Threat or Opportunity? Aggregate and Sectoral Effects on Colombia of the Global Trade Reconfiguration due to the U.S.-China Tariff Dispute

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Abstract

When America and China clash over trade, do smaller countries catch opportunities or just collateral damage? We show the answer depends entirely on whether firms believe the new tariffs will last. Using a multisector model calibrated to Colombia, we analyze the 2025 tariff shock by exploiting substantial heterogeneity in sectoral tariff changes across ten productive sectors and multiple trading partners. Temporary tariffs lasting four years shrink Colombian GDP by 0.07%. Make those same tariffs permanent, and GDP rises 0.15%. The mechanism: firms only restructure supply chains when policy changes appear credible. The sectoral story is more dramatic. Mining booms 28% in American markets. But agriculture—despite gaining a crushing 35-point tariff advantage over China—actually *contracts* 17%, exposing deep supply-side constraints. Meanwhile, Colombia's exports to the U.S. surge 20%, but simultaneous losses to China (−12%), Europe (−7%), and elsewhere (−8%) mean the trade balance worsens overall.

Keywords: DSGE model; multisector; multi-country; trade war; tariff shocks; Colombia; trade diversion; input–output linkages
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1 Introduction

Since January 2025, the U.S. has announced a broad reconfiguration of import tariffs, met by retaliatory measures—most prominently by China. These shifts alter relative prices along global value chains and affect not only the principals but also third countries through trade diversion and supply–chain reallocation. This paper quantifies those effects for Colombia using a multisector, multicountry DSGE framework with global input–output linkages. The model captures both direct bilateral channels and higher-order propagation and explicitly contrasts temporary (one-administration) versus permanent tariff regimes to isolate expectations-driven adjustment.

Colombia is an informative case for at least three reasons. First, it is a small open economy tightly integrated into world trade. Second, it is heavily exposed to the U.S. market—about one-third of total goods exports by value go to the U.S. under a bilateral FTA in force for more than a decade. Third, Colombia faces lower effective U.S. tariffs than many competing suppliers, creating scope for trade diversion in its favor even as higher global barriers depress aggregate trade. The Colombian experience thus speaks to other third countries that may be partially advantaged by preferences yet exposed to the general-equilibrium consequences of elevated tariffs.

Because tariff changes are heterogeneous across partners and sectors, trade diversion is intrinsically sectoral. Our approach lets sectoral elasticities, relative tariff differentials, and input–output linkages determine outcomes. Heterogeneity in productivity, installed capacity, market access, and labor reallocation frictions implies unequal domestic adjustment across industries—features the model is designed to capture and that generalize beyond Colombia.

Methodologically, we build a multisector, multicountry DSGE with forward-looking firms and households, endogenous monetary policy, and rich international trade linkages. Dynamism matters: agents internalize the expected duration of the tariff regime, so transition paths differ sharply depending on whether measures are perceived as transitory or permanent. Static frameworks cannot capture these expectations channels; our model delivers short-run adjustments and medium-run reallocation dynamics.

To our knowledge, this is the first study to evaluate the 2025 U.S.–China tariff configuration for Colombia in a framework that combines sectoral granularity, global input–output propagation, and explicit trade-diversion mechanisms within a DSGE setting. Our contribution is twofold. First, we provide quantitative evidence on sectoral and aggregate outcomes for Colombia under temporary versus permanent regimes. Second, we offer a reusable modeling architecture for policy analysis in open economies subject to heterogeneous, system-wide shocks such as tariff reconfigurations.

Roadmap. The paper documents the 2025 tariff measures, presents the model, describes calibration and data, reports results for temporary and permanent regimes, and concludes with policy implications.

Relationship to the Literature

Our contribution relates to several strands of the literature. First, the literature on production networks has shown how sectoral shocks propagate within and across economies, with microeconomic disturbances scaling up to macroeconomic fluctuations (Acemoglu et al., 2012; Gabaix, 2011; Carvalho and Gabaix, 2013; Baqaee and Farhi, 2019; Atalay, 2017; Di Giovanni et al., 2014). Second, the macroeconomic literature emphasizes the role of sectoral heterogeneity, price rigidities, and monetary transmission, documenting how shocks propagate in the presence of nominal and real frictions (Bouakez et al., 2014; Christiano et al., 2005; Smets and Wouters, 2007; Rotemberg, 1982; Nakamura and Steinsson, 2010; Carvalho, 2006; Pasten et al., 2020). Yet, most of this work abstracts from trade policy shocks.

On the other hand, computable general equilibrium (CGE) models and institutional assessments have been widely used to evaluate trade agreements and tariff changes (Böhringer and Rutherford, 2013; Ferrantino et al., 2019; Dolabella and Durán Lima, 2021; Durán Lima and Pellandra, 2017; Fund, 2020; Central Bank of Malta, 2023). While informative on cross-sectoral reallocations, these models are static and cannot capture expectation-driven dynamics or monetary policy feedbacks.

Recent applications of multisector DSGE models to trade and environmental policies show the increasing relevance of this approach. Examples include studies on carbon tariffs and clean energy transitions (Matsumura et al., 2024; Gu et al., 2024; Li and Peng, 2020; Yau and Chen, 2021; Benkhodja et al., 2023), which highlight how sectoral heterogeneity shapes macroeconomic responses.

Methodologically, our framework extends the DSGE approach by embedding economies within a global network of trade and production linkages captured by a multiregional input–output matrix (United Nations Economic Commission for Latin America and the Caribbean (ECLAC), 2020). This allows sectoral shocks to propagate endogenously across borders, not only through direct bilateral trade flows but also via higher-order spillovers and third-market effects, ensuring general equilibrium consistency. In comparison to representative-agent or aggregate settings, this multisectoral and multicountry design provides a significantly richer lens through which to study trade reconfigurations. Unlike static CGE models (Böhringer and Rutherford, 2013; Ferrantino et al., 2019), our dynamic framework captures short- and medium-term adjustment paths and expectation-driven responses, thereby allowing us to evaluate transitional dynamics under tariff shocks of varying persistence. In particular, we contrast two regimes for the 2025 tariff configuration between the United States and China: a temporary regime lasting four years, consistent with a single US administration, and a permanent regime with indefinite duration. This comparison highlights how horizon-dependent expectations shape both aggregate outcomes and sectoral reallocation in Colombia.

The rest of the paper is organized as follows. Section 2 documents the recent tariff changes in the United States and China and details how we model them. Section 3 details the model structure. Section 4 describes the calibration and input–output data. Section 5 presents the results, and Section 6 concludes.

2 Tariff Changes: Summary and Modelled Details

In early February 2025, the US administration announced a 25-percentage-point increase on imports from Mexico and Canada and, within days, additional measures targeting Colombia (first 25% and then 50%). The Colombian measures were subsequently not implemented.

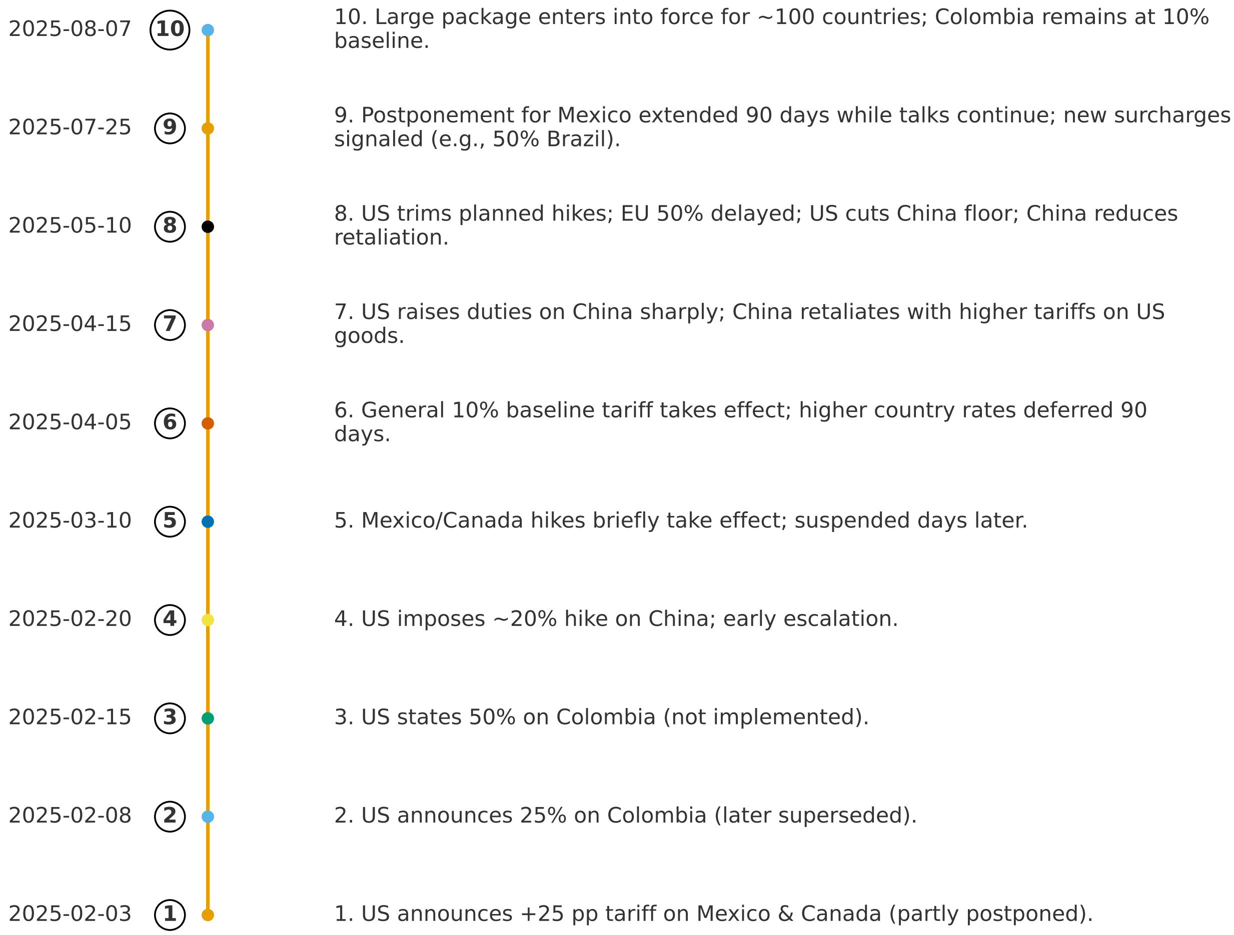

Figure 1: Key 2025 tariff announcements and effective dates (United States and selected partners).

By contrast, actions toward China intensified through February and March, and the Mexico/Canada increases briefly took effect in March before being suspended a few days later.

In April 2025, the United States instituted a general 10% across-the-board tariff on nearly all imports. Country-specific surcharges above that baseline were activated only briefly and then deferred for 90 days. China was treated as an exception: US duties on Chinese goods rose sharply, and China retaliated with substantially higher tariffs on US products. In May, Washington scaled back several planned increases, postponed the prospective 50% duty on European Union imports, and lowered the minimum rate applied to Chinese goods, while Beijing reduced its retaliatory rate on US imports.

In July, the White House announced further surcharges—approximately 30% on Mexico, 50% on Brazil, and at least 20% on several other partners—while some economies negotiated arrangements that temporarily shielded them from higher rates. Shortly before earlierannounced measures were due to come into force, the postponement for Mexican products was extended by 90 days. On August 7, 2025, a broad package of country-specific tariffs took effect for nearly one hundred countries. Throughout these changes, Colombia remained subject only to the 10% general baseline (see Figure 1).

Taken together, the 2025 actions exhibit substantial heterogeneity across countries, sectors, and time—as well as significant policy uncertainty. For our purposes, this strengthens the case for a sectoral, dynamic framework capable of tracing shifting relative prices and trade diversion. It also implies that Colombia, facing only the baseline increase, could benefit from diversion effects in specific tradable sectors even if aggregate impacts remain modest.

The US tariff changes modeled in this document correspond to the difference between the tariffs defined by the April 2025 general amendment (which became effective at different times for different countries) and the tariffs observed in the period immediately before the amendment and the first announcements regarding potential tariff changes (February 2025). For instance, the modelled change for tariffs imposed by the US on Chinese imports is the one that occurred between the ex ante situation (February 2025) and the final tariffs after the moderation of May 2025 (which are on average 30%, as explained in the previous section). Regarding the tariffs imposed by the US government on Colombian imports, the modeled change refers to the shift between the tariffs observed in the ex ante period (February 2025) and the 10% tariff hike announced in April 2025, which took effect as of August of that same year.

As explained above, opportunities for trade diversion in favor of Colombia in the US market will exist in sectors where tariffs become higher for the usual major exporters than for Colombia, and the same will be true in the Chinese market. Figure 2 illustrates the tariffs currently in effect for Chinese products entering the US, as well as those initially announced (which were later reduced) and those observed before the tariff dispute. We focus on China because it is the second-largest exporter to the United States. Therefore, changes in tariffs imposed on its products in the United States may create significant opportunities for other countries to sell in that market. The leading exporter to the United States is Mexico, but tariff increases to that country are still suspended as of the date of the analysis presented here.

The differences modeled in this paper are those that result from subtracting the green bars from the blue ones. It can be seen that the final tariffs on several manufactured products (including food, textiles, rubber, and wood products, among others) and on metals and metal products range between 45% and 50%.

On the other hand, Figure 3 below shows the changes in tariffs imposed by the US government on Colombian imports. It shows that after the general increase (which was a 10 percentage point hike in most sectors), the final rates are much lower than those of China in all sectors. The difference in favor of Colombia ranges between 30 and 40 percentage points. This implies that there are possibly widespread opportunities for trade diversion in favor of Colombia. The effective occurrence of these opportunities also depends on what happens with other countries that have greater importance in the US market than Colombia, whose tariffs for selling in that country are or will be lower than those of China, and in some cases, even lower than those of Colombia. This multiplicity of determinants allows us to conclude that it is necessary to conduct an analysis that takes into account all of them simultaneously, as presented here.

