Tariffs as a Hidden Tax: Price Pass-Through in Multi-Stage Supply Chains

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Problem definition: A commonly held belief is that tariffs on imports are directly reflected in consumer prices. However, in complex multi-stage supply chains, the actual consumer-price impact of a tariff can be diluted. This article examines how import tariffs propagate through a multi-stage supply chain and why the resulting consumer price increases are typically much smaller than the headline tariff rate. We focus on the U.S. pharmaceutical supply chain as a case in point, due to its heavy reliance on imported inputs and multiple intermediary markups.

Methodology/results: We develop a tariff impact calculator to model cost build-up, markup, and partial cost absorption at each stage of the supply chain. Our analysis shows that even a substantial tariff (e.g., 25%) on an Active Pharmaceutical Ingredient (API) leads to only a minor uptick (often around 1% or less) in the final retail price of the drug. Furthermore, we find that the government's gross tariff revenues are substantially offset by reduced corporate tax receipts and higher procurement costs for public healthcare programs. We derive a simple condition under which government net receipts from tariffs can turn negative.

Managerial implications: Our discussions highlight why tariff-induced price shocks may be smaller than commonly feared, and why firms in multi-stage supply chains often opt to absorb a portion of cost increases rather than fully passing them on. For supply chain managers, understanding the muted consumer-price impact allows for better pricing and sourcing strategies during periods of trade protectionism. For policymakers, the results caution that tariffs may fail to achieve their intended objectives—such as making reshoring more competitive or raising net government revenue—particularly in sectors like pharmaceuticals that feature multi-stage supply chains.

Key words: Tariffs, supply chains, price pass-through, pharmaceutical industry

1. Introduction

Trade tariffs have re-emerged as a prominent policy tool aimed at correcting trade imbalances and encouraging domestic production as the United States has imposed or threatened tariffs on a range of imported products from targeted countries (Office of the United States Trade Representative 2025). One policy goal is to reshore manufacturing to the U.S. in the long run (Donnan 2017). In the near term, however, when domestic capacity cannot be rapidly ramped up, tariffs effectively act as a tax on imports that can lead to shortages and price increases. The pharmaceutical industry is especially vulnerable in this regard: essential drugs often depend on global supply chains with limited short-run alternatives, making them susceptible to cost shocks from trade barriers (Socal et al. 2023).

Conventional wisdom and media coverage often give the impression that a tariff (for example, 25%) will raise consumer prices by a similar magnitude. In reality, the relationship between tariffs and consumer prices is far more complex. When a product passes through multiple stages—importers, manufacturers, distributors, and retailers—each stage has the potential to absorb some of the cost increase or adjust its margins, thereby dampening the effect of the tariff by the time it reaches the end consumer. Empirical studies of the 2018–2019 U.S.–China trade war support this nuanced view. Researchers found that while tariffs were almost fully passed through to the prices paid by U.S. importers at the border, the downstream price increases for consumers were much more muted. For instance, Amiti et al. (2019) and Fajgelbaum et al. (2020) both estimate that the incidence of the 2018 tariffs fell almost entirely on U.S. firms and consumers at the import stage (with foreign exporters not significantly lowering prices). Fajgelbaum et al. (2020) calculate an annual welfare loss to the U.S. on the order of $16 billion from these tariffs, reflecting higher costs to firms and consumers. However, further along the supply chain, retailers and distributors did *not* always pass these cost increases fully on to shoppers. Cavallo et al. (2021) analyze detailed retail price data and found that after one year, a 10 percentage-point increase in import tariffs resulted in only about a 0.44% increase in consumer prices on the affected goods, on average. In other words, roughly 4% of the tariff was reflected in final prices after a year, suggesting that firms absorbed most of the cost in their margins rather than immediately raising prices. Consistent with this, other studies observed a compression of U.S. retail margins on tariff-affected goods, with scant evidence of companies offsetting their losses by raising prices on non-tariffed products.

However, there was significant heterogeneity across product categories. Branded durable goods or those facing limited competition sometimes saw higher pass-throughs. A notable example is washing machines: following safeguard tariffs in 2018, washer prices rose by roughly the full amount of the tariff (about $86 per unit), and even the prices of dryers (which were not tariffed) increased by a similar amount, an instance of over-shifting in a concentrated market (Flaaen et al. 2020). By contrast, other products remained stable in price for months after tariffs, especially when retailers found ways to mitigate costs (for example, sourcing from non-tariffed countries or accepting lower margins). These examples underline that supply chain structures and competitive dynamics determine how tariff costs propagate.

The operations management literature has addressed tariffs through various lenses (Charoenwong et al. 2023; Cohen et al. 2018; Cohen and Lee 2020; Dong and Kouvelis 2020; Niu et al. 2025), yet a focused and accessible treatment of how tariffs affect consumer-facing outcomes remains elusive. Not surprisingly, our field's insights have had limited influence on current policy debate and business discourse.

