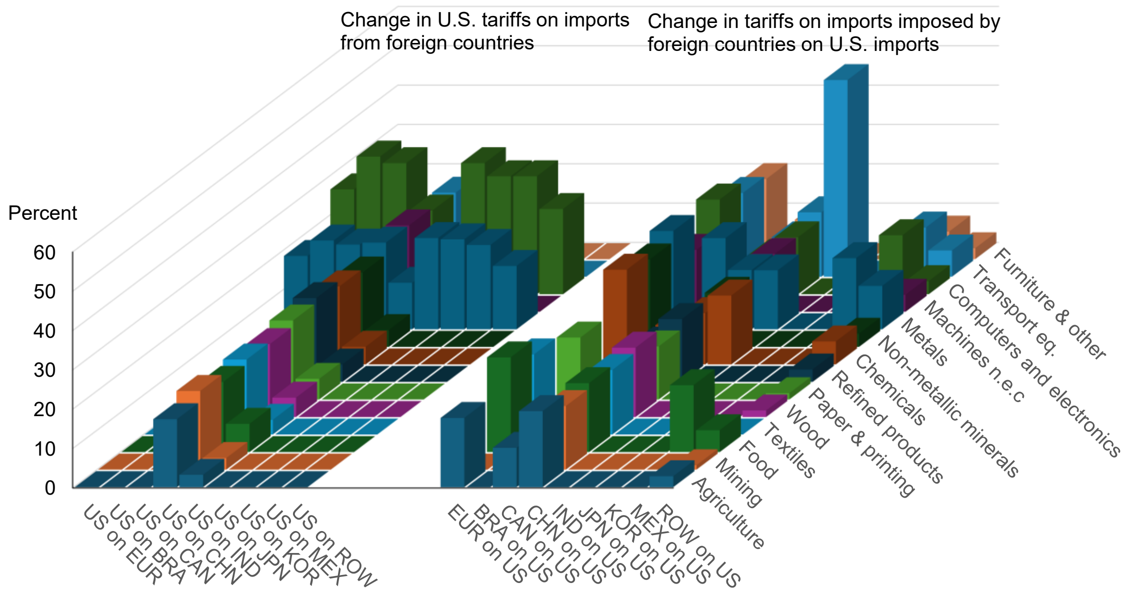
Together, these scenarios underscore the heterogeneity of tariff impacts across U.S. states, revealing substantial regional disparities in how trade policies affect local economies. As such, a comprehensive evaluation of tariff policy must go beyond aggregate national outcomes or effects on foreign trading partners to account for the significant distributional consequences within the U.S. itself.

4. At the crossroads

4.1 Tariff policy 1.0: Leveling the playing field

Before the 2018–19 trade war, U.S. tariffs were low and relatively stable, averaging around 2 percent on a trade-weighted basis. The highest tariffs were concentrated in textiles and agriculture, where average rates were significantly above those in most other sectors (Chart 8, left panel). Under the North American Free Trade Agreement (NAFTA)—later updated as the United States–Mexico–Canada Agreement (USMCA) in 2020—Mexico and Canada were largely shielded from these elevated tariffs.

Chart 9
The cross we bear: Tariff changes resulting from the 2018-19 trade war



NOTES: Tariffs shown reflect post–2018–19 trade war levels, expressed as percentages. During this period, the U.S. imposed broad tariffs on Chinese goods across most industries, as well as duties on metals and electronics affecting a wide range of trading partners.
SOURCES: Authors' calculations based on data from Santacreu *et al.* (2025).

By contrast, U.S. exports faced substantially higher tariffs abroad, particularly in emerging and developing economies (Chart 8, right panel). Even with USMCA in place, U.S. agricultural and food exports continued to encounter high tariffs in Mexico and Canada, while China imposed especially steep duties, in some cases exceeding 50 percent. This persistent asymmetry underscores the challenges U.S. exporters face in accessing foreign markets, despite the relatively open trade stance the U.S. has maintained on imports for decades.

Charts 6 and 7 illustrate the geographic effects of a stylized trade shock: a unilateral 25 percentage point tariff applied by the U.S. uniformly across all sectors and trading partners, including services. While highly simplified, this exercise helps identify the distributional consequences of broad-based tariff hikes with and without foreign retaliation. By contrast, the 2018–19 trade war was far more selective—both in terms of countries and sectors—and did not include services, which account for over 80 percent of U.S. consumption and around 20 percent of U.S. imports. Instead, the tariffs focused primarily on specific manufactured goods, such as steel, aluminum, semiconductors, and chips, and were smaller in magnitude than the stylized 25-point increase. Among trading partners, only China was subject to broad-based tariff hikes.

Chart 9 details the tariff increases and retaliatory responses during the 2018–19 episode. The European Union responded with broad-based tariffs across a wide range of U.S. products. China's countermeasures were similarly extensive, targeting key U.S. export sectors. India, by contrast, focused its retaliation on the auto industry, implementing substantial tariff hikes. These asymmetric responses underscore the complexity and strategic calculus behind international trade retaliation during the most recent episode preceding the 2025 U.S. tariff policy reassessment.

Despite the sharp rhetoric and global scale of the 2018–19 trade conflict, estimates suggest that the impact on U.S. consumption was minimal—highlighting the limited aggregate effects of a narrow, sector-targeted trade war relative to a broad-based, across-the-board tariff hike of a sizeable magnitude like the 25-percentage-point increase analyzed earlier. However, these targeted tariffs may still have contributed to longer-term diversionary effects and further decoupling between the U.S. and China—reversing a trend in which China had become the largest source of U.S. imports following its accession to the WTO in 2001.

4.2 Tariff policy 2.0: Optimal tariffs and the reshaping of global trade

The trade conflict escalated again in March 2025, when the U.S. imposed a 25 percent tariff on imports from Mexico and Canada—later adjusted to exempt USMCA-compliant goods—and increased tariffs on Chinese imports, initially by 10 percent and then up to 20 percent. In April 2025, the U.S. raised tariffs by another 25 percent on steel and aluminum from all trading partners. This was followed by a revised tariff schedule targeting countries with large bilateral trade surpluses with the U.S., resulting in an estimated average import-weighted tariff hike of 41 percentage points.

Under a "kinder", reciprocal tariff framework, however, only about half of these increases were implemented. The actual adjustments varied by country: no change for Mexico and Canada, a 34 percent hike for China, and a baseline 10 percent tariff applied broadly. On average, these adjustments were roughly equivalent to the 25 percentage point flat increase used in the stylized model.

Soon after, the U.S. granted a 90-day pause on all tariff increases above the 10 percent baseline—except for China, where tariffs escalated to 145 percent. In combination with existing duties, some products, such as electric vehicles and medical syringes, now face total tariffs of up to 245 percent, following earlier hikes by President Biden. In response, China raised its tariffs on U.S. exports, with some categories now facing rates as high as 125 percent. This tit-for-tat escalation illustrates the risks of rapidly spiraling trade barriers, leading to prohibitively high tariffs and severe disruptions in bilateral U.S.–China trade.