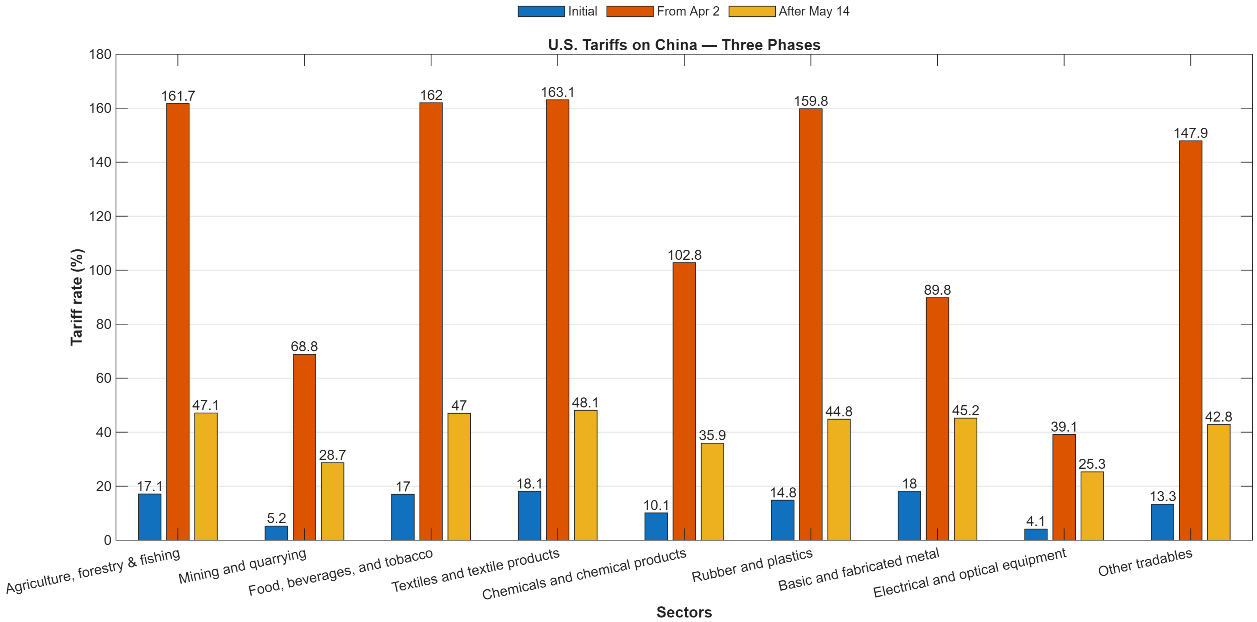

Figure 2: Tariffs imposed by the United States on imports from China. *Note: Tariff rates are authors' calculations based on U.S. tariff schedules reported by ECLAC — Division of International Trade and Integration (July 15, 2025) Economic Commission for Latin America and the Caribbean (ECLAC) (2025).*

As for the possible diversion of trade in the Chinese market in favor of Colombia, this would occur only if there were an increase in tariffs on products from the United States, since the retaliatory measures were imposed only on imports from that country. Figure 4 shows the growth for each economic sector. It can be seen that the final tariffs imposed on Chinese imports from the United States are particularly high on textiles, food, and agricultural products, and between 15% and 20% on manufactured products of wood, rubber, paper, and plastic, as well as on pharmaceuticals, metals, and metal products.

Table 1 reveals the highly concentrated structure of Colombian exports across destinations in 2024, providing the empirical foundation for our sectoral selection in the model simulations. Mining dominates the export portfolio, accounting for $25.5 billion (52% of total exports), with the bulk directed to Rest of World markets ($15.8 billion) rather than the United States ($8.5 billion) or China ($1.2 billion). This sectoral concentration makes mining the critical transmission channel for global trade shocks to the Colombian economy.

Agriculture represents the second pillar of Colombian exports at $8.45 billion (17% of total), with the United States absorbing $4.4 billion—making it Colombia's largest agricultural export market. The substantial U.S. market share in agriculture, combined with current U.S. tariffs on Chinese agricultural products ranging from 45% to 50% versus Colombia's preferential rates of 8% to 12%, creates significant trade diversion potential that justifies this sector's inclusion in our simulations.

The manufacturing sectors reveal a stark geographic asymmetry that shapes Colombia's exposure to trade policy changes. Food/Beverages ($4.1 billion), Metals ($3.2 billion), and Other Tradables ($3.1 billion) together represent 21% of exports but show extreme market concentration: virtually all manufacturing exports target the United States and

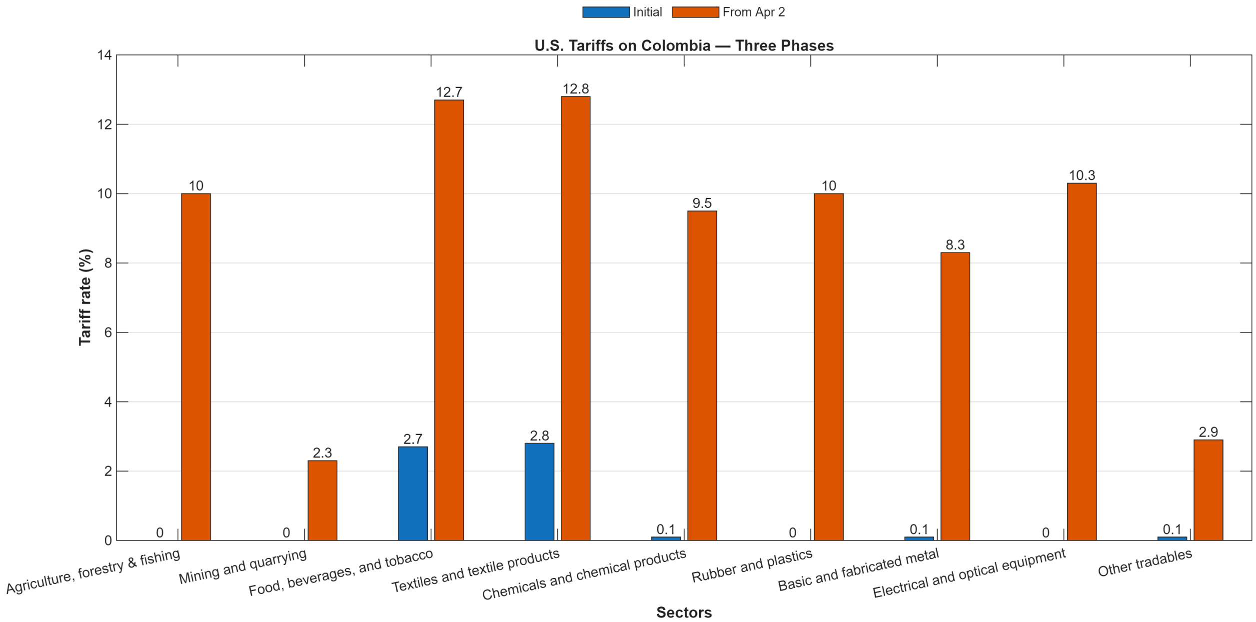

Figure 3: Tariffs imposed by the United States on imports from Colombia. *Note: Tariff rates are authors' calculations based on U.S. tariff schedules reported by ECLAC — Division of International Trade and Integration (July 15, 2025) Economic Commission for Latin America and the Caribbean (ECLAC) (2025).*

ROW markets, with negligible presence in China (less than $270 million combined across all manufacturing sectors). This near-complete absence from Chinese markets paradoxically insulates Colombian manufacturers from direct Chinese retaliation, while limiting their ability to exploit trade diversion opportunities when China imposes tariffs of 15% to 25% on U.S.-manufactured goods.

The remaining sectors —Chemicals, Textiles, Rubber/Plastics, and Electrical/Optical— collectively account for less than 5% of exports and show minimal penetration in all markets, particularly China, where they register zero exports. Their limited scale reduces their relevance for aggregate impacts, though their inclusion in the model captures potential emerging opportunities under permanent trade reconfiguration.

This export structure justifies our model's focus on the nine key sectors, as they collectively account for over 95% of Colombian exports and exhibit sufficient variation across destinations to identify differential policy impacts. The extreme concentration in mining and agriculture (69% of total exports) makes these sectors the primary channels through which global trade shocks affect Colombia's macroeconomic performance. In contrast, the emerging manufacturing sectors offer insights into potential diversification pathways under different policy scenarios.

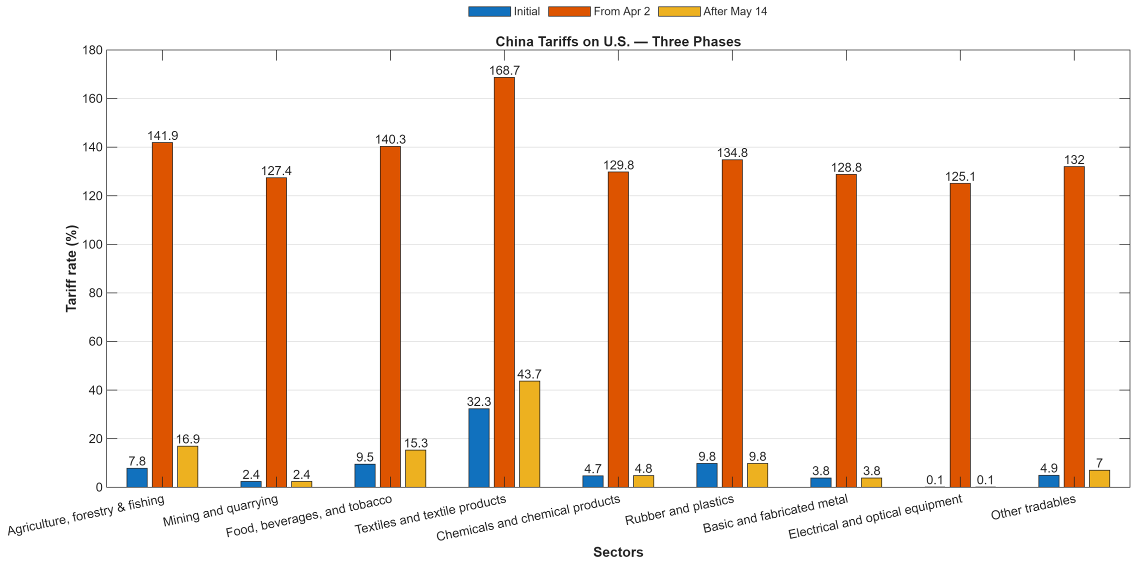

Figure 4: Tariffs imposed by China on imports from the United States. *Note: Tariff rates are authors' calculations based on U.S. tariff schedules reported by ECLAC — Division of International Trade and Integration (July 15, 2025) Economic Commission for Latin America and the Caribbean (ECLAC) (2025).*

Table 1: Colombian exports by sector and destination - 2024 estimates (Million USD)

Sector	USA	China	ROW
Mining	8,500	1,200	15,800
Agriculture	4,400	350	3,700
Metals	850	150	2,200
Food/Beverages	1,500	120	2,500
Chemicals	450	0	850
Rubber/Plastics	400	0	500
Textiles	450	0	900
Elec/Optical	150	0	500
Other Tradables	600	0	2,500
Total	**17,300**	**1,820**	**29,450**

Source: Author's calculations based on DANE-DIAN export statistics and Analdex (2025).
Note: Estimates based on January-December 2024 preliminary data. ROW = Rest of World.

3 Results

In this section, we quantify the effects of the 2025 U.S.–China tariff reconfiguration on Colombia using the multisector, multicountry, open-economy DSGE framework introduced above, which includes ten trading partners. We solve the model under the new tariff schedule and examine two persistence regimes for the tariff configuration—temporary (16 quarters) and permanent (indefinite)—to isolate horizon effects. We analyze the sector-specific changes in import demand for Colombian goods from the United States and China, as well as the macroeconomic responses in Colombia. Results are reported at both sectoral and aggregate levels (output, prices, employment, and external balances), with particular attention to the transmission channels and the sensitivity of dynamics to shock duration.

3.1 Sectoral impacts on U.S. and Chinese import demand

The results presented in Table 2 reveal substantial heterogeneity in the U.S. import demand response across Colombian sectors following the implementation of the tariff changes. The differential impacts between temporary and permanent regimes provide critical insights into the dynamic adjustment patterns of bilateral trade flows.

Most notably, the mining sector exhibits the strongest positive response under both regimes, with import demand increasing by 18.94% under the temporary regime and 27.61% under the permanent regime during the first year. This 8.67 percentage point differential represents the most significant absolute gain from permanent versus temporary implementation, with peak differences reaching an extraordinary 43.65 percentage points. The Other Tradables sector follows a similar pattern, with robust positive responses (15.87% temporary, 22.23% permanent), suggesting that resource-based and diversified tradable goods benefit substantially from enhanced market access.

A particularly striking finding emerges from the comparison of sector-level adjustments. While traditional manufacturing sectors such as Textiles, Metals, and Electrical/Optical equipment experience adverse import demand shocks under the temporary regime (-6.16%, -0.74%, and -10.69%, respectively), these same sectors demonstrate positive or less negative responses under permanent implementation (0.82%, 5.78%, and -4.17%). This pattern suggests that the credibility and time horizon associated with permanent trade liberalization fundamentally alter investment and sourcing decisions, enabling these sectors to overcome initial adjustment costs.

The agricultural sector presents an interesting case, experiencing substantial adverse demand shocks under both regimes (-22.35% temporary, -16.80% permanent); however, the permanent regime mitigates these adverse effects by 5.55 percentage points. This persistent negative response likely reflects structural competitiveness challenges that persist regardless of the policy regime's duration. However, the permanent framework provides some mitigation through enhanced certainty and potential for long-term supply chain adjustments.

Table 2: USA Import Demand for Colombian Goods (Top Winners) (avg. first year)

Sector	Temp_Y1_avg	Perm_Y1_avg	Difference	Peak_Diff
Mining	18,94	27,61	8,67	43,65
Other Tradables	15,87	22,23	6,36	18,58
Services	2,34	3,47	1,13	3,44
Metals	-0,74	5,78	6,52	9,72
Textiles	-6,16	0,82	6,98	10,15
Food/Beverages	-7,59	-3,47	4,12	-6,61
Rubber/Plastics	-9,85	-5,79	4,06	-8,91
Elec/Optical	-10,69	-4,17	6,52	9,07
Chemicals	-14,39	-11,36	3,04	-14,64
Agriculture	-22,35	-16,80	5,55	-20,42

The results in Table 3 present a starkly different pattern, revealing significant trade diversion effects as Chinese import demand for Colombian goods contracts across all sectors. This adverse spillover effect represents a critical dimension of the trade agreement's impact on Colombia's global trade relationships.

The mining sector, which emerged as the primary beneficiary in U.S. markets, experiences the most severe absolute decline in Chinese demand, with reductions of 8.79% under the temporary regime and 13.53% under the permanent regime. This asymmetric response across destination markets highlights the zero-sum nature of certain trade relationships, where preferential agreements alter relative market access conditions. The 4.75 percentage point differential between regimes, while smaller than the U.S. gain, still represents a substantial intensification of trade diversion under permanent implementation.

The manufacturing sector exhibits a particularly pronounced pattern of amplified losses under the permanent regime. Metals and Textiles, which showed improved performance in U.S. markets under permanent conditions, face dramatic deterioration in Chinese demand, with permanent-temporary differentials of -10.30 and -8.05 percentage points, respectively. The Electrical/Optical sector follows a similar trajectory (-0.40% temporary versus -5.90% permanent), suggesting that permanent trade agreements trigger strategic reorientation of supply chains that fundamentally reshape bilateral trade patterns with third countries.

Most remarkably, the agriculture sector demonstrates a complete reversal from positive to negative territory when moving from temporary (3.85%) to permanent implementation (-7.44%), representing the largest swing of -11.28 percentage points among all sectors. This dramatic shift likely reflects anticipatory adjustments by Chinese importers who redirect sourcing strategies in response to Colombia's long-term commitment to U.S. market integration. The Food/Beverages sector exhibits a similar, though less extreme, pattern (2.01% to -3.35%).