In this article, we examine the phenomenon of diluted inflationary impact in multi-stage supply chains. Our focus is on an essential goods supply chain—specifically, the U.S. pharmaceutical supply chain for essential drugs such as antibiotics—where multi-tiered production and distribution are the norm. This context is particularly salient given the public health importance of reliable access to medications and the national security concerns surrounding foreign dependence for critical drug components (U.S. Departments of Health and Human Services, Defense, Homeland Security, Commerce, State, and Veterans Affairs 2021). It also allows us to highlight several important moderating factors:

- **Imported input dependence:** Over the past few decades, the U.S. has become highly reliant on imported pharmaceutical inputs. For example, a large share of Active Pharmaceutical Ingredients (APIs) for common antibiotics are sourced from China, while much of the final pill production (Finished Dose Form, FDF) is done in India. This high import reliance means tariffs could in principle have a large impact on drug costs.
- **High markups and inelastic demand:** Pharmaceutical products often have high markups (the ratio of price to production cost) due to intellectual property or, in the case of generics, due to the small cost base relative to the value provided. Demand for essential medications is relatively price inelastic in the short run. High markups provide a cushion that can absorb cost shocks like those from tariffs, since firms can temporarily accept slightly lower profit margins rather than risk losing market share or causing patients to forego treatment.
- **Insurance and payer structure:** Most end consumers of pharmaceuticals in the U.S. have insurance coverage. Patients typically pay only a copayment or coinsurance (e.g., a percentage of the drug price) while the majority of the cost is covered by public or private insurance. This means that a given percentage increase in the drug's price translates to a much smaller percentage increase in what an insured patient pays out-of-pocket. Moreover, over half of prescription drug expenditures are ultimately paid by government programs (e.g., Medicare, Medicaid, Veterans Affairs). Thus, the government is both a tax collector (through tariffs) and a major buyer of the products subject to the tariff.

These factors suggest that the simple narrative of "tariffs cause equal consumer price inflation" is incomplete, especially in pharmaceutical supply chains. To quantify these effects, we pose two key questions: (1) What is the anticipated increase in out-of-pocket costs for patients if tariffs are applied to imported pharmaceutical inputs? (2) What is the net revenue gained by the government from such tariffs, after accounting for offsets like reduced corporate income tax and higher prices paid by government purchasers?

We address these questions by developing a scratch model ("tariff impact calculator") for a simplified multi-stage supply chain. We then apply this calculator to representative cases in the pharmaceutical industry under various tariff scenarios. The analysis shows that even sizable tariffs result in surprisingly small consumer price increases in the short run. The next sections present our case context, outline the modeling framework, discuss results from scenario analyses, and draw out managerial implications.

2. Context: Pharmaceutical Supply Chains

The supply chain for pharmaceuticals, particularly generic drugs, is a prototypical example of a multi-stage chain with global sourcing. We consider the antibiotic drug category as an illustrative case. Antibiotics have mature production technologies and have seen manufacturing shift to lower-cost countries over the last 30 years. In the case of common antibiotics like penicillins and tetracyclines, the Active Pharmaceutical Ingredients (APIs) are predominantly produced abroad (notably in China), and even the Finished Dose Forms (FDFs), such as tablets or capsules, are often imported (notably from India). Table 1 provides an example of this breakdown for one class of antibiotics (tetracyclines) over the period 2019–2024. Virtually the entire U.S. import volume of tetracycline API came from China (about 98.72%), while nearly all imported tetracycline finished doses came from India (about 98.64%). In terms of cost, raw API ingredients are significantly cheaper per kilogram (on the order of \$16.97/kg in this example) than finished dosage forms (over \$141.13/kg), reflecting the value added through formulation, quality assurance, and distribution.

Table 1 Imported antibiotic volumes and sources (Illustrative example for Tetracycline, 2019–2024).

	Tetracycline API	Tetracycline FDF
Total imported volume (kg)	21,240,496	1,202,366
Total import value (USD)	$360,434,098	$169,688,031
Average cost per kg	$16.97	$141.13
Major source country	China (98.72%)	India (98.64%)
Other source countries	Canada and EU (1.05%)	Canada and EU (1.07%)

Given this structure, a tariff on Chinese or Indian pharmaceutical imports would directly target a large portion of the supply chain for essential drugs. Yet, the impact on the final consumer price will be mitigated by how the cost increase is handled as the product moves from the foreign supplier through domestic manufacturing and distribution. Because the pharmaceutical supply chain is relatively inflexible in the short run with respect to sourcing and production volumes, a sudden tariff on Chinese APIs, for example, would leave domestic antibiotic manufacturers unable to quickly secure alternative sources or scale up domestic API production. Thus, they would be compelled to pay tariffs or halt production (which could cause drug shortages). In practice, they tend to pay tariffs, raising their input cost.

However, as we explore below, this higher cost can be absorbed or passed on in different ways at subsequent stages. Additionally, because patients typically do not pay the full cost of drugs directly, there is a cushion that softens the blow on individual consumers. Importantly, when patients are insulated from price increases, demand remains inelastic, which might make it easier for firms to pass on some costs—but competitive and regulatory pressures in generics often cap how much prices can be raised without losing business to rivals (Gatwood et al. 2014).

To study these dynamics, we focus on three representative product scenarios:

1. A generic broad-spectrum antibiotic (e.g., a tetracycline-class drug) with a low cost of production, large volumes, and heavy reliance on Chinese API and Indian FDF. This represents a worst-case for import exposure.
2. An older generic drug (e.g., a penicillin derivative) where multiple countries supply the API, not solely China, giving a more diversified import risk.
3. A branded drug, Januvia (sitagliptin), a dipeptidyl peptidase-4 (DPP-4) inhibitor, used to treat Type II diabetes, which is imported from the European Union, to contrast how tariff effects might differ when the cost structure and import dependence are different.