A tentative de-escalation quickly followed as part of an emerging détente between the U.S. and China. U.S. tariffs on Chinese imports were partially scaled back to a 30 percent increase, while China reduced its retaliatory hike to 10 percent. Bilateral negotiations have advanced, most notably with the U.K., resulting in a deal that cut U.S. auto tariffs from 27.5 percent to 10 percent, eliminated duties on aerospace goods, and established a 10 percent tariff floor without reciprocal retaliation. Preliminary "framework deals" have also been initiated with other key partners, including Vietnam and Indonesia. Elsewhere, negotiations are ongoing. A deadline extension to August 1 was granted, during which the U.S. issued formal letters warning of potential tariff hikes if talks break down.[6]

Beyond the U.S.–China tensions—which reflect a broader strategic realignment—the evolving U.S. tariff strategy marks a shift toward deploying tariffs as "industrial shields" to protect key sectors

[6] More details about recent presidential tariff policy actions can be found on the Office of the U.S. Trade Representative website: https://ustr.gov/issue-areas/presidential-tariff-actions.

such as semiconductors, energy, steel, aerospace, and pharmaceuticals, while also advancing objectives like curbing fentanyl flows. A central feature of this approach is the introduction of a 10 percent minimum tariff floor, signaling an effort to align average tariffs more closely with the revenue- and consumption-maximizing levels identified in the calibrated U.S. Laffer curves discussed earlier.

The strategy pivots away from multilateral disciplines toward bilateral negotiations, where the U.S. often holds greater bargaining power. By pre-announcing steeper tariff increases as the fallback in failed negotiations and putting “maximum pressure,” the aim is to secure agreements on tariffs at or above the 10 percent floor—without provoking retaliation—using carveouts and exemptions to facilitate agreement. If implemented broadly, this approach could raise fiscal revenue while delivering modest but positive welfare gains for U.S. consumers, consistent with the mechanisms previously outlined.

Although the final shape of the new tariff regime remains uncertain, early estimates suggest the import-weighted average U.S. tariff will likely settle well above the 10 percent minimum. The responses from other affected countries, along with potential exemptions and carve-outs, also remain in flux. While these evolving negotiations complicate precise impact assessments in real-time, the stylized 25 percent flat tariff scenario continues to serve as a valuable benchmark. It highlights the fundamental terms-of-trade mechanism through which tariffs influence revenue and consumption, and underscores the core trade-offs inherent in large-scale tariff hikes—regardless of the exact details of their eventual implementation.

That said, country- and sector-specific tariffs introduce relative price distortions and allocative inefficiencies that uniform tariffs largely avoid. As the earlier state-level analysis suggests, these more targeted measures can lead to uneven regional impacts and amplify distributional effects. Moreover, they may be strategically targeted by foreign trading partners to undermine the economic base of support for tariff hikes—specifically, by focusing retaliation on states or constituencies that are perceived to benefit most and are thus more likely to favor such measures.

Any comprehensive policy evaluation must therefore consider not only aggregate outcomes, but also how trade instruments and retaliatory strategies interact with the underlying economic geography of production, consumption, and policy support.

5. Looking ahead

Navigating the complexities of tariff policy requires balancing three core objectives—Revenue, Restriction, and Reciprocity—often giving rise to a policy trilemma commonly referred to as the "impossible trinity." Pursuing one of these goals can unintentionally compromise the others. For example, raising government revenue through high tariffs may hinder efforts to maintain open access to foreign markets for U.S. exports or to secure reciprocal trade concessions. Elevated tariffs can overly restrict imports, limit access to essential foreign inputs, fuel trade tensions, and trigger retaliatory measures from trading partners—as evidenced by historical episodes like the Great Depression (Eichengreen and Irwin, 1995).

Similarly, deploying tariffs to protect domestic industries may yield short-term sectoral gains—especially in industries facing direct import competition or experiencing gains from reshoring—but can also distort market signals, reduce efficiency, and undermine long-term competitiveness. Broader consequences include higher consumer prices, disruptions to global supply chains, and tensions with other macroeconomic and policy priorities.

A nuanced understanding of the historical role of tariffs—and the mechanisms through which they operate, particularly the terms-of-trade channel—is essential for designing policies that minimize distortions, support broader economic objectives, and strike a balance between protection and revenue generation on one hand, and the long-term benefits of reciprocal trade liberalization on the other. This trilemma remains a persistent challenge for policymakers seeking to reconcile domestic priorities with the realities of an open global trading system.

While this paper focuses on real outcomes—namely, consumption and government revenue, conditional on retaliation—policymakers must also consider a broader set of factors. These include trade policy uncertainty, interactions with macroeconomic dynamics (such as implications for monetary policy), and issues related to exchange rate behavior and currency dominance. Although these topics lie beyond the scope of our analysis, we briefly review related research and discuss their broader relevance for trade policy design.

5.1 The international trade system

The international trade system—built around the GATT/WTO framework and anchored in the principles of multilateral non-discrimination and reciprocity—has been instrumental in reducing trade barriers and fostering global trade growth over the past 75 years. As Bagwell and Staiger (2002) emphasize, the most-favored-nation (MFN) rule ensures that identical products from different countries receive equal tariff treatment, extending trade gains to third-country exporters and reinforcing a rules-based order.

Although the principle of reciprocity aims to constrain dominant players by ensuring balanced concessions and outcomes, its effectiveness can be limited in practice due to reliance on complex, costly, and time-consuming legal adjudication processes. Nonetheless, a shift away from this cooperative, multilateral approach toward a more power-based (non-cooperative) trading system—where outcomes hinge on direct and often unilateral tariff adjustments—risks eroding these foundational norms and reshaping the architecture of global trade.

5.2 Trade policy uncertainty

Persistent uncertainty in U.S. trade policy can generate significant macroeconomic effects, particularly by influencing firms' expectations and timing of trade-related decisions. Alessandria *et al.* (2024) show that this uncertainty can initially produce a “trade-boosting” effect, as firms rush to import goods ahead of anticipated tariff hikes. This front-loading behavior inflates trade volumes temporarily, contributing to short-term surges in economic activity and inventory accumulation.

However, the same uncertainty also induces a "trade-dampening" effect. Firms become more cautious, delaying investment and production decisions as they wait for policy clarity. This results in reduced trade flows and a drag on broader economic activity. The resulting cycle—characterized by inventory build-ups followed by drawdowns—adds to economic volatility and complicates macroeconomic stabilization policies. These dynamics underscore how not just the level, but the predictability of trade policy and tariffs play an important role in shaping trade and investment behavior.

5.3 The exchange rate channel

Many emerging markets operate effectively within a "dollar zone," in which maintaining a relatively stable exchange rate against the U.S. dollar becomes a central objective of macroeconomic policy. Building on the findings of Davis (2017), this *de facto* peg arises when countries with floating exchange rates—particularly those with current account deficits financed through reserve drawdowns or external borrowing—closely track U.S. monetary policy. Even without a formal commitment, their policy rates often adjust in tandem with the Federal Reserve's to limit exchange rate volatility and stem capital outflows.