Table 3: China Import Demand for Colombian Goods (Top Losers) (avg. first year)

Sector	Temp_Y1_avg	Perm_Y1_avg	Difference	Peak_Diff
Mining	-8,79	-13,53	-4,75	-13,79
Textiles	-2,61	-10,66	-8,05	-8,94
Metals	-1,56	-11,86	-10,30	-11,06
Other Tradables	-0,45	-6,06	-5,61	-6,04
Elec/Optical	-0,40	-5,90	-5,49	-5,54
Services	-0,23	-2,93	-2,71	-2,75
Rubber/Plastics	-0,21	-6,18	-5,97	-6,31
Chemicals	-0,06	-5,36	-5,30	-5,72
Food/Beverages	2,01	-3,35	-5,36	-5,88
Agriculture	3,85	-7,44	-11,28	-12,17

These findings collectively demonstrate that permanent tariff changes induce far more extensive trade reallocation effects than temporary arrangements. The amplification of both gains and losses under the permanent regime—with peak differences reaching -13.79% for mining in China versus +43.65% in the U.S.—validates theoretical predictions from forward-looking trade models incorporating sunk costs and input-output linkages (Bouakez et al., 2014; Pasten et al., 2020; Gabaix, 2011). The asymmetric responses across destination markets highlight how global tariff shocks and subsequent bilateral retaliation reshape third-country trade flows. Colombian exporters experience enhanced access to U.S. markets following the U.S. global tariff reduction, while simultaneously facing diminished Chinese demand as China's retaliatory measures against the U.S. alter relative competitiveness. The results suggest that policy permanence fundamentally alters firms' optimization calculus, enabling deeper market integration where access improves while triggering more severe disengagement from markets where relative competitiveness deteriorates.

3.2 Macroeconomic responses in Colombia

The aggregate macroeconomic responses presented in Figure 5 and Table 4 reveal profound differences in Colombia's adjustment dynamics under temporary versus permanent tariff regimes, highlighting the critical role of policy duration in shaping economic outcomes.

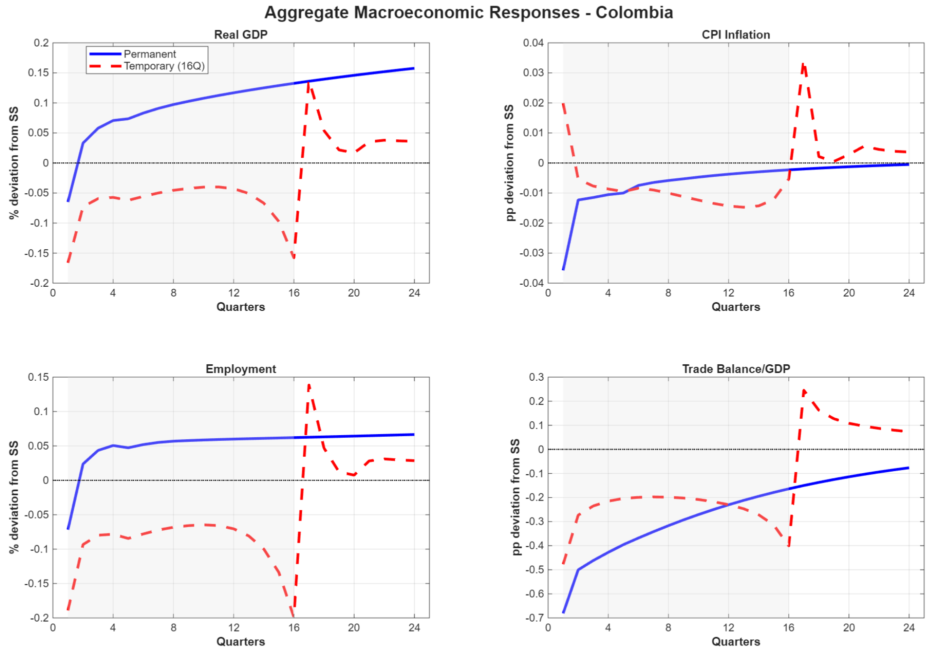

Figure 5: Macroeconomic responses in Colombia under temporary vs. permanent regimes.

Most strikingly, real GDP exhibits opposite trajectories across the two scenarios. Under the temporary regime, output contracts immediately by approximately 0.15% and remains negative throughout the 16-quarter horizon, averaging -0.069% over the first four years. In stark contrast, the permanent regime generates an immediate positive response that builds progressively, reaching 0.146% in the long run. This divergence highlights how expectations of policy persistence significantly influence investment decisions and resource allocation, with temporary shocks leading to precautionary contractions, while permanent changes facilitate productive restructuring.

Table 4: Aggregate Effects on Colombia (deviation from steady state)

Variable	Temporary-Avg-Y1-Y4	Permanent LR	Key Driver
Real GDP	-0.069	0.146	Trade diversion offset
CPI Inflation (pp)	-0.009	-0.001	Imported input costs
Employment	-0.095	0.064	Sectoral reallocation
Real Wage	-0.070	-0.092	Labor mobility frictions
Trade Balance/GDP (pp)	-0.256	-0.114	Terms-of-trade effect
Current Account/GDP (pp)	0.200	0.852	Savings response

The employment dynamics mirror the GDP patterns but with amplified magnitudes, reflecting substantial labor market frictions. The temporary regime triggers severe job losses averaging -0.095% over the first four years, with the sharpest decline occurring around quarter 16 as the policy reversal approaches. Conversely, permanent implementation supports employment growth of 0.064% in the long run, though the adjustment path reveals significant short-term disruption as workers reallocate across sectors. The more pronounced employment volatility relative to output suggests that labor mobility constraints impose substantial adjustment costs during the transition.

Inflation responses demonstrate deflationary pressures under both regimes, though with markedly different persistence. The temporary scenario generates a modest deflationary impulse averaging -0.009 percentage points, with a notable spike toward zero as the reversal date approaches. The permanent regime produces a sharp initial deflation of approximately -0.03 percentage points, which gradually converges to near-neutrality (-0.001 percentage points) in the long run, consistent with one-time relative price adjustments rather than persistent nominal effects. The external balance reveals particularly dramatic adjustments, with the trade balance deteriorating under both regimes but following distinct paths. The temporary regime induces a substantial deficit averaging 0.256% of GDP, which reverses sharply at quarter 16. The permanent regime generates an even larger initial deterioration approaching 0.6% of GDP, but this gradually improves to -0.114% in the long run as the economy restructures toward new comparative advantages. This J-curve pattern in the permanent scenario reflects the time required for export sectors to expand capacity and penetrate new markets following the improved U.S. market access.

These aggregate patterns confirm that policy permanence not only amplifies the magnitude of economic adjustments but fundamentally alters their direction. The transition from negative to positive long-run effects on output and employment under permanent implementation demonstrates that forward-looking behavior and irreversible investments are crucial determinants of the impacts of trade policy. The results strongly support the theoretical prediction that temporary trade policies generate primarily disruptive effects with limited efficiency gains. In contrast, permanent reforms enable genuine structural transformation, albeit with larger short-term adjustment costs.

3.3 Export dynamics by destination

Figure 6 provides crucial insights into the geographic recomposition of Colombian trade flows, revealing how export dynamics vary dramatically across destinations and policy regimes. The bilateral patterns demonstrate that the aggregate trade effects mask substantial heterogeneity in market-specific responses.

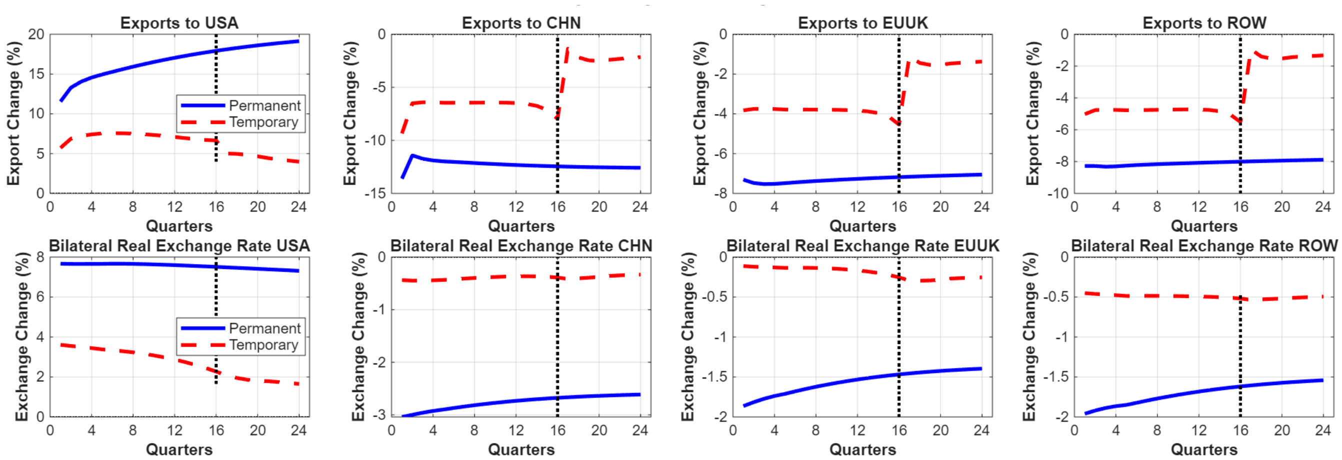

Figure 6: Dynamic responses of Colombian exports by destination under temporary vs. permanent regimes.

The export performance to the United States exhibits a counterintuitive pattern given the improved market access. Under the permanent regime, exports rise immediately to approximately 12% and continue climbing to nearly 20% by quarter 24, reflecting the sustained benefits of preferential access. The temporary regime generates a more modest increase peaking around 8% before declining sharply as the reversal date approaches. This divergence highlights the critical dependence of investment in market-specific distribution networks and production capacity on the expected duration of policy. The accompanying real exchange rate appreciation vis-à-vis the U.S. dollar (7% permanent, 3% temporary) partially offsets the tariff advantage but cannot entirely erode the market access gains under permanent implementation.

The Chinese market presents the starkest adjustment, with Colombian exports plummeting under both regimes but following markedly different trajectories. The temporary scenario triggers an immediate 7% decline that partially recovers to -6% as the policy reverses. Under permanent implementation, the initial shock deepens to -12% and stabilizes near this level, reflecting a permanent restructuring away from Chinese markets. The bilateral real exchange rate depreciation against China (-3% permanent, -0.5% temporary) fails to offset the loss of relative competitiveness as Colombia reorients toward U.S. markets. This persistent divergence highlights how the third-country effects of preferential agreements can lead to lasting trade diversion, even in markets not directly affected by the initial policy change.

European markets (EUUK) and the rest of the world (ROW) exhibit similar patterns of trade compression, though with important differences in magnitude and persistence. Exports to Europe decline by 7% under permanent implementation versus 4% under temporary conditions, while ROW exports fall by 8% and 5% respectively. The bilateral real exchange rates show modest depreciation under the permanent regime (-1.5% for both EUUK and ROW), providing limited offset to the competitiveness losses. These widespread adverse effects across non-U.S. destinations suggest that reallocating productive resources toward serving the U.S. market creates capacity constraints that limit Colombia's ability to maintain export volumes elsewhere.

The asymmetric exchange rate movements across trading partners reveal an important adjustment mechanism. While the Colombian peso appreciates against the U.S. dollar due to improved terms of trade and capital inflows, it depreciates against all other currencies, reflecting the need to maintain competitiveness in markets where preferential access has been eroded. This pattern of bilateral rate adjustments partially mitigates but cannot fully offset the trade diversion effects induced by the preferential agreement.

These destination-specific dynamics reconcile the seemingly paradoxical aggregate results. While Colombian exports to the U.S. surge under permanent implementation, the collective decline in exports to all other destinations—representing a larger share of total trade—generates the net adverse effect on the trade balance. The evidence strongly supports theoretical predictions from dynamic trade models, which suggest that policy permanence enables deeper market integration with preferential partners while simultaneously inducing more severe disengagement from other markets. The sharp reversals observed at quarter 16 under the temporary regime confirm that forward-looking expectations drive anticipatory adjustments, with firms unwilling to incur sunk costs for market penetration when policy reversal is anticipated.

3.4 Sectoral Output Responses

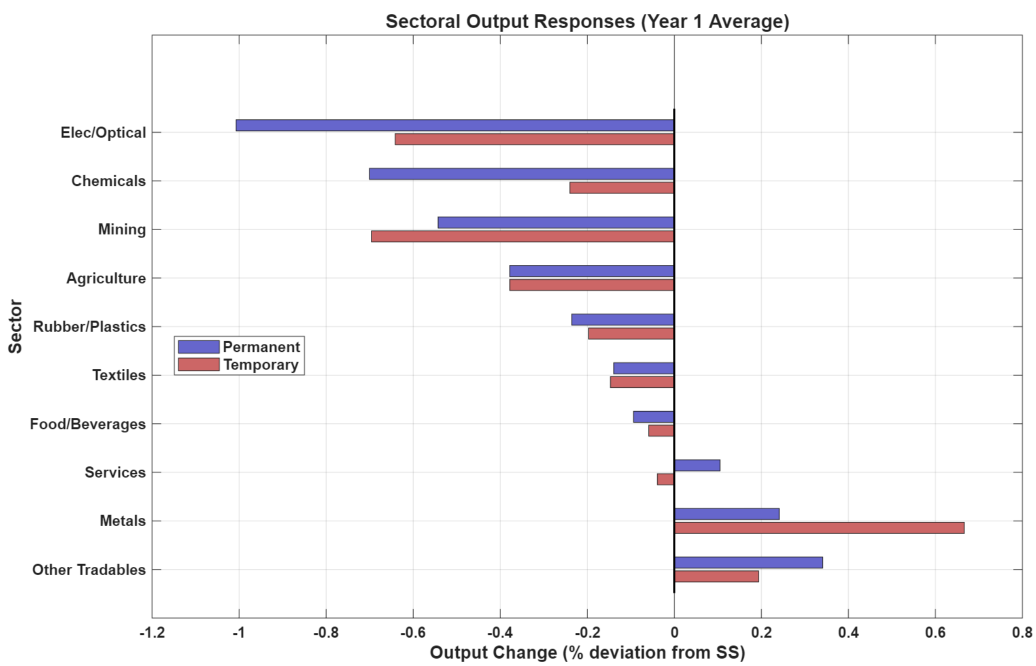

Figure 7: Sectoral output responses in Colombia: First-year average deviations from steady state

The sectoral output dynamics reveal substantial heterogeneity in adjustment patterns across industries, with policy permanence fundamentally altering both the magnitude and persistence of sectoral reallocation. Figure 7 illustrates the first-year average responses, while the scatter plot in Figure 8 and dynamic paths in Figure 9 provide deeper insights into the differential impacts across regimes. Critically, these adjustments must be understood in the context of Colombia's export structure, where Mining dominates trade flows to all major destinations, accounting for $8.5 billion to the U.S., $1.2 billion to China, and $15.8 billion to the rest of the world in 2024.

The Mining sector, representing Colombia's largest export category across all destinations, exhibits a unique adjustment pattern that drives much of the aggregate trade response. Under temporary conditions, mining output contracts modestly (-0.4%), but permanent implementation triggers substantial expansion reaching 1.5% by quarter 24. This asymmetric response is particularly consequential given mining's dominant position in Colombia's export portfolio, especially to ROW markets where it represents over 60% of total exports. The sector's capital-intensive nature means firms expand production capacity only when assured of sustained preferential access, explaining the dramatic divergence between temporary and permanent regimes.