These scenarios span a range of supply chain exposures and pricing structures. We analyze them in detail in Section 4. Before turning to those results, we introduce two examples to build intuition for the underlying model.

3. Illustrative Examples: Car Mats and Champagne

We now present two illustrative non-pharmaceutical examples—car floor mats and wines—that have been covered in the popular press. These cases help to demonstrate the broader applicability of our tariff impact model and highlight key concepts such as compounded markups, cost share dilution, and strategic absorption. For each, we apply the same underlying model used in the pharmaceutical scenarios to assess how tariffs propagate through multi-tiered supply chains.

3.1. Car Floor Mats and Trump Tariffs

A widely read *Bloomberg* analysis (Bloomberg News 2025), features a set of Chinese-manufactured car floor mats that each cost about $6 FOB (free on board), meaning that it is the base price before shipping and tariffs. When a hypothetical 125% tariff was applied, the landed cost jumped to approximately $13.50. If each downstream intermediary—wholesaler and retailer—applied a constant *percentage* markup, the retail price ballooned to nearly $89.99, doubling from the original shelf price of $44.99. This illustrates the compounding effect of percentage markups on top of a cost shock: the tariffed input gets magnified at every step.

However, if those same intermediaries instead used *fixed dollar markups* (i.e., keeping their profit per unit constant), the price would have risen only to about $52.51—a much more modest increase of 17% despite a 125% tariff at the origin. This stark contrast—17% vs. 100% increase—highlights how pricing strategy dramatically alters the final outcome. The key insight is that whether firms preserve percentage margins or absolute markups drives the inflationary impact. In this case, the combination of a low cost base and large percentage markups made the product especially vulnerable to over-shifting.

3.2. Wine Tariffs and Retailer Responses

Tariffs on wine have twice brought European imports into the spotlight of U.S. trade tensions—in 2019 and again in 2025. These two episodes offer revealing contrasts in how supply chains and retailers respond to tariff shocks.

During the 2019 U.S.–EU trade dispute, the Trump administration imposed a 25% tariff on certain European wines, cheeses, and other agricultural products in retaliation for EU subsidies for Airbus. Wine importers and distributors were caught off guard, and there were widespread fears that consumer prices would surge. However, real-world pass-through was relatively muted (Shalal 2020). Many distributors and retailers opted to absorb the cost rather than raise prices sharply. Margin compression became common in the mid-stage market segment: one importer described having to "eat" the tariff for key wines to avoid losing shelf space at grocery chains and restaurants. Some retailers responded by adjusting promotional calendars, trimming discounts, or substituting vintages rather than increasing menu prices (Cole 2019).

In 2025, a far steeper threat has emerged. As part of a retaliatory round of trade tensions, the U.S. proposed a 200% tariff on all EU alcoholic beverages. With over $5 billion in European wine exports to the U.S. at stake—nearly half from France and 40% from Italy—the industry faced existential concern. A $20 Veuve Clicquot Champagne bottle (wholesale) would jump to $60 for importers. If retail markup policies remained constant, this would translate to a $90 bottle on the shelf, well above the $50 pre-tariff price. For most American consumers, that price point would place such wines out of reach (Cooper et al. 2025).

This time, rather than raising prices outright, some sellers again turned to creative tactics. At Flûte Bar in Manhattan, owner Hervé Rousseau explained that instead of increasing menu prices, he would slightly reduce pour sizes—about 10% less per glass—while being transparent with customers via signage and social media. “We’ll explain what we’re doing,” he said, “even do some Instagram Reels to talk about it” (Rutherford 2025).

The lesson across both episodes is consistent: even when tariffs are steep, businesses often opt to adjust margins, volumes, or presentation rather than pass through the full cost to consumers. The mechanisms of pass-through are constrained not just by pricing formulas but also by customer psychology, brand positioning, and substitution risks. High-end consumers may accept modest increases, but mainstream wine buyers are highly price-sensitive, especially around psychological thresholds (e.g., $20 bottles).

The wine tariff cases—both in 2019 and 2025—illustrate that the impact of tariffs is not solely a function of tariff rates, but of market structure, markup discretion, and competitive elasticity. These dynamics mirror what we find in pharmaceutical supply chains: high initial tariffs often yield surprisingly low inflationary outcomes.

3.3. Implications for Our Scratch Model

These two non-pharmaceutical examples reinforce the core insight behind our tariff pass-through model. First, that markup structure (percentage vs. absolute) shapes cost propagation. Second, that cost share matters: a $6 item absorbing a large tariff might still only marginally impact a $60 final product if that input comprises a small fraction of the total. Third, that real-world pricing is strategic—firms do not mechanically apply cost increases, but instead consider customer expectations, competition, and long-term relationships. These principles apply just as much to prescription drugs as to car mats and champagne.

4. A Scratch Model

We model a simplified four-stage supply chain, depicted schematically in Figure 1. The stages are: (1) a foreign supplier of the API, (2) a domestic pharmaceutical manufacturer that purchases the API and produces the finished drug, (3) a distributor (wholesaler), and (4) a retailer (pharmacy) that sells to the end consumer. Each stage applies a markup to its cost when selling to the next stage. For our base scenario, we assume each stage charges a 25% markup on its cost (a relatively conservative margin in the pharmaceutical industry, where actual markups can be higher). This markup covers both value-added (processing, handling) and profit.