This dynamic complicates the international transmission of U.S. tariff policy. A key mechanism through which tariffs are expected to adjust to tariff or trade shocks—foreign exchange rate depreciation against the Dollar—is largely muted. Hence, foreign exporters must absorb more of the shock through internal adjustments, such as cost-cutting or wage compression, if they aim to preserve some of their competitiveness in U.S. markets. This phenomenon, often described as a "real wage depreciation," shifts the costs more heavily onto labor markets in the exporting country.

Moreover, because tariffs are typically perceived as inflationary for the U.S., they can increase the likelihood of monetary tightening by the Federal Reserve. In contrast, foreign economies often face deflationary forces and a contraction in activity in response to such shocks. Yet many of those countries remain constrained by the need to maintain monetary alignment with the U.S. to avoid exchange rate instability, limiting their ability to cut interest rates as needed to prop up the economy. As a result, monetary policy across the dollar zone may respond suboptimally, deepening the asymmetry of tariff effects and raising the real economic costs for foreign economies.

5.4 The role of the U.S. dollar

In a global financial system anchored by the U.S. dollar, persistent U.S. trade deficits play a central role by supplying the rest of the world with dollar liquidity. By importing more than it exports, the U.S. enables the international circulation of dollars necessary for global trade and finance, reinforcing the dollar's dominance as the primary reserve—and invoicing currency—in cross-border transactions.

Goldberg *et al.* (2022) underscore that dollar invoicing shields U.S. producers from short-term exchange rate volatility, stabilizing revenues and input costs. Despite a gradual decline in the dollar's share of global reserves, it remains dominant in foreign exchange markets and international payment systems. This dominance is supported by Federal Reserve mechanisms such as dollar liquidity swap lines and the Foreign and International Monetary Authorities (FIMA) repo facility, which reinforce the dollar's roles as a store of value, unit of account, and medium of international exchange.

Gopinath *et al*. (2020) articulate a "dominant currency pricing paradigm" to explain the persistence of dollar dominance in global trade. They document that most international transactions are invoiced in U.S. dollars—even when the U.S. is not directly involved. This practice dampens the sensitivity of U.S. import volumes to bilateral exchange rate movements relative to other countries, while amplifying the effects of dollar fluctuations on global trade. Their analysis shows that a 1 percent appreciation of the dollar leads to a 0.6 percent decline in global trade volumes (excluding the U.S.) within a year, even after controlling for the global business cycle, revealing the sizable and widespread impacts of spillovers from U.S. monetary and exchange rate shocks.

However, maintaining this international role hinges on a continued outflow of dollars—historically sustained by persistent U.S. trade deficits as pointed out earlier. Aggressive tariff policies aimed at reducing these deficits may therefore have unintended consequences. By disrupting global dollar flows and raising the effective cost of imports, such policies could weaken the foundations of dollar dominance, reduce global trade volumes, and intensify the contractionary effects identified in Gopinath *et al*. (2020). This creates tensions for policymakers between trade and financial policy objectives in the prevailing dollar-centric international monetary system.

Obstfeld (2020) emphasizes that the dollar's centrality amplifies the global repercussions of U.S. policy actions, particularly during periods of financial tightening or policy shocks. These dynamics are increasingly tied to broader concerns about global financial fragmentation, raising the risk of heightened capital flow volatility, financial spillovers, and systemic instability—especially as countries seek to reduce their exposure to dollar funding shocks, a trend potentially accelerated by ongoing, and at times contentious, trade negotiations.

Aiyar *et al*. (2023) warn also that rising protectionism, together with the emergence of alternative payment systems and shifts toward currency blocs, may pose systemic risks to the global financial architecture. In response, countries have increasingly turned to capital flow management tools (IMF, 2022) and begun reassessing their dollar exposure, with some treating capital controls as partial substitutes for macroprudential policies (Rey, 2015). These developments suggest that the coherence and resilience of the dollar-based international monetary system may come under growing strain amid ongoing trade shocks and uncertainty, raising important challenges for trade policy in a financially interconnected world.

Furthermore, Jiang *et al*. (2024) deepen the analysis of the dollar's special role by framing exchange rate movements through an asset market lens. They identify three key drivers: interest rate differentials, currency risk premia, and the convenience yield on U.S. safe assets. This convenience yield—captured by deviations from covered interest parity—reflects foreign investors' willingness to accept lower returns on U.S. Treasurys in exchange for their superior safety and liquidity. It not only helps explain episodes of dollar appreciation during periods of stress (e.g., the GFC or COVID-19), but also serves as a critical source of seigniorage and fiscal capacity for the U.S. However, as Treasury issuance has grown, convenience yields—particularly at longer maturities—have declined, raising concerns about the erosion of the dollar's safe asset premium. In the context of tariff shocks and rising financial and trade fragmentation, these insights point to a fragile equilibrium: if tariffs weaken global demand for U.S. safe assets, the resulting FX stress could test the boundaries of U.S. financial dominance and even destabilize global dollar liquidity.

5.5 Monetary policy implications

Trade costs—including tariffs—and other real rigidities shape inflation and international business cycle dynamics through the lens of the New Keynesian model, as highlighted by Martínez García and Søndergaard (2009). Recent research has underscored that the monetary policy response to tariff shocks must account for other key features of the global economy as well, particularly the dominance of the U.S. dollar in trade invoicing and the pervasiveness of global value chains (Bergin and Corsetti, 2023).

First, tariff shocks tend to be especially persistent when applied to intermediate goods—such as raw materials or semi-finished components—that are deeply embedded in U.S. supply chains. Santacreu *et al.* (2025) suggests that while tariffs may cause an immediate price increase in imported final goods—a level effect on prices—their broader impact through intermediate inputs raises production costs across sectors, disrupts supply chains, and generates second-round inflationary pressures. These persistent cost effects extend the impact of tariffs over time and complicate monetary stabilization efforts.

Second, Schmitt-Grohé and Uribe (2025) distinguish between transitory and permanent tariff shocks. Analyzing postwar U.S. data, they find that transitory tariff hikes—accounting for roughly 80 percent of observed variation—are neither inflationary nor contractionary and do not trigger monetary tightening. By contrast, permanent tariff increases lead to a temporary rise in inflation and a brief tightening of monetary policy, consistent with a one-off upward shift in the price level. These findings underscore that not all tariff shocks operate like conventional cost-push disturbances; the duration and perceived permanence of the shock critically shape the policy response.

Third, Bergin and Corsetti (2023) emphasize that the macroeconomic impact of tariffs depends critically on the invoicing structure of trade. When the tariff-imposing country dominates trade invoicing, as the U.S. does through the dollar, the usual buffering role of exchange rate adjustment is weakened, limiting the prospects of trading partners partly offsetting the tariff shocks in that way. As a result, foreign exporters may need to absorb the tariff burden by cutting costs or wages—a real wage depreciation—while the global spillovers of U.S. tariff policy are amplified.