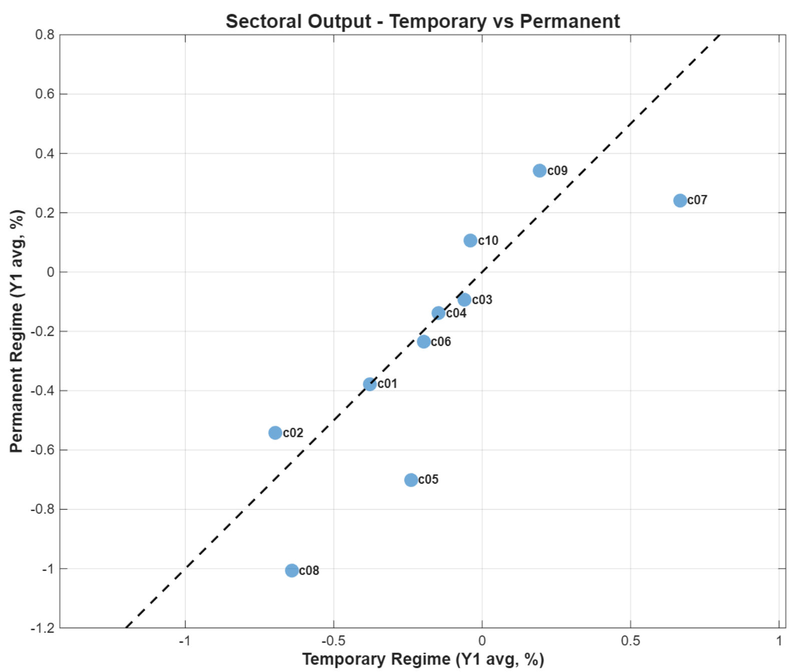

Figure 8: Comparing sectoral output responses: Temporary vs. permanent regimes

The agriculture sector, Colombia's second-largest export category with $4.4 billion to the U.S. and $3.7 billion to ROW, faces persistent challenges under both regimes. Agriculture contracts under both scenarios but more severely under permanent implementation (-0.3% versus -0.1%), while the closely linked Food/Beverages sector shows similar patterns. This is particularly concerning as these sectors represent nearly 20% of Colombia's non-mining exports to the United States. The inability of these traditional export sectors to benefit from improved market access suggests structural competitiveness challenges that intensify with permanent trade reorientation.

The manufacturing sector exhibits a marked divergence based on its trade orientation. Metals and related industries, accounting for \$0.9 billion in U.S. exports and significant shares in other markets, experience a dramatic reversal from -0.8% under temporary to +0.25% under permanent implementation. In contrast, import-competing sectors like Electrical/Optical and Chemicals face deep contractions of approximately 0.7% under both regimes. The Textiles sector, despite its modest export values, shows interesting dynamics with less severe contraction under permanent conditions, suggesting potential for gradual adjustment when policy certainty is assured.

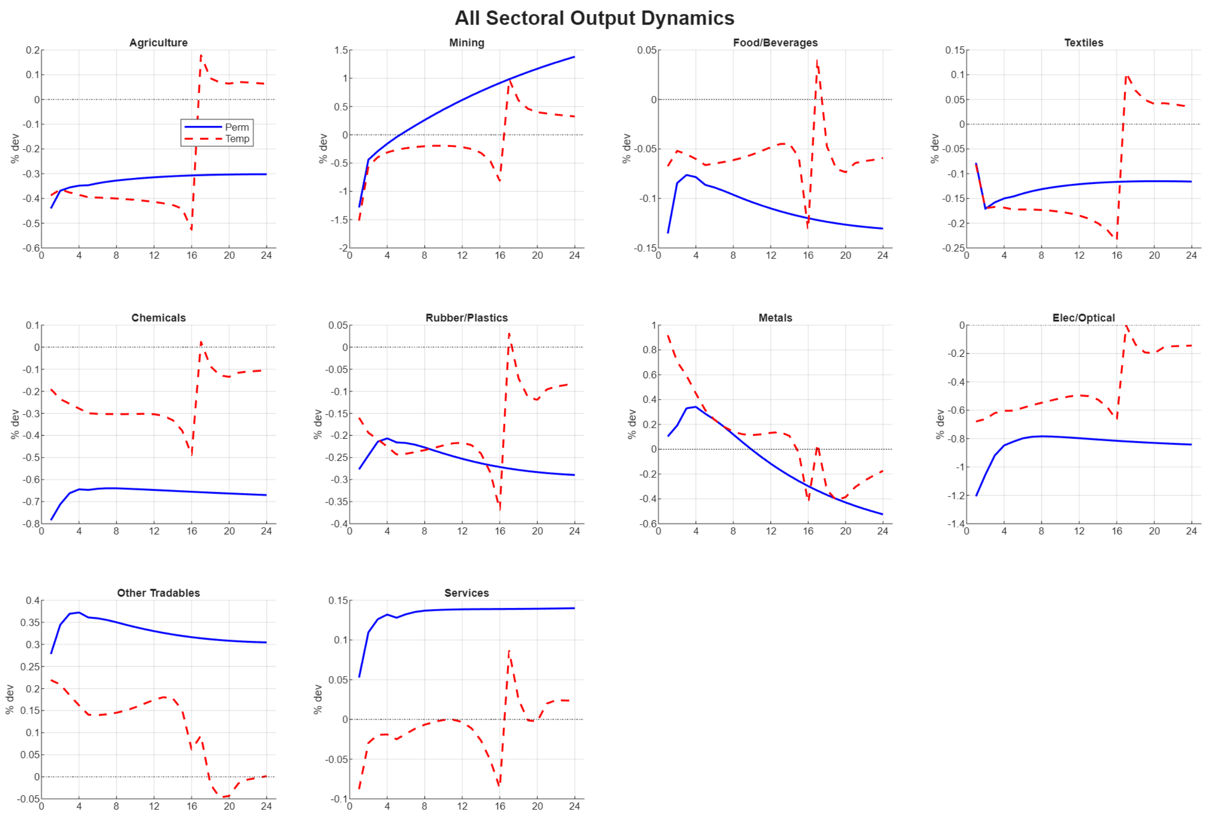

Figure 9: Dynamic sectoral output responses over 24 quarters

The "Other Tradables" category, which encompasses a diverse range of manufactured goods and represents Colombia's third-largest export segment to the U.S., demonstrates the clearest benefits from policy permanence. This sector contracts by 0.2% under temporary implementation but expands by 0.35% under permanent conditions. Given its role in export diversification beyond primary commodities, this differential response has important implications for Colombia's long-term development strategy.

The scatter plot analysis reveals systematic patterns: sectors positioned above the 45-degree line benefit from permanence, while those below face amplified adjustments. The weak correlation between temporary and permanent responses confirms that policy duration fundamentally reshapes sectoral comparative advantages rather than simply scaling effects. Notably, the sharp reversals at quarter 16 under temporary implementation impose substantial adjustment costs across all sectors without enabling the productive reallocation necessary for efficiency gains.

These sectoral patterns, when weighted by their actual importance in Colombia's export basket, explain the paradoxical aggregate results. While mining and select manufacturing sectors expand under permanent implementation, the collective struggles of agriculture and traditional industries—which together represent substantial export shares—generate mixed overall effects. The concentration of Colombia's exports in mining amplifies the importance of this sector's response, making the economy particularly sensitive to global commodity market conditions and the credibility of trade policy reforms.

4 Conclusion

We build and deploy a multisector, multicountry DSGE to quantify how the 2025 tariff reconfiguration—initiated by U.S. actions and met by Chinese retaliation—propagates through Colombia. Embedding global input–output linkages allows us to capture both bilateral shocks and higher-order general-equilibrium spillovers. The core result is dynamic: outcomes hinge on beliefs about policy persistence.

Colombia's concentrated export structure magnifies both upside and downside. Mining accounts for \$25.5 billion (52% of exports), with \$15.8 billion sold to the rest of the world (RoW), \$8.5 billion to the United States, and \$1.2 billion to China. Under permanent implementation, mining expands 27.6% in the U.S., generating outsized aggregate effects, while a simultaneous 13.5% decline in Chinese demand is muted by China's small share (7%). Agriculture—\$8.45 billion (17%)—underperforms across regimes despite improved U.S. access, indicating supply-side constraints rather than tariff frictions per se (Acemoglu et al., 2012; Gabaix, 2011; Baqaee and Farhi, 2019).

Nascent manufacturing gains are real but small in levels. Metals, Food/Beverages, and Other Tradables together represent 21% of exports and respond most positively when access is perceived permanent; for example, metals move from -0.8% (temporary) to $+0.25\%$ (permanent). Yet with less than \$1 billion each shipped to the U.S., these margins cannot offset mining volatility; minimal exposure to China limits direct retaliation but also caps diversification.

Policy duration changes the macro path, but commodity dependence caps the level effect. Permanent implementation raises long-run GDP by 0.146% versus a -0.069% contraction under temporary measures; employment shifts from -0.095% to $+0.064\%$, concentrated in mining and agriculture. The horizon-dependent asymmetry corroborates dynamic trade mechanisms in DSGE environments (Bouakez et al., 2014; Pasten et al., 2020).

Geography matters as much as sectors. RoW absorbs 60% of exports (\$29.5 billion). Under permanent implementation, an 8% fall in RoW sales—driven by factor reallocation toward the U.S.—implies roughly \$2.4 billion in losses, exceeding gains from improved U.S. access. China's direct share (4%, \$1.8 billion) is small, so retaliation operates mainly through value chains and commodity prices. The U.S., at 35% (\$17.3 billion), cannot absorb sufficient volume to offset third-market losses.

Policy. (i) Hedge and diversify destinations given heavy mining exposure to RoW. (ii) Scale nascent tradables that respond to persistent access via targeted industrial policy. (iii) Address agriculture's productivity, logistics, and SPS gaps to leverage preferences.

Methodological note. Sectoral resolution inside a DSGE uncovers mechanisms invisible in aggregates: a $2.2 billion mining swing between temporary and permanent regimes; negligible manufacturing exposure to China that dampens retaliation risk; and J-curve dynamics in external balances from forward-looking behavior interacting with IO networks and concentration.

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A The model

We develop a multisector, multicountry DSGE framework that embeds economies within a global network of trade and production linkages as captured by a multiregional input–output matrix. This structure ensures that sectoral shocks propagate endogenously across borders through both direct bilateral linkages and higher-order spillovers, preserving general-equilibrium consistency. A harmonized sectoral classification provides a common taxonomy across countries, allowing for a transparent mapping of external disturbances into sector-specific trade flows. The model is calibrated and solved for three benchmark economies—the United States, China, and Colombia—while also incorporating regional aggregates for Europe, Asia, and Latin America to capture trade diversion toward third markets. Within this integrated setting, the 2025 tariff reconfiguration between the United States and China is introduced directly into the global system, such that its effects are transmitted simultaneously across all regions and sectors. The framework, therefore, yields a coherent quantification of both the direct impact of altered bilateral trade flows and the indirect propagation through third markets, enabling a rigorous assessment of trade diversion, sectoral reallocation, and the aggregate responses of output, prices, employment, and external balances. Beyond its empirical application, the model contributes methodologically by extending the DSGE approach to a multisectoral, multipartner environment, thereby enriching the analysis well beyond representative-agent or aggregate settings. Unlike static CGE models, this framework explicitly captures short- and medium-term adjustment dynamics, allowing for the evaluation of transitional paths under shocks of varying duration and persistence. This provides a richer and more policy-relevant characterization of the macroeconomic consequences of global trade reconfigurations.

We study two persistence regimes for the tariff configuration: (i) temporary, lasting 16 quarters (consistent with the horizon of a single administration), and (ii) permanent, with indefinite duration. Contrasting these regimes highlights how horizon-dependent expectations shape Colombian sectoral dynamics and aggregate outcomes.

Relative to Bouakez et al. (2014) and Pasten et al. (2020), the model incorporates a complete import–export structure spanning intermediate inputs, final consumer goods, and capital goods; a disaggregated tax system on consumption, imports, and exports; capital as a production factor; Rotemberg-style price rigidities (Rotemberg, 1982) and labor-mobility frictions; and demand and supply features in the tradition of Christiano et al. (2005) and Smets and Wouters (2007)—including habit formation, investment adjustment costs, variable capital utilization, and endogenous capital depreciation.

A.1 Production and firms

Let $S^c \equiv \{c_{IM}^1, \ldots, c_{IM}^{n_c}\}$ denote the set of countries, and let $S \equiv \{s_1, \ldots, s_{N_S}\}$ denote the set of productive sectors. In each country $i \in S^c$, production is carried out by a continuum of firms indexed by $j \in (0, 1)$ within each sector $k \in S$. Firms within a given sector are identical in their technologies and produce differentiated varieties. Each firm faces a negatively sloped demand curve, where the slope depends on the elasticity of substitution across varieties, implying monopolistic competition within sectors. Sectors differ in their technologies, factor intensities, and nominal rigidities, while competing firms within a sector choose optimal input combinations given their production technologies.

The materials required for both production and investment are sourced both domestically and internationally. In particular, firm j in sector $k \in S$ of country $i \in S^c$ produces $y_{i,t}^{k,j}$ units of its differentiated variety according to

$$y_{i,t}^{k,j} = a_{i,t}\Big[\theta_{i,k}^{z}\left(Z_{i,t}^{k,j}\right)^{\alpha_{i,k}} + \left(1-\theta_{i,k}^{z}\right)\left(VA_{i,t}^{k,j}\right)^{\alpha_{i,k}}\Big]^{\frac{1}{\alpha_{i,k}}}, \tag{1}$$

where $a_{i,t}$ is an aggregate productivity shock common to all firms in country i, and $\alpha_{i,k}$ is a sector-specific parameter governing the share of materials relative to value added.

Value added is produced through a Cobb–Douglas function of effective capital and labor:

$$VA_{i,t}^{k,j} = a_{i,t}^{k}\Big(u_{i,t}^{k,j}K_{i,t-1}^{k,j}\Big)^{\beta_{i,k}}\Big(n_{i,t}^{k,j}\Big)^{1-\beta_{i,k}}, \tag{2}$$

where $a_{i,t}^{k}$ is a sector-specific productivity shock, $K_{i,t-1}^{k,j}$ is the firm-specific capital stock, $u_{i,t}^{k,j}$ is the capital utilization rate, and $n_{i,t}^{k,j}$ is labor input. The parameter $\beta_{i,k}$ measures the capital share in value added, with $\alpha_{i,k}, \beta_{i,k} > 0$ and $\alpha_{i,k} + \beta_{i,k} < 1$.