Let c_{API} be the unit cost of the API required for one unit of finished drug (e.g., the API needed for one pill or one vial). Let c_o represent the remaining unit manufacturing costs (labor, excipients (inactive ingredients), processing) for the manufacturer. Then, the manufacturer’s total unit cost (pre-tariff) is

$$C = c_{API} + c_o.$$

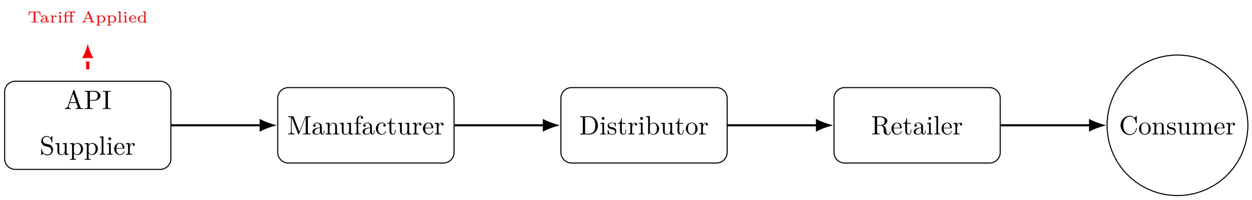

Figure 1 **Simplified four-stage pharmaceutical supply chain: API supplier $\rightarrow$ manufacturer $\rightarrow$ distributor $\rightarrow$ retailer $\rightarrow$ consumer. A tariff applies at the API import stage.**

For many generic drugs, the API accounts for a significant fraction of C; for our base case we take c_{API} to be 20% of C (though it can range from 20% to 50% depending on the drug).

Now suppose a tariff of rate τ is imposed on the imported API. This effectively increases the manufacturer's cost for that input to $(1+\tau)c_{API}$. The post-tariff total manufacturing cost is

$$C' = (1+\tau)c_{API} + c_o = C + \tau \cdot c_{API}.$$

The immediate cost increase to the manufacturer per unit is $\Delta_m = C' - C = \tau\, c_{API}$.

The manufacturer must decide how much of this increased cost to pass through to in its selling price while absorbing the rest. We define ϕ_m as the *pass-through fraction* at the manufacturing stage ($0 \leq \phi_m \leq 1$). In particular, $\phi_m = 1$ would mean the manufacturer raises its price by the full amount of the cost increase (preserving its margin), whereas $\phi_m = 0$ would mean it absorbs the entire cost (reducing its profit margin accordingly). In practice, ϕ_m will be between 0 and 1; in our scenario analysis, we use $\phi_m = 0.5$ as a baseline assumption, meaning the manufacturer passes through half of the cost increase to the next stage and absorbs the other half. The portion not passed through effectively lowers the manufacturer's pretax profit, which also means the manufacturer saves on taxes (since costs are higher). We discuss this tax effect shortly.

The manufacturer's pre-tariff unit price to the distributor is $P_m = C(1+\mu_m)$, where μ_m is the manufacturer markup (25% in base case). With the tariff, the new price becomes:

$$P'_m = P_m + \phi_m \Delta_m.$$

We can also express P'_m as $P'_m = C(1+\mu_m) + \phi_m \tau c_{API}$.

The distributor faces P'_m as its cost. The distributor's own markup is μ_d (25% by default). If there were no further cost increases, the distributor would charge $P_d = P_m(1+\mu_d)$ to the retailer. With the tariff-induced higher cost P'_m, the distributor similarly can choose to pass through some fraction ϕ_d of the cost increase $\Delta_d = P'_m - P_m$. We model $P'_d = P_d + \phi_d(P'_m - P_m)$.

Likewise, the retailer (pharmacy) buys at P'_d and normally applies a markup μ_r (25% in base case), for a pre-tariff consumer price $P_r = P_d(1+\mu_r)$. With the cost increase $\Delta_r = P'_d - P_d$, the retailer's new price is $P'_r = P_r + \phi_r(P'_d - P_d)$.

Combining these stages, we can derive the total effect on the final price. The baseline (no tariff) final price is:

$$P_r = C(1+\mu_m)(1+\mu_d)(1+\mu_r).$$

The incremental increase in final price $\Delta_{final} = P_r' - P_r$ is:

$$\Delta_{final} = \tau \cdot c_{API} \cdot \phi_m \cdot \phi_d \cdot \phi_r.$$

If the pass-through fractions at all stages are equal (say ϕ for each stage, as in our symmetric scenario with $\phi = 0.5$), this further simplifies to:

$$\Delta_{final} = \tau \cdot c_{API} \cdot \phi^3.$$

Dividing this by the original P_r yields the percentage increase in consumer price due to the tariff. For example, plugging in $\mu_m = \mu_d = \mu_r = 0.25$ and $\phi = 0.5$, and assuming $c_{API} = 0.2C$ (20% API cost share), a tariff of $\tau = 0.25$ (25%) results in:

$$\begin{aligned} \Delta_{final} &= 0.25 \cdot 0.2C \cdot (0.5)^3 = 0.25 \cdot 0.2 \cdot 0.125 \cdot C = 0.00625C, \\ P_r &= 1.953125 \cdot C, \\ \frac{\Delta_{final}}{P_r} &= \frac{0.00625C}{1.953125C} \approx 0.0032, \end{aligned}$$

that is, a 0.32% increase in the final price. This order of magnitude (sub-1 percent increase from a 25% tariff) reflects the dampened or diluted inflationary effect under partial pass-through.