Fourth, the elasticity of substitution—both by U.S. consumers away from imports and by foreign exporters toward other markets—shapes the terms-of-trade effects and macroeconomic outcomes. Auclert *et al.* (2025) argue that tariffs are more likely to be stagflationary—raising prices while reducing output—when substitution elasticities are low, through the lens of a New Keynesian model with intermediate input trade.

Fifth, exploiting the terms-of-trade highlighted by Santacreu *et al.* (2025), the distinction between universal tariffs with and without retaliation is pivotal. Both Bergin and Corsetti (2023) and Auclert *et al.* (2025) confirm that retaliation significantly deepens the contraction in output and can intensify inflationary pressures—consistent with cost-push-driven dynamics. In contrast, unilateral tariffs that avoid retaliation—particularly when revenues are rebated to households—can, when near the consumption-maximizing point on the U.S. tariff Laffer curve, operate more like demand-side shocks that raise output and inflation.

Sith, these findings underscore the importance of how tariff revenues are used. Alessandria *et al*. (2025) show that allocating tariff receipts toward investment subsidies—rather than simply cutting distortionary taxes—can significantly enhance fiscal multipliers and amplify the expansionary effects associated with improved terms of trade. This highlights a critical fiscal and trade policy interaction: the macroeconomic payoff of tariff policy depends not only on where the economy sits on the tariff Laffer curve but also on how tariff revenues are deployed. This reinforces the idea that tariffs should not be viewed in isolation, but rather as instruments that, if well-designed, can support broader tax reform by improving the efficiency and composition of government revenue generation.

Taken together, these findings challenge the conventional view that tariffs are purely cost-push shocks or simple, transitory price level shifts. When tariffs improve the terms of trade and revenues are recycled efficiently, they can stimulate domestic demand and dampen inflation pass-through—acting more like a persistent demand-side shock, particularly when intermediate goods are affected. This requires that part of the tariff burden be absorbed by foreign exporters, either through lower production costs or currency depreciation relative to the U.S. dollar.

The distinction between cost-push and demand-side shocks has critical implications for monetary policy. If the inflationary impulse reflects a one-off price-level shift or a transitory cost-push shock, central banks may choose to "look through" it—particularly if output weakens. But if tariffs function as demand shocks—raising real disposable income and consumption—then tighter policy may be warranted to contain inflationary pressures. These trade-offs underscore the importance of understanding not only the inflation trajectory but also the underlying source and duration of tariff shocks when crafting monetary responses.

Bergin and Corsetti (2023) and Auclert *et al.* (2025) argue that these distinctions call for a reassessment of monetary policy rules, which often follow a one-size-fits-all approach. Departing from conventional Taylor-type rule guidance, they suggest that in the presence of cost-push-type tariff shocks, a more accommodative stance could be optimal—even at the expense of temporarily elevated inflation—in order to better support real activity.

Nonetheless, the debate remains open. Some emphasize the risks of persistent inflation, de-anchored expectations, demand-side effects of tariffs, or exacerbated supply disruptions—arguing for a tighter policy stance and greater emphasis on preserving monetary policy credibility. Others highlight the cost-push nature of tariffs under retaliation, potentially compounded by financial vulnerabilities, falling asset prices, and a contraction in global demand, to support the case for monetary accommodation.

Ultimately, the monetary response to tariff shocks is highly context-dependent. Policymakers must balance inflation risks with real economic activity and financial vulnerabilities, while considering fiscal interactions, the likelihood and impact of retaliation, and global spillovers. Emerging research provides valuable analytical tools to help navigate these complexities and inform monetary policy in an increasingly dynamic global trade environment.

6. Concluding remarks

In summary, the quantitative analysis in this paper highlights a fundamental tradeoff between revenue generation and the inflationary effects of rising import prices. Modest, universal tariff hikes—especially when calibrated near the consumption-maximizing range of the U.S. tariff Laffer curve—can increase fiscal revenue while delivering modest welfare gains. These gains arise from improvements in the terms of trade and the recycling of tariff revenues through lump-sum transfers to households. However, as tariffs exceed this range or as most trading partners retaliate, the benefits vanish and turn into net losses. Tariffs become a drag on economic activity, and the inflationary effects on consumer prices intensify.

Beneath the aggregate results, tariff policy produces clear winners and losers. Sectors exposed to foreign competition may gain from reshoring or reduced import penetration, yet input costs can rise throughout the supply chain—particularly when intermediate goods are targeted—weakening competitiveness and potentially prolonging inflationary pressures. The burden of tariffs often shifts across borders as foreign exporters absorb part of the cost through price adjustments or currency depreciation. Even in favorable scenarios for the U.S., such as when retaliation is limited and terms of trade improve, macroeconomic outcomes hinge on how tariff revenues are recycled—whether through lump-sum transfers, tax cuts, or targeted subsidies. Outcomes are also shaped by import substitution elasticities, the ability of foreign exporters to redirect goods, and the extent of exchange rate pass-through. These dynamics complicate monetary and fiscal tradeoffs and broaden the macroeconomic and distributional consequences of tariff policy.

Additional global factors further complicate the policy landscape. Persistent trade policy uncertainty—especially during drawn-out negotiations—can distort firm behavior, prompting precautionary inventory buildup and delaying investment. At the same time, the international role of the U.S. dollar as both a reserve currency and the dominant unit of invoicing shapes how tariff shocks propagate. The dominant currency pricing role of the dollar weakens the exchange rate's buffer, dampening its ability to absorb external shocks and magnifying international spillovers of U.S. shocks—particularly for countries constrained by capital flow volatility or compelled to shadow U.S. monetary policy due to their integration into the dollar zone. This alignment can be especially problematic when tariff shocks generate asymmetric effects across countries that call for divergent policy responses. These structural features limit the effectiveness of traditional adjustment channels and raise the costs for foreign economies.

Taken together, these findings argue for situating tariff policy within a broader strategic framework. The effectiveness of tariffs depends not only on their scale, scope, design, and global response, but also on how they interact with monetary and fiscal policy, the nature of global value chains and international spillovers, and the structural role of the dollar in the international monetary system. Policymakers must weigh domestic goals—such as industrial policy or revenue generation—against broader trade-offs involving inflation, distributional effects, production and trade network realignment, and the potential for further economic and financial fragmentation and instability. A well-calibrated, integrated approach can help avoid unintended consequences and align tariff instruments with broader macroeconomic and strategic objectives.