Finally, $Z_{i,t}^{k,j}$ is the Armington-type composite of intermediate materials, defined in Eqs. (3)–(8), which distinguishes energy and non-energy inputs, and aggregates domestic and imported varieties across sectors and countries.

$$Z_{i,t}^{k,j} = \left(\omega_{i,k,E}^{\frac{1}{\nu}}\left(E_{i,t}^{k,j}\right)^{1-\frac{1}{\nu}} + (1-\omega_{i,k,E})^{\frac{1}{\nu}}\left(NE_{i,t}^{k,j}\right)^{1-\frac{1}{\nu}}\right)^{\frac{\nu}{\nu-1}}, \tag{3}$$

where $Z_{i,t}^{k,j}$ denotes the composite bundle of materials employed in sector k of country i. The aggregator combines energy ($E_{i,t}^{k,j}$) and non-energy ($NE_{i,t}^{k,j}$) inputs with a substitution elasticity ν calibrated close to zero, reflecting the limited short-run substitutability between the two categories. The set of energy-related activities includes coal, refined petroleum, natural gas, and electricity, which are themselves treated as imperfect substitutes with elasticity η_E. Each sector further incorporates both imported and domestic varieties of materials.

This specification enables the model to capture, in a parsimonious manner, the differential role of energy and non-energy inputs in production. By maintaining a near-Leontief structure between these two categories, the framework preserves the rigidity observed empirically in energy use while still permitting substitution within each group. Crucially, this separation enhances the identification of tariff effects, since energy products were largely unaffected by the 2025 tariff changes, whereas non-energy goods were subject to significant adjustments. The structure, therefore, provides sharper insights into how trade shocks propagate through production chains and shape sectoral and aggregate outcomes.

Intermediate inputs in sector k of country i are aggregated following a nested Armington structure. Energy and non-energy composites are first defined as

$$E_{i,t}^{k,j} = \left(\sum_{k' \in S^E} \omega_{i,k,k'}^{\frac{1}{\eta_E}} Z_{i,t}^{k,j}(k')^{1-\frac{1}{\eta_E}} \right)^{\frac{\eta_E}{\eta_E - 1}}, \tag{4}$$

$$NE_{i,t}^{k,j} = \left(\sum_{k' \in S^{NE}} \omega_{i,k,k'}^{\frac{1}{\eta}} Z_{i,t}^{k,j}(k')^{1-\frac{1}{\eta}} \right)^{\frac{\eta}{\eta - 1}}, \tag{5}$$

where S^E and S^{NE} denote the sets of energy and non-energy activities, respectively. For each material k', domestic and imported varieties are combined as

$$Z_{i,t}^{k,j}(k') = \left(\omega_{i,k,k',DM}^{\frac{1}{\eta_k}} Z_{DM,i,t}^{k,j}(k')^{1-\frac{1}{\eta_k}} + \left(1 - \omega_{i,k,k',DM}\right)^{\frac{1}{\eta_k}} Z_{IM,i,t}^{k,j}(k')^{1-\frac{1}{\eta_k}} \right)^{\frac{\eta_k}{\eta_k - 1}}, \quad \forall k' \in S, \tag{6}$$

with imported inputs themselves aggregated across foreign regions as

$$Z_{IM,i,t}^{k,j}(k') = \left(\sum_{i' \in S^c} \omega_{i,k,i',k'}^{\frac{1}{\eta_{IM,k'}}} Z_{i',t}^{i,k,j}(k')^{1-\frac{1}{\eta_{IM,k'}}} \right)^{\frac{\eta_{IM,k'}}{\eta_{IM,k'} - 1}}, \quad \forall i' \in S^c, \tag{7}$$

where S^c denotes the set of foreign countries. At the most disaggregated level, imported and domestic varieties are CES composites of firm-level inputs:

$$Z_{i',t}^{i,k,j}(k') = \left(\int_0^1 Z_{i',t}^{i,k,j}(k', j')^{1-\frac{1}{\theta}} dj' \right)^{\frac{\theta}{\theta - 1}}, \quad \forall i, \tag{8}$$

where $Z_{i',t}^{i,k,j}(k')$ denotes the quantity of material from firm j' in sector k' of country i' used by firm j in sector k of country i. This structure applies symmetrically to domestic ($i = DM$) and foreign ($i \in S^c$) materials, and encompasses both energy and non-energy inputs ($E_{i,t}^{k,j}$ and $NE_{i,t}^{k,j}$).

The parameter η_{NE} is the elasticity of substitution across all non-energy materials, η_E is the elasticity of substitution across energy sectors, η_k is the elasticity of substitution between domestic and imported materials of sector k, and $\theta > 1$ is the elasticity of substitution across varieties produced by firms within a sector. The weights $\omega_{r,k,i,k'}$ satisfy $\sum_{k' \in S} \omega_{r,k,i,k'} = 1$, $\forall k \in S$, $\forall i \in S^c$, and differ across sectors, a key feature of the model. By construction, $\omega_{r,k,i,k'}$ equals the expenditure share of sector k' in country i in the total intermediate input expenditure of sector k in country r. Calibration of these parameters relies on the multiregional input–output matrix developed by ECLAC's *Global Input–Output Matrices: Tools to Facilitate the Study of Latin America's Integration with the World*. Hence, the input–output structure of the model replicates that of the selected group of countries.

The demand functions for materials and the associated composite price indices are reported in the appendix. For imported inputs, firms in country r solve the following cost-minimization problem:

$$\max_{\{Z_{i,i',t}^{k,j}(k')\}_{i' \in S^c}} \quad P_{IM_z,t}^{i,k,k'} Z_{IM,t}^{i,k,j}(k') - \sum_{i' \in S^c} \left(1 + \tau_{i,i',k'}\right) s_{i,i',t} P_{i',t}^{k'} Z_{i,i',t}^{k,j}(k'), \tag{9}$$

subject to

$$Z_{IM,t}^{r,k,j}(k') = \left(\sum_{i \in S^c} \omega_{r,k,i,k'}^{\frac{1}{\eta_{IM,k'}}} \left(Z_{r,i,t}^{k,j}(k') \right)^{1-\frac{1}{\eta_{IM,k'}}} \right)^{\frac{\eta_{IM,k'}}{\eta_{IM,k'}-1}}. \tag{10}$$

Here, $s_{r,i,t}$ is the nominal exchange rate between countries r and i, while $\tau_{r,i,k'}$ denotes the tariff imposed by r on imports from i in sector k'. [1] The structure thus embeds tariffs and exchange rates directly into the demand for imported intermediates.

The demand for investment goods thus links capital accumulation to the production structure, as firms' future productive capacity depends not only on current value added and intermediate inputs, as well as on the composition and sourcing of materials embodied in the investment. This connection ensures that trade shocks and policy changes affect production both contemporaneously, through intermediate inputs, and intertemporally, through capital accumulation.

A.2 Investment

The capital stock of each firm $j \in (0, 1)$ in sector $k \in S$ of country $i \in S^c$ is firm-owned and evolves according to

$$K_{i,t}^{k,j} = (1 - \delta(u_{i,t}^{k,j}))K_{i,t-1}^{k,j} + I_{i,t}^{k,j} - \frac{\Psi_{x,k}}{2} \left(\frac{I_{i,t}^{k,j}}{K_{i,t-1}^{k,j}} - \delta_i \right)^2 K_{i,t-1}^{k,j} \tag{11}$$

where $\delta(u_{i,t}^{k,j})$ is the depreciation rate, which depends positively on the intensity of capital utilization $u_{i,t}^{k,j}$, and $I_{i,t}^{k,j}$ is firm j's demand for the aggregate investment good $X_{i,t}$. The adjustment cost function $S(\cdot)$ ensures that rapid changes in investment are costly.

The aggregate investment good is a CES composite of energy and non-energy materials:

$$X_{i,t} = \left[\mu_{X,i,E}^{\frac{1}{\nu}} \left(E_{i,t}^X \right)^{1-\frac{1}{\nu}} + \left(1 - \mu_{X,i,E} \right)^{\frac{1}{\nu}} \left(NE_{i,t}^X \right)^{1-\frac{1}{\nu}} \right]^{\frac{\nu}{\nu-1}}, \tag{12}$$

where $E_{i,t}^X$ and $NE_{i,t}^X$ are the energy and non-energy components, respectively. These are themselves CES composites:

$$E_{i,t}^X = \left(\sum_{k' \in S^E} \mu_{X,i,k'}^{\frac{1}{\eta_E}} \left(X_{i,t}^{k'} \right)^{1-\frac{1}{\eta_E}} \right)^{\frac{\eta_E}{\eta_E-1}}, \tag{13}$$

$$NE_{i,t}^X = \left(\sum_{k' \in S^{NE}} \mu_{X,i,k'}^{\frac{1}{\eta_{NE}}} \left(X_{i,t}^{k'} \right)^{1-\frac{1}{\eta_{NE}}} \right)^{\frac{\eta_{NE}}{\eta_{NE}-1}}. \tag{14}$$

[1] Tariff revenues are rebated to households and firms via lump-sum transfers, Eq. (37), maintaining government budget balance.

For each sector k, the investment composite combines domestic and imported varieties:

$$X_{i,t}^{k}=\left[\mu_{X,DM,i,k}^{\frac{1}{\eta_k}}\left(X_{DM,t}^{i,k}\right)^{1-\frac{1}{\eta_k}}+\left(1-\mu_{X,DM,i,k}\right)^{\frac{1}{\eta_k}}\left(X_{IM,t}^{i,k}\right)^{1-\frac{1}{\eta_k}}\right]^{\frac{\eta_k}{\eta_k-1}}, \tag{15}$$

where $X_{DM,t}^{i,k}$ and $X_{IM,t}^{i,k}$ denote the domestic and imported investment goods, respectively.

Imported investment goods are CES composites of varieties sourced from all foreign partners $i' \neq i$:

$$X_{IM,t}^{i,k}=\left(\sum_{i'\in S^c,\, i'\neq i}\mu_{X,i,i',k}^{\frac{1}{\eta_{IM,k}}}\left(X_{i',t}^{i,k}\right)^{1-\frac{1}{\eta_{IM,k}}}\right)^{\frac{\eta_{IM,k}}{\eta_{IM,k}-1}}, \tag{16}$$

with

$$X_{i',t}^{i,k}=\left(\int_0^1\left(X_{i',t}^{i,k,j}\right)^{1-\frac{1}{\theta}}dj\right)^{\frac{\theta}{\theta-1}}, \quad i'\in S^c, \tag{17}$$

where $X_{i',t}^{i,k,j}$ is the demand for investment goods produced by firm j in sector k of country i' by country i. The weights $\mu_{X,i,i',k}$ satisfy $\sum_{i'\in S^c, i'\neq i}\mu_{X,i,i',k}=1$.

Finally, equilibrium in the investment goods market requires that total demand across all sectors and firms in country i equals aggregate supply:

$$X_{i,t}=\int_0^1\sum_{k\in S}I_{i,t}^{k,j}dj. \tag{18}$$

As in the case of intermediate materials, the detailed demand functions for materials used in investment and their composite price indices are reported in the appendix.

This formulation highlights the role of input composition in shaping investment dynamics. By distinguishing between energy and non-energy materials in the construction of the investment good, the model allows for heterogeneous transmission of trade shocks depending on their sectoral incidence. In particular, the low substitutability between energy and non-energy inputs implies that tariff-induced adjustments are primarily absorbed through the non-energy component, as energy products remain relatively insulated from tariff changes. The domestic–import decomposition further captures the extent of trade diversion across partners, while the adjustment cost on investment ensures smooth capital accumulation dynamics. Together, these features provide a richer characterization of how tariff shocks propagate into investment, capital accumulation, and ultimately, long-run productive capacity.

A.3 Firms

Firms face convex adjustment costs when changing either their labor input or the nominal price of their variety. The cost of adjusting labor for firm j in sector k of country i is given by

$$\Phi_{L,i,t}^{k,j}=\frac{\psi_L^k}{2}\left(\frac{n_{i,t}^{k,j}}{n_{i,t-1}^{k,j}}-1\right)^2, \quad \psi_L^k>0,\ \forall k\in S,\ \forall i\in S^c, \tag{19}$$

while the cost of adjusting nominal prices is

$$\Phi^{k,j}_{P,i,t} = \frac{\psi^k_P}{2}\left(\frac{P^{k,j}_{i,t}}{\pi_{i,ss}P^{k,j}_{i,t-1}} - 1\right)^2, \quad \psi^k_P \geq 0,\ \forall k \in S,\ \forall i \in S^c, \tag{20}$$

where $P^{k,j}_{i,t}$ is the price of the variety produced by firm j, $\pi_{i,ss}$ is steady-state inflation, and $\psi^k_P = 0$ implies fully flexible prices. All firms in a sector charge a single price across buyers, regardless of whether their output is used for final consumption, investment, or as an intermediate input, since the elasticity of demand is independent of use.

Given these frictions, firm j in sector k of country i solves

$$\max_{\{y^{k,j}_{i,t},\, n^{k,j}_{i,t},\, K^{k,j}_{i,t+1},\, Z^{k,j}_{i,t},\, I^{k,j}_{i,t},\, P^{k,j}_{i,t}\}} \quad \mathbb{E}_\tau \sum_{t=\tau}^{\infty} \beta_i^{t-\tau} \frac{\Lambda_{i,\tau}}{\Lambda_{i,t}} \frac{d^{k,j}_{i,t}}{P_{i,t}}, \tag{21}$$

subject to the production technologies (1)–(2), the aggregation of intermediate inputs (3)–(8), the capital accumulation law (11), and the demand constraint

$$y^{k,j}_{i,t} = c^{i,k,j}_{DM,t} + \sum_{k' \in S} \int_0^1 z^{i,k',j'}_{DM,t}(k,j)\, dj' + X^{i,k,j}_{DM,t} + \sum_{\substack{i' \in S^c \\ i' \neq i}} e^{i,k,j}_{i',t}, \tag{22}$$

where $\beta_i \in (0,1)$ is the intertemporal discount factor, $\Lambda_{i,t}$ is the marginal utility of wealth of households in country i, and $P_{i,t}$ is the aggregate consumption price index. Equation (22) states that demand for firm j's output arises from (i) household consumption $c^{i,k,j}_{DM,t}$, (ii) intermediate demand $z^{k',j'}_{i,t}(k,j)$ from firms in other sectors, (iii) investment demand $X^{i,k,j}_{DM,t}$, and (iv) exports $e^{i,k,j}_{i',t}$.

Nominal profits are defined as

$$\begin{aligned} d^{k,j}_{i,t} = {} & P^{k,j}_{i,t} y^{k,j}_{i,t} - W^{k,j}_{i,t} n^{k,j}_{i,t} - P^k_{Z,i,t} Z^{k,j}_{i,t} - P_{X,i,t} I^{k,j}_{i,t} \\ & - \Phi^{k,j}_{L,i,t} P^k_{i,t} y^k_{i,t} - \Phi^{k,j}_{P,i,t} P^k_{i,t} y^k_{i,t} + T^k_{i,t}, \end{aligned} \tag{23}$$

where $W^{k,j}_{i,t}$ is the nominal wage, $P^k_{Z,i,t}$ the price of intermediate inputs, $P_{X,i,t}$ the price of the investment good, and $T^k_{i,t}$ a sector-specific subsidy or transfer.

This formulation embeds labor and price adjustment frictions into the firms' optimization problem, ensuring that shocks affect production not only through factor and input costs, but also through dynamic margins of adjustment. As a result, tariffs, productivity shocks, or demand disturbances propagate to the macroeconomy via the combined effects on labor, investment, and pricing decisions at the firm level.