It is important to note how the tariff costs are distributed:

- The government collects $\tau \cdot c_{API}$ per unit in tariff revenue at the border (stage 1).
- Each supply chain stage that does not fully pass through the cost is effectively absorbing some of the tariff in lower margin. In our example with $\phi_m = \phi_d = \phi_r = 0.5$, the manufacturer absorbs $0.5\,\Delta_m$, the distributor absorbs $0.5\,\Delta_d$, and the retailer absorbs $0.5\,\Delta_r$. Summing these absorbed amounts across the chain gives the total tariff cost not passed on to the consumer.
- Because absorbed costs reduce profit, the firms pay less income tax. If the corporate tax rate is t_c, then for each dollar of tariff cost absorbed by a firm, the government effectively returns t_c dollars via lower taxes. In our model, this tax offset partially compensates each stage for the cost absorbed. From the government's perspective, it reduces the net gain from the tariff.
- The presence of insurance/government payers means that even when the consumer price P_r increases, the incidence on end consumers vs. payers is split. If a patient has a coinsurance rate of α (e.g., $\alpha = 0.2$ or 20%), then the patient's out-of-pocket price only rises by $\alpha \cdot \Delta_{final}$, with the remainder paid by the insurer or a government program.

We can express the net impact on government revenue more formally. Let G_{tariff} be the gross tariff revenue collected per unit (i.e., τc_{API}). Let $G_{\text{tax loss}}$ be the loss in corporate tax revenue due to lower profits. And let $G_{\text{gov cost}}$ be the additional amount government programs pay if they purchase a fraction γ of the output (either directly or via reimbursement). Then:

$$G_{\text{net}} = G_{\text{tariff}} - G_{\text{tax loss}} - \gamma \cdot \Delta_{final}.$$

Using our earlier expressions, if $\phi_m = \phi_d = \phi_r = \phi$, then the cost *not* passed through is $(1-\phi^3)\tau c_{API}$, and the tax loss is:

$$G_{\text{tax loss}} = t_c \cdot (1-\phi^3)\tau c_{API}.$$

The final price increase is:

$$\Delta_{final} = \phi^3 \cdot \tau \cdot c_{API}.$$

Substituting into the previous expression, the net government gain becomes:

$$G_{\text{net}} = \tau c_{API} - t_c(1-\phi^3)\tau c_{API} - \gamma \cdot \phi^3 \cdot \tau c_{API}.$$

Without going into further algebra, the key point is that G_{net} will be substantially less than the nominal tariff revenue τc_{API} due to these tax and procurement offsets. In our numerical scenarios, we will compute how much of the tariff revenue actually remains with the government after accounting for these effects. In particular, in Scenario 4, we will show how a more long-term strategic pricing can actually result in a net loss in receipts.

With the framework in place, we next turn to the results of applying this model to the pharmaceutical supply chain context described in Section 2.

5. Discussions and Extensions

We now discuss four tariff scenarios using the above model for the three representative drug cases (broad-spectrum generic antibiotic, other generic, and DPP-4). Key assumptions such as cost shares (c_{API} as a percentage of total cost) and baseline markups (μ_m, μ_d, μ_r) are calibrated based on industry reports and our compiled import data. We focus on the percentage change in final consumer price, the change in patient out-of-pocket cost, and the effective government revenue after offsets.

5.1. Tariff Scenarios

5.1.1. Scenario 1: A Broad 25% Tariff on Chinese and Indian Pharmaceutical Imports. In the first scenario, we simulate a 25% tariff applied broadly to pharmaceutical imports from China and India, targeting both Active Pharmaceutical Ingredients (APIs) and finished dosage forms (FDFs). Using the broad-spectrum antibiotic case as an example—a market heavily dependent on Chinese APIs and Indian FDFs—our model predicts that the final retail price increases by only about 0.01% to 0.39%, despite the large tariff applied to inputs. The range reflects product-specific differences: tetracycline-based antibiotics are at the higher end (0.39%), while older penicillin-based products with mixed sourcing show smaller impacts around 0.11%.

For insured patients with a 20% coinsurance rate, the out-of-pocket cost increases by a similarly negligible amount. For instance, a drug with a pre-tariff retail price of $20 would rise to approximately $20.08 under the higher-end estimate, resulting in a copayment increase from $4.00 to $4.02. The 2-cent change is effectively imperceptible to patients.

At the import stage, the government would collect substantial gross tariff revenue. If the API accounts for $4 of the $20 drug cost, a 25% tariff would generate $1.00 per unit imported. However, the government's net revenue would be meaningfully smaller. Firms absorb a portion of the tariff in the form of reduced taxable profits, lowering corporate tax collections—approximately $0.20 lost at a 20% tax rate. In addition, if government programs such as Medicare or Medicaid purchase 50% of these drugs, public procurement costs rise by about $0.06 per unit. After accounting for both effects, the government nets approximately $0.75 per unit, retaining about 75% of the headline tariff amount. Across the market for such drugs, a gross tariff collection of $77.78 million would translate into an effective budgetary impact of roughly $58.63 million, demonstrating that offsets can substantially erode the apparent revenue benefits of tariffs.

5.1.2. Scenario 2: A 10% Global Tariff on Pharmaceutical Inputs. The second scenario considers a generalized 10% tariff applied to all imported pharmaceutical inputs, regardless of country of origin. Although the tariff rate is lower, its broader scope affects a larger share of supply chains. In this case, our model finds that a 10% tariff on all API imports leads to approximately a 0.16% increase in retail drug prices. The dilution effect persists: only about 2.5% of the tariff burden is reflected in consumer prices.