Bibliography

Aiyar, S., Chen, J., Ebeke, C. H., Garcia-Saltos, R., Gudmundsson, T., Ilyina, A., Kangur, A., Kunaratskul, T., Rodriguez, S. L., Ruta, M., Schulze, T., Soderberg, G., & Trevino, J. P. (2023). Geoeconomic Fragmentation and the Future of Multilateralism. IMF Staff Discussion Note No. 2023/001. Washington, DC: International Monetary Fund. http://www.imf.org/external/pubs/cat/longres.aspx?sk=527266

Alessandria, G., Khan, S. Y., & Khederlarian, A. (2024). Taking Stock of Trade Policy Uncertainty: Evidence from China's pre-WTO Accession. Journal of International Economics, 150, 103938. https://doi.org/10.1016/j.jinteco.2024.103938

Alessandria, G., Ding, J., Khan, S. Y., & Mix, C. B. (2025). The Tariff Tax Cut: Tariffs as Revenue. NBER Working Paper No. 33784. Cambridge, MA: National Bureau of Economic Research, May 2025. https://doi.org/10.3386/w33784

Auclert, A., Rognlie, M., & Straub, L. (2025). The Macroeconomics of Tariff Shocks. NBER Working Paper No. 33726. Cambridge, MA: National Bureau of Economic Research, April 2025. https://doi.org/10.3386/w33726

Bagwell, K., & Staiger, R. W. (2002). The Economics of the World Trading System. The MIT Press. https://doi.org/10.7551/mitpress/2628.001.0001

Bergin, P. R., & Corsetti, G. (2023). The Macroeconomic Stabilization of Tariff Shocks: What is the Optimal Monetary Response? Journal of International Economics, 143, 103758. https://doi.org/10.1016/j.jinteco.2023.103758

Bond, E. W., Crucini, M. J., Potter, T., & Rodrigue, J. (2013). Misallocation and Productivity Effects of the Smoot–Hawley Tariff. Review of Economic Dynamics, 16(1), 120-134. https://doi.org/10.1016/j.red.2012.11.002

Costinot, A., & Rodríguez-Clare, A. (2014). Trade Theory with Numbers: Quantifying the Consequences of Globalization. Handbook of International Economics, 197-261. https://doi.org/10.1016/b978-0-444-54314-1.00004-5

Davis, S. (2017). External Debt and Monetary Policy Autonomy. Ensayos Política Económica. 35(82): 53-63. https://doi.org/10.1016/j.espe.2016.11.004

Eaton, J. & Kortum, S. (2002). Technology, Geography, and Trade. Econometrica, 70(5): 1741-1779. https://doi.org/10.1111/1468-0262.00352

Eichengreen, B., & Irwin, D. A. (1995). Trade Blocs, Currency Blocs and the Reorientation of World Trade in the 1930s. Journal of International Economics, 38(1-2): 1-24. https://doi.org/10.1016/0022-1996(95)92754-P

Giri, R., Yi, K.-M., & Yilmazkuday, H. (2021). Gains from Trade: Does Sectoral Heterogeneity Matter? Journal of International Economics, 129: 103429. https://doi.org/10.1016/j.jinteco.2021.103429

Gopinath, G., Boz, E., Casas, C., Díez, F. J., Gourinchas, P-O, & Plagborg-Møller, M. (2020). Dominant Currency Paradigm. American Economic Review, 110(3): 677-719. http://doi.org/10.1257/aer.20171201

Goldberg, L. S., Lerman, R., & Reichgott, D. (2022). The U.S. Dollar's Global Roles: Revisiting where Things Stand. Federal Reserve Bank of New York Liberty Street Economics. https://libertystreeteconomics.newyorkfed.org/2022/07/the-u-s-dollars-global-roles-revisiting-where-things-stand/

Herrendorf, B., Rogerson, R., & Valentinyi, Á. (2014). Growth and Structural Transformation. In Handbook of Economic Growth, Vol. 2, edited by Philippe Aghion and Steven N. Durlauf, 855-941. Amsterdam: Elsevier. https://doi.org/10.1016/B978-0-444-53540-5.00006-9. Data accessed here: https://sites.google.com/site/valentinyiakos/home/research/gowth-and-structural-transformation

Hummels, D. (2007). Transportation Costs and International Trade in the Second Era of Globalization. Journal of Economic Perspectives, 21(3): 131-154. http://doi.org/10.1257/jep.21.3.131

IMF (2022). Review of The Institutional View on The Liberalization and Management of Capital Flows. IMF Policy Paper No. 2022/008. Washington, DC: International Monetary Fund. https://doi.org/10.5089/9798400204593.007

Irwin, D. A. (2011). Peddling Protectionism Smoot-Hawley and the Great Depression. Princeton, NJ: Princeton University Press. https://doi.org/10.23943/princeton/9780691150321.001.0001

Irwin, D. A. (2017). Clashing over Commerce: A History of U.S. Trade Policy. University of Chicago Press. https://doi.org/10.7208/chicago/9780226399010.001.0001

Irwin, D. A. (2021). The Rise and Fall of Import Substitution. World Development, 139(2021): 105306. https://doi.org/10.1016/j.worlddev.2020.105306

Jiang, Z., Krishnamurthy, A., & Lustig, H. (2024). What Drives Fluctuations in Exchange Rates? An Asset Market Perspective. NBER Reporter, No. 4, December 2024. Cambridge, MA: National Bureau of Economic Research. https://www.nber.org/reporter/2024number4/what-drives-fluctuations-exchange-rates-asset-market-perspective

Johnson, H. G. (1953). Optimum Tariffs and Retaliation. Review of Economic Studies, 21(2), 142-153. https://doi.org/10.2307/2296006

Kehoe, T. J., Ruhl, K. J., & Steinberg, J. B. (2018). Global Imbalances and Structural Change in the United States. Journal of Political Economy, 126(2): 761-796. https://doi.org/10.1086/696279

Martínez-García, E., & Søndergaard, J. (2009). Investment and Trade Patterns in a Sticky-Price, Open-Economy Model. The Economics of Imperfect Markets, 183-212. https://doi.org/10.1007/978-3-7908-2131-4_10

Obstfeld, M. (2020). Global Dimensions of U.S. Monetary Policy. International Journal of Central Banking, 16(1): 73-132. https://www.ijcb.org/journal/ijcb2002_2.htm

Rey, H. (2013). Dilemma Not Trilemma: The Global Financial Cycle and Monetary Policy Independence. Paper presented at the Federal Reserve Bank of Kansas City Jackson Hole Symposium, August 2013. https://www.kansascityfed.org/Jackson%20Hole/documents/4575/2013Rey.pdf

Rustici, T. C. (2009). Lessons from the Great Depression: The Economic Effects of the Smoot-Hawley Act of 1930 and the Beginning of the Great Depression. Capitalism Works Publishing. https://books.google.es/books/about/Lessons_from_the_Great_Depression.html?id=gD9dPgAACAAJ&redir_esc=y

Santacreu, A. M. M., Sposi, M., & Zhang, J. (2025). What Determines State Heterogeneity in Response to U.S. Tariff Changes? Southern Methodist University, Economics Department working papers. https://people.smu.edu/msposi/files/2025/02/SSZ-US-State_Tariffs.pdf

Schmitt-Grohé, S., & Uribe, M. (2025). Transitory and Permanent Import Tariff Shocks in the United States: An Empirical Investigation. NBER Working Paper No. 33997. Cambridge, MA: National Bureau of Economic Research, July 2025. https://doi.org/10.3386/w33997

Wen, Y. & Reinbold, B. (2019). What's Behind the U.S. Trade Deficit? Federal Reserve Bank of St. Louis, On the Economy Blog, January 10, 2019. https://www.stlouisfed.org/on-the-economy/2019/january/behind-us-trade-deficit

Wen, Y. & Reinbold, B. (2020). How Industrialization Shaped America's Trade Balance. Federal Reserve Bank of St. Louis, Regional Economist, February 6, 2020. https://www.stlouisfed.org/publications/regional-economist/fourth-quarter-2019/industrialization-trade-balance

Appendix: A quantitative framework for state-level tariff analysis: The model of Santacreu *et al.* (2025)

Santacreu *et al.* (2025) develop a multi-location, multi-sector Ricardian trade model based on the Eaton and Kortum (2002) framework, extending it to U.S. states and foreign countries with sectoral production, Fréchet-distributed productivities, trade costs, and tariffs. The model incorporates two labor types (high- and low-skill), intermediate input linkages, and tariff revenues rebated to households. It captures how U.S. states, as part of a customs and fiscal union, experience heterogeneous welfare effects in response to changes in common U.S. external tariffs, including scenarios with and without foreign retaliation.