The optimization problem of firms thus determines supply-side behavior, linking production, pricing, and investment decisions to sectoral and aggregate outcomes. On the demand side, households determine consumption, savings, and labor supply, providing the counterpart to firms' decisions through product and factor markets. We now turn to the behavior of consumers, who play a central role in closing the model's general equilibrium by linking intertemporal preferences with the allocation of resources across goods, sectors, and countries.

A.4 Consumers

Each country is populated by a representative household that lives infinitely, with population size normalized to one. Households are identical and maximize intertemporal utility, which depends on habit-adjusted consumption, real money balances, and leisure. Formally, the representative household in country $i \in S^c$ chooses sequences of consumption, money holdings, and labor supply to solve

$$\max_{\{C_{i,t},M_{i,t},N_{i,t}\}} \mathbb{E}_\tau \sum_{t=\tau}^{\infty} \beta_i^{t-\tau} \left[\ln\left(C_{i,t} - b_i \bar{C}_{i,t-1}\right) + A_{i,m} \ln\left(\frac{M_{i,t}}{P_{i,t}}\right) + A_{i,n} \ln\left(1 - N_{i,t}\right) \right], \quad (24)$$

where $C_{i,t}$ is final consumption, $\bar{C}_{i,t-1}$ is lagged aggregate consumption capturing external habits, $M_{i,t}$ is nominal money holdings, $N_{i,t}$ is hours worked, and $P_{i,t}$ is the aggregate price index.

Final consumption is a CES composite of energy and non-energy goods:

$$C_{i,t} = \left[\omega_{C_E,i}^{\frac{1}{\nu}} (E_{i,t}^C)^{1-\frac{1}{\nu}} + (1-\omega_{C_E,i})^{\frac{1}{\nu}} (NE_{i,t}^C)^{1-\frac{1}{\nu}} \right]^{\frac{\nu}{\nu-1}}, \quad (25)$$

with

$$NE_{i,t}^C = \left(\sum_{k' \in S^{NE}} \omega_{C,i,k'}^{\frac{1}{\eta_{NE}}} \left(C_{i,t}^{k'}\right)^{1-\frac{1}{\eta_{NE}}} \right)^{\frac{\eta_{NE}}{\eta_{NE}-1}}, \quad (26)$$

$$E_{i,t}^C = \left(\sum_{k' \in S^{E}} \omega_{C,i,k'}^{\frac{1}{\eta_{E}}} \left(C_{i,t}^{k'}\right)^{1-\frac{1}{\eta_{E}}} \right)^{\frac{\eta_{E}}{\eta_{E}-1}}. \quad (27)$$

At the sectoral level, the composite of consumption in sector k combines domestic and imported varieties:

$$C_{i,t}^k = \left[\omega_{C,DM,i,k}^{\frac{1}{\eta_k}} (C_{DM,t}^{i,k})^{1-\frac{1}{\eta_k}} + (1-\omega_{C,DM,i,k})^{\frac{1}{\eta_k}} (C_{IM,t}^{i,k})^{1-\frac{1}{\eta_k}} \right]^{\frac{\eta_k}{\eta_k-1}}, \quad (28)$$

where imported goods are a CES composite of varieties sourced from foreign partners:

$$C_{IM,t}^{i,k} = \left(\sum_{\substack{i' \in S^c \\ i' \neq i}} \omega_{C,i,i',k}^{\frac{1}{\eta_{IM,k}}} \left(C_{i,t}^{i',k}\right)^{1-\frac{1}{\eta_{IM,k}}} \right)^{\frac{\eta_{IM,k}}{\eta_{IM,k}-1}}, \quad \forall k \in S, \quad (29)$$

with

$$C_{i,t}^{i',k} = \left(\int_0^1 \left(C_{i,t}^{i',k,j}\right)^{1-\frac{1}{\theta}} dj \right)^{\frac{\theta}{\theta-1}}, \quad i' \in S^c,\ i' \neq i, \quad (30)$$

where $C_{i,t}^{i',k,j}$ is the consumption of the variety produced by firm j in sector k of country i' by households in country i.

This nested structure ensures that consumption responds to trade shocks through both substitution across domestic and imported varieties and reallocation between energy and non-energy goods, capturing the key channels through which tariff changes and relative price shifts affect household welfare.

A.5 Labor

Aggregate labor supply in country i is a CES composite of hours worked across sectors,

$$N_{i,t} = \left(\sum_{k \in S} \mu_n^{i,k} \left(n_{i,t}^k \right)^{\frac{\xi+1}{\xi}} \right)^{\frac{\xi}{\xi+1}}, \quad \xi > 0, \tag{31}$$

where $n_{i,t}^k = \int_0^1 n_{i,t}^{k,j} dj$ is total hours in sector k, and $n_{i,t}^{k,j}$ denotes hours worked in firm j. This specification introduces imperfect labor mobility across sectors in a parsimonious way. When $\xi \to \infty$, labor is perfectly mobile and wages equalize across sectors. For finite ξ, mobility is limited, generating dispersion in hours and wages across sectors, consistent with Davis and Haltiwanger (1991).

A.6 Financial Assets and Budget Constraint

Households in each country hold money balances, one-period nominal bonds, and shares in sector-specific mutual funds. At the start of period t, the representative household in country i carries $M_{i,t-1}$ units of money, $B_{i,t-1}$ domestic bonds, $s_{i,t-1}^j$ shares in the mutual fund of sector j (priced at $a_{i,t}^{j,k}$), and foreign bonds $B_{i,t-1}^*$ denominated in foreign currency. Foreign bonds yield a gross return $R_{t-1}^* \Phi(a_{i,t-1}, \phi_i^e)$, where $\Phi(\cdot)$ is a risk premium[2]. The nominal exchange rate $s_{i,t}$ is defined as domestic currency per unit of foreign currency.

Household income consists of wages, mutual fund dividends $\text{div}_{i,t}^{k,j}$, bond returns, and lump-sum government transfers $\Gamma_{i,t}$. These resources finance consumption and asset accumulation subject to the dynamic budget constraint:

$$\begin{aligned}
&(1+\tau_{i,c}) \frac{P_{C,t}^i}{P_{i,t}} C_{i,t} + b_{i,t} + s_{i,t} \frac{P_{i,t}^*}{P_{i,t}} b_{i,t}^* + m_{i,t} + \sum_{k \in S} \int_0^1 \frac{a_{i,t}^{j,k} s_{i,t}^{j,k}}{P_{i,t}} dj \\
&= (1-\tau_{i,w}) \sum_{k \in S} \int_0^1 w_{i,t}^{j,k} n_{i,t}^{j,k} dj + \frac{R_{i,t-1} b_{i,t-1}}{\pi_{i,t}} + \frac{R_{i,t-1}^* \Phi(a_{i,t-1}, \phi_i^e)}{\pi_{i,t}^*} \frac{s_{i,t} P_{i,t}^*}{P_{i,t}} b_{i,t-1}^* \\
&\quad + \frac{m_{i,t-1}}{\pi_{i,t}} + (1-\tau_{i,K}) \sum_{k \in S} \int_0^1 \frac{\left(\text{div}_{i,t}^{k,j} + a_{i,t}^{j,k} \right) s_{t-1}^{j,k}}{P_t} dj + \frac{\Gamma_{i,t}}{P_{i,t}}.
\end{aligned} \tag{32}$$

Here, $\tau_{i,c}$, $\tau_{i,w}$, and $\tau_{i,K}$ denote consumption, income, and capital tax rates. Real variables are defined as $b_{i,t} = B_{i,t}/P_{i,t}$ (domestic bonds), $b_{i,t}^* = B_{i,t}^*/P_t^*$ (foreign bonds), and $m_{i,t} = M_{i,t}/P_{i,t}$ (money).

A.7 Household Optimality Conditions

Maximization of utility (24) subject to (31) and (32) yields standard first-order conditions. Consumption follows the Euler equation:

$$\left(C_{i,t} - b_i C_{i,t-1} \right)^{-1} = \beta_i \frac{R_{i,t}}{\pi_{C,i,t+1}} \left(C_{i,t+1} - b_i C_{i,t} \right)^{-1}, \tag{33}$$

[2]The term Φ is a premium that depends on the net foreign asset position of the domestic economy and guarantees a well-defined steady state. See Schmitt-Grohé and Uribe (2003) and Adolfson et al. (2007).

Real money demand is given by

$$m_{i,t} = A_{m,i}\frac{P^i_{C,t}}{P_{i,t}}\frac{(1+\tau_{i,c})(C_{i,t}-b_iC_{i,t-1})R_{i,t}}{R_{i,t}-1}, \tag{34}$$

and labor supply to firm j of sector k is

$$A_{n,i}\left(n^{k,j}_{i,t}\right)^{1/\xi} = \frac{(1-\tau_{i,w})(1-N_{i,t})(N_{i,t})^{1/\xi}}{(1+\tau_{i,c})(C_{i,t}-b_iC_{i,t-1})}w^k_t. \tag{35}$$

Finally, combining the Euler conditions for domestic and foreign bonds delivers the uncovered interest parity condition:

$$R_{i,t} = R^*_t\frac{s_{i,t+1}}{s_{i,t}}\Phi(a_{i,t},\phi^e_i), \tag{36}$$

which equates expected returns on domestic and foreign bonds, adjusted for exchange rate depreciation and country-specific risk premia.

This completes the description of household behavior. The following sections introduce the government and external sectors, which close the model by specifying fiscal policy, taxation, and international linkages.

A.8 Fiscal and Monetary Policy

The government in each country $i \in S^c$ consists of fiscal and monetary authorities. Fiscal policy is represented by periodic lump-sum transfers to households and firms, financed through money creation and the collection of distortionary taxes on consumption, labor income, capital income, and international trade flows. The government budget constraint is given by

$$\frac{\Gamma_{i,t}}{P_{i,t}} + \sum_{k'\in S}\frac{T^{k'}_{i,t}}{P_{i,t}} = \frac{m_{i,t}-m_{i,t-1}}{\pi_{i,t}} + \frac{\mathrm{Tax}_{i,t}}{P_{i,t}}, \tag{37}$$

where $\Gamma_{i,t}$ denotes lump-sum transfers to households, $T^{k'}_{i,t}$ sectoral transfers to firms, and $\mathrm{Tax}_{i,t}$ total tax revenues.

Total revenues are defined as

$$\begin{aligned}\mathrm{Tax}_{i,t} = {} & \tau_{i,c}P^i_{C,t}C_{i,t} + \tau_{i,w}\sum_{k\in S}\int_0^1 W^{j,k}_{i,t}n^{j,k}_{i,t}dj + \tau_{i,K}\sum_{k\in S}\int_0^1 d^{k,j}_{i,t}dj \\ & + \sum_{k\in S}\sum_{k'\in S}\sum_{\substack{i'\in S^c \\ i'\neq i}}(1+\tau_{i,i',k'})s_{i,i'}P^{k'}_{i,t}Z^{k,j}_{i,t}(k') \\ & + \sum_{k\in S}\sum_{\substack{i'\in S^c \\ i'\neq i}}(1+\tau_{i,i',k})s_{i,i'}P^k_{i,t}C^{k,j}_{i,t} + \sum_{k\in S}\sum_{\substack{i'\in S^c \\ i'\neq i}}(1+\tau_{i,i',k})s_{i,i'}P^k_{i,t}X^{k,j}_{i,t},\end{aligned} \tag{38}$$

where $\tau_{i,c}$, $\tau_{i,w}$, and $\tau_{i,K}$ are the tax rates on consumption, labor, and capital, respectively, while $\tau_{i,i',k}$ denotes tariffs applied to imports of good k from country i'.

Sectoral transfers are proportional to government net revenues net of household transfers:

$$\frac{T^k_{i,t}}{P_{i,t}} = \gamma_{i,k}\left(\frac{m_{i,t}-m_{i,t-1}}{\pi_{i,t}} + \frac{\text{Tax}_{i,t}}{P_{i,t}} - \frac{\Gamma_{i,t}}{P_{i,t}}\right), \quad \sum_{k'\in S}\gamma_{i,k'} = 1, \tag{39}$$

with $\gamma_{i,k} \in [0,1]$ denoting the share of revenues allocated to sector k.

A.9 Monetary Policy

Monetary policy follows a Taylor rule on the annual inflation gap and annual output growth to set the annual policy interest rate. For each region or country $i \in S^c$, define four-quarter gross inflation as $\Pi^{(4)}_{i,t} \equiv \pi_{i,t}\pi_{i,t-1}\pi_{i,t-2}\pi_{i,t-3}$. Denote steady-state quarterly gross inflation by $\bar{\pi}_i$ and steady-state gross trend growth by μ_t. Define the gaps:

$$\breve{\Pi}^{(4)}_{i,t} \equiv \frac{\pi^{(4)}_{i,t}}{\bar{\pi}_i^4}, \qquad \breve{y}^{(4)}_{i,t} \equiv \frac{\Pi^3_{j=0}\left(\frac{GDP_{i,t-j}}{GDP_{i,t-j-1}}\right)}{1+\mu_t}.$$

Let $s_{i,t}$ be the nominal FX rate (domestic per RoW currency) and $R^{\text{an}}_{i,t}$ the gross annualized policy rate. The multiplicative Taylor rule is

$$R^{\text{an}}_{i,t} = \left(R^{\text{an}}_{i,t-1}\right)^{\rho_i}\left[(R^{\text{ss}}_i)^4\left(\breve{\Pi}^{(4)}_{i,t}\right)^{\phi_{\pi,i}}\left(\breve{y}^{(4)}_{i,t}\right)^{\phi_{y,i}}\left(\frac{s_{i,t}}{s_{i,t-1}}\right)^{\phi_{s,i}}\right]^{1-\rho_i}\exp(\varepsilon^{\mu}_{i,t}). \tag{40}$$

Where ρ_i is the weight of the interest rate in previous periods, $\phi_{\pi,i}$ is the weight of the inflation gap, $\phi_{y,i}$ the weight of the GDP growth gap, and $\phi_{s,i}$ the weight on the real exchange rate. $\varepsilon^{\mu}_{i,t}$ is a shock that deviates monetary policy from its rule.

A.10 Market Clearing and Value-Added

In equilibrium, net private bond holdings vanish due to household symmetry, and shares of sectoral mutual funds sum to one. Identical firms within each sector imply

$$P^{k,j}_{i,t} = P^k_{i,t}, \quad C^{k,j}_{i,t} = C^k_{i,t}, \quad n^{k,j}_{i,t} = n^k_{i,t}, \quad d^{k,j}_{i,t} = d^k_{i,t}.$$

Aggregate demand for the output of sector k in country i is therefore

$$y^k_{i,t} = C^{i,k}_{DM,t} + X^{i,k}_{DM,t} + \sum_{k'\in S} z^{i,k'}_{DM,t}(k) + \sum_{\substack{i'\in S^c \\ i'\neq i}} e^{i,k}_{i',t} + \Phi^k_{i,t}, \tag{41}$$

where $\Phi^k_{i,t}$ denotes sectoral adjustment costs.

Finally, sectoral value added is defined as

$$V^k_{i,t} = P^k_{i,t}y^k_{i,t} - P^{i,k}_{Z,t}Z^k_{i,t}, \tag{42}$$

i.e., gross production net of intermediate input costs.