The net effect on government revenue, expressed as a percentage of gross tariff collections, remains similar to Scenario 1. Structural features such as cost absorption by firms and tax offsets are not highly sensitive to the nominal tariff rate. Thus, whether the tariff is 10% or 25%, approximately 70–75% of the gross tariff revenue remains after adjustments.

5.1.3. Scenario 3: Tariffs on Finished Drugs versus APIs. Scenario 3 examines the effects of imposing tariffs on finished pharmaceutical products rather than on raw APIs. For example, instead of a tariff on Chinese-produced APIs, consider a 25% tariff on Indian-made tetracycline capsules imported in finished form (Wosińska 2025). In this case, the tariff applies to the entire production cost, since the imported good reflects the full cost of manufacturing. This stands in contrast to API tariffs, which affect only a subset of the total cost structure. Moreover, because the foreign manufacturer supplies the final dosage form, the domestic supply chain loses an intermediate processing stage.

With one fewer tier, there are fewer domestic firms available to absorb or dilute the cost increase, resulting in a higher effective pass-through to the final price.

In this case, a 25% tariff leads to a higher consumer price increase relative to an API tariff. Our model estimates that the retail price of tetracycline capsules would rise between 0.04% and 1.59%, depending on the specific supply chain characteristics—still far less than the full 25%, but notably higher than the sub-1% increases observed in API-tariff scenarios. An uninsured consumer buying a $20 bottle of pills would thus see the price rise to between approximately $20.08 and $20.32.

Government net revenue dynamics follow a similar pattern: offsets due to lower corporate tax collections and higher government procurement costs remain, but the magnitude differs slightly. The offset from public purchases would be higher, since the retail price rises more substantially, while the corporate tax offset could be slightly smaller, as a larger share of profit accrues abroad (and thus outside the U.S. tax base). Overall, tariffs on finished pharmaceuticals impose a more visible burden on final prices than tariffs on raw APIs, although the inflationary effect remains moderate.

5.1.4. Scenario 4: A High-Value Branded Drug Subject to Full Tariff Pass-Through. Consider a high-value branded DPP-4 drug, such as Januvia, produced in the European Union and imported into the United States as a finished dosage form (FDF). Reflecting its branded status and recent development, we assume an imported cost of $100. As in Scenario 3, the distributor (importer) applies a 100% markup, yielding a wholesale price of $200. The retailer, in turn, applies a 100% markup to the wholesale price, leading to a final consumer price of $400.

Now suppose a 100% tariff is imposed on the imported FDF, raising the distributor's effective acquisition cost from $100 to $200. Following strategic pricing practices observed in other sectors—such as car mats and French wine imports—the distributor fully passes through the increased cost and applies the same markup. Consequently, the wholesale price doubles to $400. Similarly, the retailer applies a 100% markup to the new wholesale price, setting the final consumer price at $800.

Assuming inelastic demand, consistent with branded pharmaceutical markets, quantity sold remains unchanged. In this case, the distributor's taxable income increases by $100, and the retailer's taxable income increases by $200. Aggregating across the supply chain, total revenue rises by $400, offset by an increased input cost of $100, resulting in a net increase in taxable income of $300.

Thus, under full pass-through and full markup behavior, a tariff can unintuitively increase total supply chain profitability. This dynamic reflects broader concerns voiced during past trade disputes, when the European pharmaceutical sector braced for potential tariffs on high-value drug exports to the United States (Smialek et al. 2025).

5.1.5. Observations. Across these scenarios, we observe that the short-run inflationary impact of tariffs in a multi-stage supply chain is diluted. Even when the entire supply of a product is affected by a tariff, the cascading effect of partial pass-through at each stage, combined with the structure of insurance payments, results in final consumer price increases that are an order of magnitude smaller than the tariff rate. This outcome hinges on the assumption that firms will not fully pass through costs immediately, which is supported by historical evidence in many consumer goods sectors (with some exceptions as noted). It represents a short- to medium-term analysis. Notably, this assumption also aligns with recent reporting that pharmaceutical companies are likely to absorb most tariff costs in the near term, with insurers acting as intermediaries that shield patients from price changes (Reuters 2025). However, over a longer horizon, as we showed in Scenario 4, which features a branded FDF, repeated cost increases or an inability to sustain reduced margins could lead to more pass-through, an aspect we address further in the discussion section.

5.2. Conditions for Negative Net Government Receipts under Tariffs

As in the scenarios above, government revenues would increase by the collected tariff of \$100 and the incremental tax collection of \$60 for a total of \$160. These would be offset by governmental purchases whose cost would increase by half of \$200, so in toto the government would see a decline in revenue of \$40. This result is quite robust and it is easy to show that if we write

$$\Delta_{final} = \tau \cdot c_{API} \cdot \delta_{final},$$

we can write

$$G_{\text{net}} = \tau \cdot c_{API} \cdot ((1 - t_c) - \delta_{final}(\gamma - t_c)).$$

Then, rearranging terms and removing the common factor $\tau \cdot c_{API}$ yields that $G_{\text{net}} > 0$ if and only if

$$\delta_{final} < \frac{1 - t_c}{\gamma - t_c}.$$

Interestingly, whether net government receipts increase or decrease is *independent of* both the tariff rate and the cost of the imported finished good. Instead, negative net receipts are more likely when supply chain markups and the share of government purchases are sufficiently high, and less likely when corporate tax rates are higher. Such outcomes imply a transfer of welfare from insurers and end consumers to supply chain operators, illustrating how the imposition of a tariff regime can lead to unanticipated and potentially undesirable fiscal consequences.