A1. Economic environment

Locations and sectors:

- The model is calibrated to *N* locations *n*=1,...,*N*, comprising both U.S. states and foreign countries: 50 U.S. states, 8 foreign countries (Brazil, Canada, China, the European Union, India, Japan, Mexico, and South Korea), and 1 Rest of the World (RoW) aggregate.
- There are *J* sectors *j*=1,...,*J*, each producing a continuum of tradable varieties, consisting of 14 goods-producing sectors and 2 services-producing sectors.
- The model is static and excludes capital as a factor of production; there is no capital accumulation.

Customs and fiscal union among U.S. states:

- The U.S. is modeled as a customs union with common external tariffs and duty-free internal trade.
- The U.S. is also a fiscal union: tariff revenues collected at the national level are redistributed across U.S. states in equal real per-capita terms, ensuring uniform transfers in consumption units across states.

A2. Firms

- Each location n is endowed with fixed, inelastically supplied quantities of high-skill (skilled) and low-skill (unskilled) labor. These labor endowments are specified at the sector-location-skill level and cannot be reallocated in the baseline specification. Labor is immobile across sectors and locations. Wages and amenities are type-specific and may vary across sectors and regions. (Extensions of the model allow for labor mobility across sectors and/or U.S. states.)
- Production in each sector combines labor inputs and intermediate goods. Value added is formed via a CES aggregator over the two labor types, with sector-specific labor shares. Intermediate goods enter through a Cobb-Douglas structure.
- Each sector *j* in location *n* produces a continuum of varieties $v \in [0,1]$, with gross output for each variety $y_n^j(v)$ given by:

$$y_n^j(v) = a_n^j(v)\left[A_n^j \prod_{s\in\{l,h\}} \left(e_n^{sj}(v)\right)^{\lambda^{sj}}\right]^{\nu^j} \left[\prod_{k=1}^{J} m_n^{jk}(v)^{\mu^{jk}}\right]^{1-\nu^j}$$

where:

- A_n^j: fundamental productivity in sector *j* and location *n*,
- $a_{jn}(v) \sim Fréchet(\theta_j)$: idiosyncratic productivity draw in sector *j* and location *n*, independently and identically distributed across varieties,
- $e_n^{sj}(v)$: quantity of type-*s* workers (with *s*=*h* is for high-skill and *s*=*l* for low-skill) employed in the production of variety v in sector *j* and location *n*, each of them endowed with a unit of labor supplied inelastically,
- $m_n^{jk}(v)$: quantity of the composite good from sector *k* used by country *n* to produce variety v in sector *j*,
- λ^{sj}: labor share of type-*s* workers in labor compensation in sector *j* with $\sum_{s\in\{l,h\}} \lambda^{sj} = 1$,
- μ^{jk}: share of composite good *k* in intermediate input use by firms in sector *j* with $\sum_{k=1}^{J} \mu^{jk} = 1$,
- $\nu^j \in (0,1)$: value-added share (i.e., labor input) in gross output for sector *j*.

- Varieties are aggregated into a nontradable composite good using a CES aggregator with elasticity of substitution $\eta > 1$:

$$Q_n^j = \left[\int_0^1 q_n^j(v)^{1-\frac{1}{\eta}}\, dv\right]^{\frac{\eta}{\eta-1}}$$

where:

- $q_n^j(v)$: quantity of variety v used in location *n*. The composite serves both intermediate and final demand.

- At the sector level, factor payments are derived from firms' cost-minimization behavior. Under CES aggregation of skilled and unskilled labor, the cost share of each labor type in total labor value added determines its factor payment. In equilibrium, the labor compensation for each type is:

$$w_n^{sj}\, e_n^{sj} = \lambda^{sj}\, \nu^j\, p_n^j\, y_n^j$$

and Intermediate input expenditure on sector-*k* good equals the remainder of output value:

$$p_n^k\, m_n^{jk} = \left(1 - \nu^j\right) \mu^{jk}\, p_n^j\, y_n^j$$

where:

- p_n^j: price of the sector-*j* good in location *n*,
- y_n^j: quantity of the sector-*j* bundle of varieties in location *n*.

The right-hand side reflects the unit cost share of type-*s* labor and intermediate inputs from sector *k* in sector-*j* value added, respectively. These relationships follow from the dual of the cost minimization problem.

A3. Households

- Each type-*s* worker in location *n*, sector *j*, makes a two-part decision:

1. First, if mobility were possible, they would choose their sector and location to maximize expected utility. However, in the baseline, the worker's allocation across sectors and locations is taken as exogenous.

2. Second, conditional on their location and sector, workers choose optimal consumption. Each type-*s* worker employed in location *n*, sector *j*, derives utility from both consumption c_n^{sj} and work b_n^{sj}:

$$v_n^{sj} = c_n^{sj} + b_n^{sj}$$

where v_n^{sj} represents the indirect utility:

- consumption utility c_n^{sj} takes the form of a Cobb-Douglas aggregator over sectoral goods:

$$c_n^{sj} = \prod_{k=1}^{J} \left(c_n^{sj}(k)\right)^{\omega_n^k}$$

$c_n^{sj}(k)$: type-*s* worker quantity consumed of the sector *k* good,

ω_n^k: preference weight of sector *k* in location n's consumption basket, common across skill type s, with $\sum_{k=1}^{J} \omega_n^k = 1$.

- work-related utility b_n^{sj} is:

$$b_n^{sj} = \delta_n^{sj} \frac{w_n^{sj}}{P_n^c}$$

w_n^{sj}: location-sector-skill specific wages,

δ_n^{sj}: location-sector-skill amenity factor,

P_n^c: location-specific ideal consumption price index.

- Conditional on being in a given location and sector, the type-*s* worker optimally chooses sectoral consumption $c_n^{sj}(k)$ subject to the budget constraint:

$$P_n^c c_n^{sj} = \sum_{k=1}^{J} p_n^k c_n^{sj}(k) = w_n^{sj} + t_n$$

where:

- p_n^k: price of the sector-*k* good in location *n*,
- t_n: location-specific indirect business tax transfer from the government,
- P_n^c: ideal price index which governs the cost of living in location *n*.