A.11 Balance of Payments

One element of S^c is the *Rest of the World* (RoW, denoted by $*$), which provides the numéraire currency. Each country $i \in S^c$ trades with all other countries $j \in S^c$, $j \neq i$, including RoW, and accumulates net foreign assets (NFA) denominated in $*$.

The balance of payments condition is specified as

$$b^*_{i,t} \;=\; \frac{R^*_{t-1}\,\Phi(a_{i,t-1})}{\pi^*_t}\, b^*_{i,t-1} \;+\; NX_{i,t}, \tag{43}$$

where R^*_{t-1} is the gross world interest rate, π^*_t is the world inflation, and $\Phi(a_{i,t-1})$ is a country-specific risk premium that depends on its relative external position. Net exports are defined as the difference between total exports and imports across all partners,

$$NX_{i,t} \equiv \sum_{j\in S^c,\, j\neq i} \left(EXP_{i\to j,t} - IMP_{i\leftarrow j,t}\right). \tag{44}$$

Expressed in domestic currency, the condition takes the form

$$IMP_{i,t} + \hat{s}_{i,t} b^*_{i,t} \;=\; EXP_{i,t} + \frac{R^*_{t-1}\,\Phi(a_{i,t-1})}{\pi^*_t}\, \hat{s}_{i,t} b^*_{i,t-1}, \tag{45}$$

where $\hat{s}_{i,t}$ denotes the real exchange rate relative to RoW, and the trade balance is

$$TB_{i,t} \equiv EXP_{i,t} - IMP_{i,t}. \tag{46}$$

This formulation allows for bilateral trade imbalances at the country level while ensuring global consistency through the restrictions

$$\sum_{i\in S^c} NX_{i,t} = 0, \qquad \sum_{i\in S^c} b^*_{i,t} = 0, \tag{47}$$

which guarantees that world exports equal world imports and that the net supply of the international bond is zero. The foreign interest rate R^*_t, which coincides with the interest rate of the Rest of the World region, adjusts to ensure that the net supply of international bonds is zero every period.

B Calibration and data

B.1 Input–Output Matrices and Geographic Aggregation

The calibration of the model relies on a ten-block geographic aggregation that strikes a balance between analytical precision and computational tractability. Three economies are treated individually: the United States (USA), Colombia (COL), and China (CHN). The tariff shock originates in the USA; Colombia is the focus economy, and China faces the steepest duties—up to 145 percent—driving the most substantial trade diversion effects across global value chains (GVCs). Isolating these three prevents the dilution of extreme tariff peaks and preserves the key heterogeneity shaping firms' relocation incentives.

The second tier separates USMCA (Mexico and Canada) and EU–UK (European Union and United Kingdom). Both groups enjoy deep trade links or preferential access to the U.S. market; modeling them individually captures intra–North American reallocation and cross-price effects that are transmitted to Colombia through intermediate inputs. Mercosur+ (Argentina, Brazil, Paraguay, Uruguay) and the Andean–Pacific South block (Chile, Peru, Ecuador, Bolivia, Venezuela) are grouped separately, given their tariff profiles and specialization in agribusiness and natural-resource processing, making them Colombia's closest regional competitors.

Finally, two Asian poles are distinguished. The OECD–Asia (comprising Japan, Korea, and Australia) represents advanced economies with stable tariffs and high-tech supply chains, which are relevant for substitution in skill-intensive manufacturing. Extended ASEAN (Thailand, Malaysia, Indonesia, Philippines, Singapore, Brunei, Cambodia, Laos, Vietnam) acts as an "alternative to China in GVCs," increasingly attracting FDI and intermediate production in electronics and textiles. The residual category ROW (Other Asia and Rest of World) ensures global closure. This ten-block partition preserves over 95 percent of Colombia's relevant bilateral trade, minimizes intra-group tariff variance, and maintains computational tractability.

Table 5: Geographic Aggregation and Rationale

Block	Countries (codes)	Rationale
1 USA	USA	Country imposing tariff shock
2 COL	COL	Focus economy
3 CHN	PRC	Largest tariff increase (∼145%)
4 USMCA	MEX, CAN	Preferential partners of the USA
5 EU–UK	EU28, UKG	Mid-range tariffs (7–24%)
6 MERCOSUR	ARG, BRA, PAR, URY	High tariffs in metals and autos
7 ANDIN	VEN, CHL, BOL, ECU, PER	Regional competitors, agribusiness
8 OECD–Asia	JPN, KOR, AUS	High-tech content, tariffs ∼10–22%
9 ASEAN	THA, MAL, INO, PHI, SIN, BRU, CAM, LAO, VIE	Alternative to China in GVCs
10 ROW	OAS, ROW	Model closure

The benchmark input–output (I–O) structure is provided by ECLAC's *Global Input–Output Matrices: Tools to Facilitate the Study of Latin America's Integration with the World* (2017), aggregated consistently into the ten regions above.[3]

[3]Comisión Económica para América Latina y el Caribe (ECLAC/CEPAL), 2017. "Global Input–Output Matrices: Tools to Facilitate the Study of Latin America's Integration with the World." Available at: `https://www.cepal.org/en/events/global-input-output-matrices-tools-facilitate-study-latin-americas-integration-world`.The most recent ECLAC multi-regional I-O matrices available for Colombia are from 2017. Updating these matrices would require comprehensive data collection across all trading partners and sectors, which is beyond our scope. This timing mismatch is common in applied DSGE work (e.g., Baqaee and Farhi, 2019, use 2007 I-O tables for analyses extending into the 2010s). Our approach—using 2017 for structural calibration but 2024 for trade exposures—follows best practice when detailed structural data lag current

By construction, the steady-state weights $\omega_{(k,i,k')}$ of the demand functions coincide with the observed expenditure shares in the I–O table, ensuring that the model replicates the base-year input–output structure of the calibration economy. In a steady state, relative prices equal one, and the weights can be directly recovered from the demand system. Using firms' first-order conditions together with national accounts data on labor remuneration and gross operating surplus, we calibrate sector-specific capital shares $\beta_{(i,k)}$ in the production function. This guarantees consistency between the theoretical structure and the empirical I–O matrix, providing a solid basis for the quantitative simulations.

For the calibration of the Armington elasticities, see appendix C. The construction of Sector-Country Rotemberg Price Adjustment Costs is in appendix D, while the Monetary Policy Rule parameters are in appendix E. The labor adjustment cost and investment adjustment cost are in appendices F and G. In the current simulation, we use the baseline of 4.5 for labor adjustment costs and 6.5 for the investment adjustment costs. For the risk premium parameter, we used the standard value of 0.001 for all countries, except for Colombia, for which we used 0.01, as the risk premium responds more to changes in emerging markets. The habit persistence parameter is set to 0.75 for all regions. We solve the model using Dynare Adjemian et al. (2024). We perform a perfect foresight simulation in which we introduce the change in tariff from U.S. to all regions and the retaliation from China to U.S.[4]

C Armington Elasticities Calibration

The nested CES Armington structure requires calibration of two sets of substitution elasticities: the upper-tier elasticity between domestic and composite imports (η_k), and the lower-tier elasticity across import sources ($\eta_{IM,k}$). Our calibration follows the empirical literature documenting systematic patterns across sectors and countries.

C.1 Empirical Foundations

The calibration builds on three well-established empirical regularities. First, micro elasticities (substitution across import sources) systematically exceed macro elasticities (substitution between home and imports). Feenstra et al. (2018) document median micro elasticities of 4.4 versus macro elasticities near 1.0 using disaggregated U.S. data, a pattern confirmed across multiple countries including China (Li et al., 2021) and Colombia (Flórez Bustamante and Ramírez Gallego, 2016).

Second, sectoral heterogeneity follows a consistent ordering: homogeneous commodities (agriculture, mining) exhibit higher substitutability than differentiated manufactures (chemicals, electrical equipment), which in turn exceed services (Ahmad et al., 2021). This pattern reflects product differentiation, regulatory barriers, and tradability constraints that vary systematically across sectors.

Third, the operational "rule-of-two" ($\eta_{IM,ci} \approx 2\eta_{ci}$), originating in the SALTER/ORANI model family (Jomini et al., 1991) and adopted in GTAP applications (Hertel and van der

conditions.

[4]The model was solved using perfect foresight methods in Dynare. The linearized system satisfies the Blanchard-Kahn conditions for saddle-path stability.

Mensbrugghe, 2019), provides a conservative yet empirically consistent approximation when sector-specific micro estimates are unavailable.

C.2 Baseline Calibration

Table 6 presents our baseline calibration across ten sectors for the United States, Colombia, and China. The values reflect the empirical ordering while maintaining cross-country comparability for sectoral analysis.

For Colombia, the calibration incorporates country-specific econometric evidence from Flórez Bustamante and Ramírez Gallego (2016), which reports long-run elasticities ranging from 0.34 (beverages) to 5.89 (sugar) using ARDL/VEC methods. The baseline values capture this heterogeneity while maintaining consistency with global patterns. Mining and agriculture show higher elasticities (3.5 and 2.5 respectively), reflecting Colombia's commodity export orientation, while differentiated manufactures and services exhibit lower values consistent with limited industrial development.

Table 6: Baseline Armington Elasticities by Country and Sector

	United States		Colombia		China	
Sector	η_{ci}	$\eta_{IM,ci}$	η_{ci}	$\eta_{IM,ci}$	η_{ci}	$\eta_{IM,ci}$
c01 Agriculture	3.0	6.0	2.5	5.0	3.0	6.0
c02 Mining	4.0	8.0	3.5	7.0	3.5	7.0
c03 Food/Beverages	1.5	3.0	1.2	2.4	1.3	2.6
c04 Textiles	2.5	5.0	2.0	4.0	2.5	5.0
c05 Chemicals	1.5	3.0	1.4	2.8	1.6	3.2
c06 Rubber/Plastics	1.5	3.0	1.4	2.8	1.5	3.0
c07 Metals	3.0	6.0	2.5	5.0	2.8	5.6
c08 Elec/Optical	1.2	2.4	1.0	2.0	1.2	2.4
c09 Other Tradables	1.6	3.2	1.5	3.0	1.6	3.2
c10 Services	0.8	1.6	0.8	1.6	0.8	1.6

Note: η_{ci} denotes domestic-import substitution elasticity; $\eta_{IM,ci}$ denotes across-import substitution elasticity.

C.3 Robustness and Sensitivity

Given the empirical uncertainty surrounding Armington elasticities, we need to conduct systematic sensitivity analysis with $\pm 25\%$ and $\pm 50\%$ variations around baseline values. This is particularly important for services (c10), where low tradability and measurement issues generate substantial parameter uncertainty. Additionally, we will test alternative specifications where the rule-of-two is relaxed to allow $\eta_{IM,ci} \in [1.5\eta_{ci}, 3\eta_{ci}]$, encompassing the range of empirical estimates while maintaining the fundamental ordering constraint.

The calibration strategy balances three objectives: consistency with micro-level evidence on substitution patterns, incorporation of country-specific estimates where available, and maintenance of cross-country comparability for policy analysis. This approach ensures that the model captures both the structural differences across sectors and the institutional variations across countries that shape trade responses to tariff shocks.

D Constructing Sector–Country Rotemberg Price Adjustment Costs (with Trend Inflation)

D.1 Objective and Overview

This appendix documents the procedure used to calibrate *Rotemberg* (1982) quadratic price adjustment costs, $\varphi_{c,s}$, by country c and sector s for a quarterly, multisector, multi-country New Keynesian model. The core idea is to (i) take sectoral price-change *durations* from the micro-price literature, (ii) translate those into a Calvo (Calvo, 1983) "no re-optimization" parameter that delivers an identical New Keynesian Phillips Curve (NKPC) slope, and (iii) map that NKPC slope to the Rotemberg parameter using the Calvo–Rotemberg equivalence under standard assumptions (see Woodford, 2003; Galí, 2015). Here we incorporate a nonzero steady-state inflation rate.

We adopt a standard Dixit–Stiglitz environment with monopolistic competition, no indexation, and no real rigidities. We allow for a constant (gross) trend inflation factor $1 + \pi^*$ in steady state. Under these assumptions, the mapping between the Calvo slope and the Rotemberg cost is exact in the log-linear NKPC up to a deterministic scaling by $(1 + \pi^*)$ discussed below (Woodford, 2003; Galí, 2015).

Step 1. Sectoral Price Durations from the Literature

We compile sectoral price-change frequencies/durations from established micro-price studies. For the U.S., Bils and Klenow (2004) and Nakamura and Steinsson (2008, 2012) document substantial heterogeneity: energy and some food items are flexible (high frequency), while services and complex durables are rigid (low frequency). For the euro area, the ECB IPN documents broadly similar patterns (Dhyne et al., 2006). For Colombia, micro CPI studies by the Banco de la República provide analogous evidence (e.g., Julio and Zárate, 2008; Julio et al., 2011). For China, available CPI/PPI micro-evidence indicates relatively high rigidity in services and greater flexibility in energy and some food items, consistent with international patterns.

Let $D^{(m)}_{c,s}$ denote the *monthly* expected duration from the literature (or internal microdata). To harmonize with a quarterly model, we convert to quarters and enforce a minimum of one quarter:

$$D_{c,s} \;=\; \max\left\{1,\; \frac{D^{(m)}_{c,s}}{3}\right\}. \tag{48}$$

If the empirical duration is shorter than a quarter (e.g., energy), prices are effectively *flexible* at the quarterly horizon, which our truncation captures.

Step 2. From Durations to the Calvo Parameter

Under Calvo pricing, the expected duration in quarters is $1/(1-\alpha_{c,s})$. Hence,

$$\alpha_{c,s} \;=\; 1-\frac{1}{D_{c,s}}. \tag{49}$$

If $D_{c,s} = 1$, then $\alpha_{c,s} = 0$, i.e., prices reset each quarter (flexible prices at a quarterly resolution).

Step 3. Calvo NKPC Slope with Trend Inflation

With no indexation and a constant steady-state (gross) inflation factor $(1+\pi^*)$, the log-linear NKPC under Calvo pricing around the non-zero inflation steady state is

$$\pi_t \;=\; \beta\,\mathbb{E}_t[\pi_{t+1}] + \kappa_{c,s}^{\pi^*}\,\widehat{mc}_t, \qquad \kappa_{c,s}^{\pi^*} \;=\; \frac{(1-\alpha_{c,s})(1-\beta\,\alpha_{c,s})}{\alpha_{c,s}\,(1+\pi^*)}, \tag{50}$$

where $\widehat{mc}_t$ is the (log) real marginal cost deviation. The $(1+\pi^*)$ factor arises from log-linearization around a growing-price steady state and the scaling of reset-price deviations (see Woodford, 2003; Galí, 2015).[5]

Step 4. Rotemberg NKPC and Equivalence with Trend Inflation

Under Rotemberg quadratic costs, the NKPC is unchanged in form except for the evaluation around π^*:

$$\pi_t \;=\; \beta\,\mathbb{E}_t[\pi_{t+1}] \;+\; \underbrace{\frac{\varepsilon_{c,s}-1}{\varphi_{c,s}}}_{\kappa_{c,s}^{\mathrm{Rot}}}\,\widehat{mc}_t. \tag{51}$$

Equating (50) and (51) delivers the Calvo–Rotemberg equivalence under trend inflation:

$$\boxed{\varphi_{c,s} \;=\; \frac{\varepsilon_{c,s}-1}{\kappa_{c,s}^{\pi^*}} \;=\; \frac{(\varepsilon_{c,s}-1)\,\alpha_{c,s}\,(1+\pi^*)}{(1-\alpha_{c,s})(1-\beta\,\alpha_{c,s})}} \tag{52}$$

Given $(\beta, D_{c,s}, \varepsilon_{c,s}, \pi^*)$, Eq. (52) delivers $\varphi_{c,s}$ for each (c,s).