5.3. Extensions

Beyond the above results, several additional factors merit attention in understanding how tariffs propagate through supply chains and influence pricing outcomes:

5.3.1. Surcharges as Tactical Pass-Through. One notable real-world response to tariffs has been the use of explicit line-item surcharges (Ashworth 2025). Rather than adjusting base prices, some businesses apply a separate "China tariff surcharge" or "import fee" at checkout. This strategy makes the tariff visible to the buyer without embedding it in list prices, allowing firms to preserve base price points for comparison or branding reasons. From a modeling perspective, this represents a partial and transparent pass-through—akin to increasing ϕ (pass-through fraction) without changing the markup structure. In sectors like furniture, bicycle components, and small appliances, surcharges ranging from 5% to over 25% were observed during the 2018–2020 tariff period. While less common in pharmaceuticals due to regulatory pricing norms, some wholesalers and distributors in adjacent health categories (e.g., OTC products) have adopted this tactic.

5.3.2. Optimal Pass-Through Rates. The decision of how much tariff cost to pass along is not an either/or decision; each firm faces a continuous choice between absorbing and shifting costs, constrained by its own margins and demand elasticity. In a dynamic setting, optimal pass-through balances short-term profit against long-term customer retention and regulatory risks. A company may choose to absorb costs temporarily—such as to maintain sales volume or preserve formulary placement in the pharmaceutical sector—before gradually raising prices as contracts are renegotiated. Our model can be extended to consider a firm-level optimization problem:

$$\max_{\phi \in [0,1]} \quad \Pi(\phi) = (P(\phi) - C(\phi)) \cdot D(P(\phi))$$

where $P(\phi)$ is the price passed to customers based on pass-through fraction ϕ, and $D(P)$ is demand. The curvature of $D(P)$ (i.e., elasticity) and the structure of fixed vs. percentage markups will determine the optimal ϕ^*. In practice, firms may vary ϕ by product type, market segment, and channel, suggesting that this optimization is done implicitly or heuristically through managerial judgment and institutional precedents.

5.3.3. Reshoring Pressures and Strategic Substitutions. While the immediate consumer impact of tariffs may be muted, the long-run strategic consequences may trigger shifts in sourcing and production strategies. Some pharmaceutical manufacturers and intermediaries are evaluating U.S.-based or "friend-shoring" alternatives to reduce geopolitical and trade exposure (Dai and Tang 2022). This is particularly relevant in essential medicine categories where the government plays a dual role as payer and strategic planner. Reshoring initiatives are often motivated less by tariff-induced inflation and more by concerns about supply continuity, national security, and political optics. However, if tariffs remain persistent and global supply frictions increase, the total landed cost advantage of foreign APIs may erode over time, tipping the balance toward domestic or allied production. Modeling reshoring requires dynamic investment and capacity models, but the short-run insights from our tariff model can inform threshold analysis: at what effective tariff rate τ does a switch to domestic sourcing become profitable?

5.3.4. Markup Policies: Fixed vs. Percentage. A key determinant of how tariffs propagate is driven by the markup policy used at each stage. If a firm maintains a constant *percentage* markup on cost (e.g., 25%), then any increase in cost—including tariffs—is magnified multiplicatively through the supply chain. In contrast, if markups are fixed in absolute terms (e.g., $3 per unit), then tariffs are absorbed more directly and the final price increases would be lower. This trade-off is well-known in the operations literature. Petruzzi and Dada (1999) analyze the newsvendor problem with endogenous pricing, demonstrating how price-sensitive demand and cost variability influence optimal pricing and inventory decisions. Their framework provides insights into how firms can adjust pricing strategies in response to uncertain costs, such as those introduced by tariffs. In the context of tariffs, price increases are notably smaller when downstream players adopt fixed markups compared to constant percentage ones.

In sum, these considerations demonstrate that tariff-induced price effects are highly contingent on tactical and strategic choices throughout the supply chain. Firms choose not only how much to pass through, but *how* to pass it—via pricing, surcharges, product redesign, or supplier shifts—and these decisions ultimately shape the inflationary footprint of such a trade shock.

6. Managerial and Policy Implications

Our analysis has several implications for supply chain managers and policymakers evaluating the role of tariffs, especially in critical industries such as pharmaceuticals that involve complex, multi-level supply chains.

A first insight concerns the muted effect of input tariffs on final consumer prices. For managers in manufacturing and retail, this means tariff-induced cost increases may not lead to significant reductions in demand, particularly in sectors where consumers are insulated from price fluctuations by intermediaries such as insurers. In such settings, firms might choose to absorb higher costs in the form of lower margins, rather than pass them through as higher retail prices. Such decisions can be rational when competitors face similar tariff conditions and are unlikely to raise prices themselves. In such contexts, avoiding market share losses becomes more pressing than maintaining margin stability.