Given Cobb-Doublas preferences, workers optimally allocate a fraction of their income ω_n^j on sector *j* goods. This holds true individually and is preserved in aggregation due to linearity.

- The total indirect utility v_n^{sj} conditional on being employed in sector *j* and location *n* becomes:

$$v_n^{sj} = \frac{w_n^{sj}(1 + \delta_n^{sj}) + t_n}{P_n^c}$$

With immobile labor, there is no labor and location choice that seeks to maximize v_n^{sj}.[7]

- Each type-s worker in sector j and location n consumes a Cobb-Douglas composite of sectoral goods and allocates income accordingly. Optimal sectoral consumption expenditure $p_n^j c_n^j = p_n^j(c_n^{hj} e_n^{hj} + c_n^{lj} e_n^{lj})$ in location *n* becomes:

$$p_n^j c_n^j = \omega_n^j P_n^c C_n$$

  - where the ideal consumption price index P_n^c in location *n* is:

$$P_n^c = \prod_{j=1}^{J} \left(\frac{p_n^j}{\omega_n^j}\right)^{\omega_n^j}$$

  This index governs the cost of living in location n and directly enters into both the indirect utility function and the real wage calculation for each type-*s* worker.

- Aggregation occurs over decentralized worker decisions and not from a centralized utility-maximizing planner. Sectoral labor income is pooled within a location *n*, so aggregate factor income F_n is:

$$F_n = \sum_{j=1}^{J} (w_n^{hj} e_n^{hj} + w_n^{lj} e_n^{lj})$$

- Each location *n* also receives indirect business taxes T_n:

$$T_n = \left(\sum_{j=1}^{J} (e_n^{hj} + e_n^{lj})\right) t_n$$

which consists primarily of tariff revenues rebated lump-sum by the government and distributed uniformly across U.S. states in real per-capita terms.

- Aggregating across all workers in location *n*, total consumption C_n is:

[7] In more general versions of the model, labor is allowed to move across sectors within each U.S. state (sectoral mobility), and across both states and sectors within the U.S. (state-sector mobility). These extensions impose different wage equalization conditions in equilibrium.

$$C_n = \sum_{j=1}^{J} \left(c_n^{hj} e_n^{hj} + c_n^{lj} e_n^{lj} \right)$$

- Aggregate consumption expenditure C_n in location *n* expressed in nominal terms equates the aggregate factor income F_n plus government transfers T_n:

$$P_n^c C_n = F_n + T_n$$

A4. Trade relations

- Trade between any two locations *n* and *i* is subject to iceberg trade costs $d_{ni}^j \geq 1$.
- Cross-country trade also faces *ad-valorem* tariffs $\tau_{ni}^j \geq 0$, while trade between U.S. states is tariff-free but still incurs iceberg trade costs.
- Only the least-cost supplier serves each variety.
- Trade is balanced at the country level: each country's total import expenditure equals its total export revenue.
- As in Eaton and Kortum (2002), the share of sector *j* expenditure in location *n* sourced from location *i* is given by:

$$\pi_{ni}^j = \frac{\left(\left(A_i^j\right)^{-\nu^j} u_i^j d_{ni}^j \left(1 + \tau_{ni}^j\right) \right)^{-\theta^j}}{\sum_{i'=1}^{N} \left(\left(A_{i'}^j\right)^{-\nu^j} u_{i'}^j d_{ni'}^j \left(1 + \tau_{ni'}^j\right) \right)^{-\theta^j}}$$

where u_i^j denotes the unit cost of the composite input bundle (labor and intermediates) used in sector *j* at location *i*, given by:

$$u_i^j = B^j \left(\prod_{s \in \{l,h\}} \left(w_i^{sj}\right)^{\lambda^{sj}} \right)^{\nu^j} \left(\prod_{k=1}^{J} \left(p_i^k\right)^{\mu^{jk}} \right)^{1-\nu^j}$$

The price of the sector *j* composite good in location *n* is then:

$$p_n^j = \gamma^j \left[\sum_{i=1}^{N} \left(\left(A_i^j\right)^{-\nu^j} u_i^j d_{ni}^j \left(1 + \tau_{ni}^j\right) \right)^{-\theta^j} \right]^{-1/\theta^j}$$

where B^j and γ^j are sector-specific constants. Here, $\theta^j > 0$ represents the trade elasticity for sector j, governing the sensitivity of trade flows to changes in trade costs.

A5. Governments

- Tariff collection and redistribution: Each government collects tariff revenue from imports and redistributes the proceeds to households via lump-sum transfers. A balanced government budget holds for each country. Within the U.S., tariff revenue is collected centrally and redistributed such that state-level real transfers are equalized in real terms. U.S. states do not balance independent budgets.

- Calculation of tariff revenue in location *n*:
  - For imports from location *i* in sector *j*, the tariff-inclusive value of imports is:

$$p_n^j Q_n^j \pi_{ni}^j$$

  - Dividing by the gross tariff rate $\left(1+\tau_{ni}^j\right)$ yields the tariff-exclusive value.
  - Multiplying by the net tariff rate τ_{ni}^j gives the revenue collected from that import flow.
  - Summing across all sectors and sources, total tariff revenue in location *n* is:

$$R_n = \sum_{j=1}^{J}\sum_{i=1}^{N}\left(\frac{p_n^j\, Q_n^j\, \pi_{ni}^j}{1+\tau_{ni}^j}\right)\tau_{ni}^j$$

- Transfers in foreign countries:
  - Each foreign country is modeled as a single location with a common consumption price.
  - The nominal per-worker transfer is:

$$t_n = \frac{R_n}{E_n}$$

    where E_n is the total number of workers in country *n*.

- Transfers in the U.S.:
  - Due to variation in state-level consumption prices, transfers are equalized in real terms (i.e., in consumption units).
  - The nominal transfer in each U.S. state *n* satisfies:

$$\frac{t_n}{P_n^c} = \frac{\sum_{i\in \mathrm{US}} R_i}{\sum_{i\in \mathrm{US}} P_i^c E_i}$$

    ensuring that each U.S. worker receives the same real transfer regardless of location.

- Budget balance and net transfers:
  - Governments rebate all tariff revenue, so national budgets are balanced.
  - In the U.S., this implies interstate net transfers equal to $R_n - T_n$, such that:

$$\sum_{n\in \mathrm{US}} R_n = \sum_{n\in \mathrm{US}} T_n$$

- This real-consumption-based redistribution ensures that tariff transfers do not distort workers' location choices if labor mobility is introduced.

A6. Equilibrium conditions

Competitive equilibrium definition

- A competitive equilibrium under a given tariff policy $\{\tau_{ni}^{j}\}$ satisfies the following conditions:
  - (i) Given prices, workers maximize utility subject to their budget and mobility constraints.
  - (ii) Given prices, firms maximize profits subject to technological constraints.
  - (iii) Varieties are sourced from the lowest-cost supplier, accounting for iceberg trade costs and tariffs.
  - (iv) National government budgets are balanced (tariff revenue equals transfers).
  - (v) Labor and goods markets clear.
  - (vi) Trade is balanced at the country level.