D.2 Implementation Details, Edge Cases, and Units

1. **Quarterly discount factor.** We set $\beta = 0.99$ at a quarterly frequency, consistent with the macro literature (Woodford, 2003; Galí, 2015).

2. **Steady-state inflation.** We assume an *annualized* 3% steady-state inflation, i.e., quarterly $\pi^* = 0.03/4 \approx 0.0075$ (gross factor $1+\pi^* \approx 1.0075$).

[5] Alternative derivations may feature slightly different multiplicative constants (e.g., $(1+\beta\pi^*)$) depending on the precise normalization of prices and the definition of inflation (gross vs. net). Our implementation adopts the $(1+\pi^*)$ scaling, which is a standard and transparent approximation for small trend inflation.

3. **Durations shorter than one quarter.** When $D^{(m)}_{c,s} < 3$, we set $D_{c,s} = 1$ in (48), implying $\alpha_{c,s} = 0$ and $\kappa^{\pi^*}_{c,s} \to \infty$, so $\varphi_{c,s} \to 0$ in (52). Numerically, we implement a tiny positive α solely to avoid division by zero; the resulting $\varphi_{c,s}$ is effectively zero.

4. **Elasticities by sector and country.** The user-provided elasticities (originally denoted as `theta_COUNTRY_cXX`) are taken as $\varepsilon_{c,s}$. These imply markups $\mu_{c,s} = \varepsilon_{c,s}/(\varepsilon_{c,s} - 1)$ and allow the NKPC slope to differ across sectors even for identical durations.

5. **Units.** Under the usual normalization of the Rotemberg cost function, $\varphi_{c,s}$ is dimensionless. Larger $\varphi_{c,s}$ implies higher price rigidity (a smaller NKPC slope), holding $\varepsilon_{c,s}$ fixed.

D.3 Calibrated Rotemberg Parameters (Quarterly, $\pi^* = 3\%$ annualized)

Table 7 reports the calibrated Rotemberg parameters $\varphi_{c,s}$ by sector and country using $\beta = 0.99$, sectoral durations mapped to quarterly frequency with a minimum of one quarter, sector–country elasticities $\varepsilon_{c,s}$ provided by the user, and steady-state inflation $\pi^* = 3\%$ annualized.

Table 7: Rotemberg Parameters $\varphi_{c,s}$ by Sector and Country (Quarterly Model, $\pi^* = 3\%$ annualized)

Sector	USA	COL	CHN	ROW
c01 Agriculture, hunting, forestry, and fishing	0.00	2.93	4.02	1.56
c02 Mining and quarrying	0.00	0.00	0.00	0.00
c03 Food, beverages, and tobacco	1.17	3.57	6.01	2.68
c04 Textiles and textile products	0.00	0.00	3.32	0.00
c05 Chemicals and chemical products	5.56	11.97	20.14	9.98
c06 Rubber and plastics	11.97	30.93	30.93	15.10
c07 Basic metals and fabricated metal	12.21	30.21	15.96	9.98
c08 Electrical and optical equipment	22.02	30.84	65.19	35.56
c09 Other tradables	5.56	9.16	15.96	7.63
c10 Services	47.98	38.29	58.69	47.98

Notes: Values are dimensionless Rotemberg parameters calibrated to match the NKPC slope of a Calvo model with quarterly discount factor $\beta = 0.99$, sectoral durations converted from monthly to quarterly with a minimum of one quarter (prices effectively flexible within-quarter), sector–country elasticities $\varepsilon_{c,s}$ provided by the user, and steady-state inflation of 3% annualized ($\pi^* = 0.03/4$ per quarter). Larger $\varphi_{c,s}$ indicates greater price rigidity.

D.4 Algorithm (Pseudo-code)

1. Input: β, sector–country monthly durations $D^{(m)}_{c,s}$, elasticities $\varepsilon_{c,s}$, and steady-state inflation π^*.

2. Convert to quarters: $D_{c,s} \leftarrow \max\{1, D_{c,s}^{(m)}/3\}$.
3. Compute Calvo parameter: $\alpha_{c,s} \leftarrow 1 - 1/D_{c,s}$ (if $\alpha_{c,s} = 0$, set a tiny positive value for numerical stability).
4. NKPC slope: $\kappa_{c,s}^{\pi^*} \leftarrow \frac{(1-\alpha_{c,s})(1-\beta\,\alpha_{c,s})}{\alpha_{c,s}\,(1+\pi^*)}$.
5. Rotemberg parameter: $\varphi_{c,s} \leftarrow \dfrac{\varepsilon_{c,s} - 1}{\kappa_{c,s}^{\pi^*}}$.

Discussion and Robustness

Trend inflation. The $(1+\pi^*)$ scaling is a parsimonious way to incorporate non-zero steady-state inflation in the NKPC. For small π^* (e.g., 3% annualized), the quantitative effect is modest but non-negligible. Alternative normalizations (e.g., $(1 + \beta\pi^*)$) can be adopted with minimal changes and would rescale $\varphi_{c,s}$ proportionally.

Sensitivity to $\varepsilon_{c,s}$. From (52), $\varphi_{c,s}$ scales linearly with $(\varepsilon_{c,s} - 1)$. If independent evidence on sectoral markups is available, one can replace $\varepsilon_{c,s}$ accordingly.

Extensions. If real rigidities, indexation, or wage stickiness are introduced, $\kappa_{c,s}^{\pi^*}$ is rescaled by additional terms (Galí, 2015). In those cases, apply (52) using the *augmented* slope.

E Monetary Policy Rule Calibration

The monetary policy stance in each region follows a generalized Taylor rule that accounts for interest rate smoothing, inflation stabilization, output gap responses, and exchange rate management, as shoun in equation 40.

Table 8 reports the calibrated parameters, which reflect substantial heterogeneity in monetary frameworks across regions. The United States exhibits conventional inflation targeting with $\phi_{\pi,\mathrm{US}} = 1.50$ satisfying the Taylor principle, moderate output stabilization ($\phi_{y,\mathrm{US}} = 0.25$), and zero weight on exchange rates, following the post-Volcker consensus documented by Clarida et al. (2000). This calibration aligns with comparative studies of monetary models by Taylor and Wieland (2012), who find similar parameter ranges across multiple U.S. monetary policy specifications. China's calibration captures its multiple-objective framework with weaker inflation response ($\phi_{\pi,\mathrm{CHN}} = 1.25$), stronger output focus ($\phi_{y,\mathrm{CHN}} = 0.50$) reflecting explicit growth targets, and active exchange rate management ($\phi_{s,\mathrm{CHN}} = 0.15$), consistent with recent evidence from Zhang and Murasawa (2024) and the comprehensive analysis of Chinese monetary policy evolution in Chang et al. (2019).

Table 8: Monetary Policy Rule Parameters by Region

Region	ρ_r	$\phi_{\pi,r}$	$\phi_{y,r}$	$\phi_{s,r}$	Source
USA	0.80	1.50	0.25	0.00	Clarida et al. (2000)
Colombia	0.7	1.5	0.375	0.00	Gómez et al. (2021)
China	0.85	1.25	0.50	0.15	Zhang and Murasawa (2024)
USMCA (MEX,CAN)	0.75	1.60	0.20	0.05	
EU-UK	0.85	1.50	0.10	0.00	ECB standard
MERCOSUR	0.70	1.50	0.35	0.20	EM average
ANDIN	0.75	1.65	0.30	0.15	Regional IT framework
OECD-Asia	0.90	1.35	0.05	0.00	BoJ/BoK consensus
ASEAN	0.80	1.40	0.40	0.25	Open economy EM
ROW	0.75	1.50	0.25	0.10	Global average

Note: ρ_r denotes interest rate smoothing, $\phi_{\pi,r}$ inflation response coefficient, $\phi_{y,r}$ output gap response, and $\phi_{s,r}$ exchange rate stabilization. Parameters calibrated for annualized rates with four-quarter inflation and output growth measures.

Colombia's parameters reflect its inflation targeting regime adopted in 1999, with aggressive price stabilization ($\phi_{\pi,\text{COL}} = 1.5$) documented by Gómez et al. (2021); González-Gómez et al. (2020), moderate output consideration ($\phi_{y,\text{COL}} = 0.375$), and zero exchange rate intervention ($\phi_{s,\text{COL}} = 0.0$). The remaining regions follow institutional characteristics: (USMCA) Canada (AE) often no explicit FX term, but evidence of some exchange-rate sensitivity; Mexico (EM IT) with nontrivial pass-through $\Rightarrow$ small ϕ_s. (Lubik and Schorfheide, 2007; Murchison and Rennison, 2006; Capistrán and Ramos-Francia, 2010), EU-UK mirrors ECB-style strict inflation targeting; emerging market regions (MERCOSUR, ASEAN) exhibit "fear of floating" with higher exchange rate coefficients; OECD-Asia reflects ultra-smooth policy with minimal responsiveness characteristic of the Bank of Japan; and ANDIN approximates Colombia's framework given similar institutional evolution.

The persistence parameters ρ_r range from 0.70 (MERCOSUR) to 0.90 (OECD-Asia), capturing cross-regional variation in policy gradualism. Higher smoothing in advanced economies reflects well-anchored expectations permitting gradual adjustments, while lower persistence in some emerging markets indicates more reactive policy stances necessitated by credibility concerns. These heterogeneous monetary frameworks critically shape the transmission of trade shocks, as regions with stronger exchange rate focus experience amplified real effects through the monetary channel, while strict inflation targeters maintain greater insulation from external nominal disturbances.

F Labor Adjustment Cost Calibration

The quadratic labor adjustment cost specification in equation 19 requires calibration of the parameter ψ_L^k, which governs the severity of labor market frictions. Following the empirical labor economics literature, we adopt a uniform calibration across regions but allow for sectoral heterogeneity to reflect differences in skill requirements and labor market institutions.

Table 9: Labor Adjustment Cost Parameters by Sector

Sector	ψ_L^k	Std. Dev.	Range	Source/Justification
Mining	8.0	2.0	[4.0, 12.0]	High capital intensity
Agriculture	2.0	0.8	[0.5, 4.0]	Seasonal flexibility
Metals	6.0	1.5	[3.0, 9.0]	Skilled manufacturing
Food/Beverages	3.0	1.0	[1.0, 5.0]	Moderate skills
Chemicals	5.0	1.5	[2.5, 7.5]	Technical workforce
Rubber/Plastics	4.0	1.2	[2.0, 6.0]	Semi-skilled labor
Textiles	2.5	0.8	[1.0, 4.0]	Low adjustment costs
Elec/Optical	7.0	2.0	[3.5, 10.5]	High-tech specialization
Other Tradables	4.0	1.2	[2.0, 6.0]	Mixed skill levels
Services	3.5	1.0	[1.5, 5.5]	Service sector average
Baseline (all sectors)	**4.5**	**1.5**	**[2.0, 7.0]**	Cooper and Willis (2009)

The baseline calibration of $\psi_L = 4.5$ implies that a 10% quarterly change in employment generates adjustment costs equivalent to 2.25% of output, consistent with micro-econometric evidence from Cooper and Willis (2009) who estimate adjustment costs ranging from 1-3% of quarterly revenue for comparable employment changes. This value falls within the range established by Bloom et al. (2007) for OECD countries (2.0-7.0) and aligns with Mertz and Yashiv (2007) who find adjustment costs of 2-8% of the quarterly wage bill.

Using a uniform parameter across regions is justified by Hamermesh and Pfann (1996) who document that labor adjustment cost differences across countries primarily reflect institutional factors (captured in our model through different steady-state levels) rather than the technological cost function itself. Cacciatore and Fiori (2016) support this approach in their multi-country analysis, finding that once controlling for institutional differences, the underlying adjustment technology shows remarkable similarity across developed and emerging markets.

The sectoral variation reflects well-documented industry differences: mining and electrical/optical sectors exhibit higher adjustment costs due to specific human capital requirements (Oi (1962)); agriculture and textiles show lower costs due to seasonal employment patterns and lower skill specificity (Holt et al. (1960)); services fall in the intermediate range consistent with Davis and Haltiwanger (1992).

G Investment Adjustment Cost Calibration

The capital accumulation equation 11 incorporates quadratic adjustment costs through the parameter $\Psi_{x,k}$, which governs the cost of deviating from steady-state investment rates.

Table 10: Investment Adjustment Cost Parameters by Sector

Sector	$\Psi_{x,k}$	Std. Dev.	Range	Source/Justification
Mining	12.0	3.0	[6.0, 18.0]	Long-lived capital, lumpy investment
Agriculture	4.0	1.5	[1.0, 7.0]	Equipment turnover, seasonal
Metals	8.0	2.0	[4.0, 12.0]	Heavy machinery
Food/Beverages	5.0	1.5	[2.0, 8.0]	Processing equipment
Chemicals	9.0	2.5	[4.0, 14.0]	Specialized facilities
Rubber/Plastics	6.0	1.8	[2.5, 9.5]	Production lines
Textiles	3.5	1.2	[1.0, 6.0]	Lower capital intensity
Elec/Optical	7.0	2.0	[3.0, 11.0]	High-tech equipment
Other Tradables	5.5	1.5	[2.5, 8.5]	Mixed capital types
Services	4.5	1.5	[1.5, 7.5]	IT and facilities
Baseline (all sectors)	**6.5**	**2.0**	**[2.5, 10.5]**	Christiano and Fisher (2000)

The baseline calibration of $\Psi_{x,k} = 6.5$ implies that a 10 percentage point deviation of the investment rate from steady state generates adjustment costs equivalent to 3.25% of the capital stock value. This calibration aligns with Christiano and Fisher (2000) who estimate adjustment cost parameters between 2 and 11 for U.S. data, and Cooper and Haltiwanger (2006) who find costs in the range of 2-9% of annual investment for comparable deviations.

The cross-country uniformity assumption follows Caselli and Bennett (2023) who document that investment adjustment costs primarily reflect technological constraints rather than institutional differences once controlling for financial frictions (captured separately in our model). Bloom et al. (2018) support this approach using firm-level data from 60 countries, finding that adjustment cost parameters cluster around similar values after accounting for measurement differences and financial development.

Sectoral heterogeneity reflects capital specificity and project scale. Mining exhibits the highest adjustment costs ($\Psi_x = 12.0$) due to large-scale, irreversible investments in extraction infrastructure (Kellogg (2014)). Chemical and metals industries show elevated costs (9.0 and 8.0) reflecting specialized production facilities with limited redeployability (Ramey and Shapiro (2001)). Agriculture and textiles display lower adjustment costs (4.0 and 3.5) due to more standardized equipment and active secondary markets (Eisfeldt and Papanikolaou (2013)).