Labor market clearing conditions

- In the baseline with no labor mobility, labor demand e_n^{sj} equals exogenous labor supply $\bar{e}_n^{sj}$ at the sector-location level:

$$e_n^{sj} = \bar{e}_n^{sj}$$

- Wages w_n^{sj} adjust to equate labor demand to fixed labor supply. Workers cannot move to arbitrage amenity-adjusted wage differences.
- When mobility is allowed, labor clearing conditions adjust accordingly, and wage equalization constraints must also hold (as shown in Santacreu *et al.*, 2025). Those equilibrium wage conditions apply only to U.S. workers. Foreign workers are restricted to their country of origin and do not face any location choice.

Goods market clearing conditions

- Sectoral goods within each location *n*: Output of sector *j* equals local final and intermediate demand:

$$c_n^j + \sum_{k=1}^{J} m_n^{kj} = Q_n^j$$

- Output market clearing across destinations: The value of sector-*j* output produced in location *n* equals the (pre-tariff) value of that output purchased by all other locations:

$$p_n^j y_n^j = \sum_{i=1}^{N} \left[\left(p_i^j c_i^j + \sum_{k=1}^{J} p_i^j m_i^{kj} \right) \frac{\pi_{in}^j}{1 + \tau_{in}^j} \right]$$

Aggregate resource constraint (absorption identity)

- For each location n, the total pre-tariff value of goods absorbed (consumed or used as intermediate inputs) must equal the value of domestic production plus net government transfers. This ensures consistency between expenditure and resource availability:

$$\sum_{j=1}^{J}\sum_{i=1}^{N}\left(\frac{p_n^j Q_n^j \pi_{ni}^j}{1+\tau_{ni}^j}\right) = \sum_{j=1}^{J} p_n^j y_n^j - R_n + T_n$$

where:

- $\sum_{j=1}^{J}\sum_{i=1}^{N}\left(\frac{p_n^j Q_n^j \pi_{ni}^j}{1+\tau_{ni}^j}\right)$: total gross absorption (pre-tariff) in location *n* represents total spending in location *n* on sectoral goods from all source locations *i*, valued at pre-tariff prices,
- $\sum_{j=1}^{J} p_n^j y_n^j - R_n + T_n$: gross output produced in location *n* plus net government transfer received in location *n* $T_n - R_n$ (rebates minus collected tariffs).

This condition ensures that total resource absorption equals total resource availability in each location.

A7. Data and calibration

The model is calibrated to match sectoral and regional data on production, trade, labor, and prices across 59 regions: 50 U.S. states, 8 foreign countries (Brazil, Canada, China, the European Union, India, Japan, Mexico, and South Korea), and one aggregate Rest of the World (RoW).

Production and labor endowments

- Each region-sector pair is assigned observed labor endowments for high- and low-skill workers, using U.S. data from the Bureau of Economic Analysis (BEA) and foreign labor statistics from the Penn World Table (PWT) and the World Input-Output Database (WIOD).
- Sectoral gross output by location is taken from input-output (I-O) tables. For the U.S., this includes BEA's state-level I-O accounts and the Commodity Flow Survey (CFS); for international regions, the WIOD is used.

Trade flows and tariffs

- Domestic and international trade flows are calibrated using data from the U.S. Census Bureau Foreign Trade Database (FTB), the BACI trade dataset from the Centre d'Etudes Prospectives et d'Informations Internationales (CEPII), and the World Integrated Trade Solution (WITS) tariff database.
- Bilateral trade shares π_{ni}^j are derived using observed trade flows, adjusted to match the model's sectoral classification.

- Tariffs τ_{ni}^{j} are applied at the bilateral level using HS-6 data from the BACI database developed by CEPII, mapped to model sectors using concordance tables. Domestic trade within the U.S. is assumed to be tariff-free, but still subject to iceberg trade costs.
- Tariff revenues R_n are computed using calibrated trade shares π_{ni}^{j} and tariff rates τ_{ni}^{j}.

Trade costs and gravity estimation

- Bilateral iceberg trade costs d_{ni}^{j} are estimated using a standard structural gravity model:

$$\ln d_{ni}^{j} = ex_i^j + \sum\nolimits_{r=1}^{6} \gamma_{d,r}^{j} dis_{ni}^{r} + \gamma_b^j bdr_{ni} + \gamma_c^j cur_{ni} + \gamma_l^j lng_{ni} + \gamma_f^j fta_{ni} + \varepsilon_{ni}^{j}$$

  where:

  - dis_{ni}^{r}: distance dummies in miles (six intervals: [0, 350), [350, 750), [750, 1500), [1500, 3000), [3000, 6000), [6000, ∞)),
  - bdr_{ni}: common border dummy,
  - cur_{ni}: common currency dummy,
  - lng_{ni}: shared official language dummy,
  - fta_{ni}: joint membership in a free trade agreement,
  - ex_i^j: asymmetric trade costs are captured through these exporter fixed effects, varying by sector *j*,
  - ε_{ni}^{j}: log-normal residuals satisfying standard independence assumptions.

Technology and productivity inference

- Fundamental productivities A_n^j are inferred from observed trade patterns and prices using the closed-form solution implied by the Eaton–Kortum structure.
- S_i^j denotes the log technology shifter used to recover fundamental productivity. It captures the combined influence of sectoral fundamental productivity, unit costs, and trade elasticities. Specifically, technology shifters are constructed as:

$$S_i^j = \ln\left(\left(A_n^j\right)^{\nu^j \theta^j} \left(u_n^j\right)^{-\theta^j}\right)$$

  where u_n^j is the unit cost index, ν^j is the value-added share (i.e., labor input) in gross output for sector *j*, and θ^j the sectoral trade elasticity.

- The price index for sector *j* in location *n* is recovered from:

$$\left(p_n^j\right)^{-\theta^j} = \gamma^j \sum_{i=1}^{N} \exp\left(S_i^j\right) \left(d_{ni}^j\left(1 + \tau_{ni}^j\right)\right)^{-\theta^j}$$

where γ^j is a sector-specific constant.

Elasticities and preference parameters

- **Trade elasticities** θ^j vary across sectors and are taken from Giri *et al.* (2021), reflecting empirical estimates consistent with sector-specific comparative advantage.
- **Consumption preference weights** ω_n^j are calibrated using household expenditure data across regions and sectors, ensuring that Cobb-Douglas expenditure shares match observed budget allocations.
- **Labor shares** λ^{sj} and **input shares** μ^{jk} are calibrated from sectoral I-O tables, with $\sum_{s\in\{l,h\}} \lambda^{sj} = 1$ and $\sum_{k=1}^{J} \mu^{jk} = 1$.

Normalization and constants

- Model constants B^j (unit cost aggregator) and γ^j (price index normalization) are either normalized or absorbed into the calibration. They ensure consistency of units and help scale the model to observed prices.

More details about the data and calibration can be found in Santacreu *et al.* (2025).