Second, the extent to which tariffs dilute through the supply chain depends on the underlying cost structure. In our focal case, the dilution effect is magnified by the relatively high gross margins typical of pharmaceutical supply chains. Managers in other industries should evaluate how cost increases will propagate through their own chains. In sectors with similarly long mark-up chains, even large input shocks can result in surprisingly modest changes at the retail level. In contrast, firms operating in low-margin, highly competitive environments may have little room to absorb costs and could experience more direct pass-through. Managers can use tools like our tariff impact calculator to model various scenarios under their own parameters, such as setting an internal policy to absorb the first 5 percent of cost increases and pass along anything beyond that. Simple simulations can help make pricing decisions more systematic and less reactive.

Tariffs, even when small in their impact on consumers, still impose real costs somewhere in the supply chain. From a firm's perspective, if only half the tariff is passed on, the remaining half erodes profitability. This has long-run implications. Firms may respond not by changing retail prices, but by altering sourcing strategies. Supply chain managers might begin diversifying input suppliers or shifting procurement toward countries less exposed to tariff risk. Even when alternate suppliers are more expensive, avoiding uncertainty and regaining margin stability may be worth the tradeoff. Persistent tariffs may therefore induce reshoring or supplier diversification—not because prices rise, but because firms discreetly re-optimize to protect margins.

The muted pass-through of tariff costs creates a strategic opportunity for downstream firms, which may choose to hold retail prices steady or implement only modest increases—moves that can help preserve customer goodwill and build market differentiation. A relevant example comes from outside healthcare: when faced with new tariffs on European imports, a wine bar in New York City opted not to increase menu prices but instead slightly reduced pour sizes to maintain margins (Rutherford 2025). Though less visible than price hikes, such adjustments allow firms to absorb shocks while minimizing consumer resistance. Similar tactics may be available in pharmaceuticals: for example, switching from blister packs to bulk dispensing, lowering tablet counts per bottle (raising per-unit prices), or shifting production toward dosage strengths that fall outside price regulation thresholds. These forms of non-price adaptation highlight how firms creatively manage upstream cost shocks in environments where consumer sensitivity or regulatory oversight constrains traditional pricing responses.

From a policy standpoint, the muted consumer price response has several consequences. If the intent of tariffs on pharmaceutical inputs is to make imports more expensive and incentivize domestic production, the price effect may be too small to achieve that goal. A half-percent increase in hospital acquisition costs is unlikely to trigger supplier switching, especially when domestic alternatives are scarce or nonexistent. On the other hand, if the policy objective is to raise revenue or penalize foreign producers, then policymakers should recognize that a portion of that revenue is effectively coming from U.S. firms—and, in some cases, from the government itself as a healthcare payer. This creates a situation in which the state is partially- or over-taxing itself.

Moreover, to the extent that firms absorb the cost of tariffs, these measures function like deadweight losses for supply chain intermediaries. Policymakers should consider the financial health of the firms expected to bear these burdens. In segments like generic drug manufacturing and distribution, where margins may already be thin, sustained tariffs could lead to consolidation or exit, potentially reducing competition and raising long-term prices—contrary to the intended policy outcome.

Finally, it is important to recognize that our analysis is static and short-run. Over time, firms will adapt. Margins cannot compress indefinitely. Businesses may find ways to improve operational efficiency, adjust contracts, or gradually introduce price increases. Exchange rate adjustments could also buffer tariff shocks if foreign suppliers face currency depreciation, mitigating some of the adverse cost effects. While our model does not capture these dynamics explicitly, using variants of Scenario 4, it can be extended or used iteratively to forecast medium-run outcomes as absorption capacity erodes.

In short, the right managerial response is not to panic but to plan. Tariff shocks may not drastically change consumer prices in the near term, but they alter the internal economics of supply chains in ways that are consequential. Managers should develop frameworks for how to allocate the burden of tariffs across partners, and policymakers should calibrate expectations. While public-facing inflation may remain modest, much of the cost of tariffs will be quietly absorbed by firms and government budgets.

7. Conclusion

This article set out to explain why the inflationary impact of tariffs can be much smaller than the tariff rates themselves in multi-stage supply chains. Using the pharmaceutical supply chain for essential drugs as a focal example, we developed a model to trace cost increases and their dispersion through successive markups. The analytical framework and scenario analysis consistently showed a dramatic attenuation of tariff effects: a tariff that adds double-digit percentage costs at the border often translates to a price increase well under 1% at the pharmacy counter, at least in the short term.

The key drivers of this dilution effect are the partial pass-through behavior of firms (stemming from strategic pricing and market considerations) and the structure of end consumer payments (insurance coverage in healthcare, or similar mechanisms in other industries like subsidies or financing deals). These factors cause tariffs, at least in the short-term, to behave less like a sales or value-added tax (which is usually fully passed to prices) and more like a complex cost shock that gets distributed across various players.

Our analysis has practical relevance for supply chain decision-makers in anticipating the real impact of trade policies, and for economists and policymakers in understanding the short-run incidence of tariffs. One implication is that consumers may not respond strongly to tariff-induced price changes simply because they are small or delayed, which can blunt the intended protective effect for domestic industries. Another implication is that governments may realize far less revenue or domestic production growth in the pharmaceutical sector than tariff rates alone would suggest.

These results suggest several promising directions for future research in operations management. One avenue for future research is empirical, building on a growing economics literature that has documented tariff pass-through across a range of consumer goods. While much of this work has focused on broad manufacturing and retail sectors, opportunities remain to examine how these dynamics play out in more complex, regulated supply chains such as in the public health sector (e.g., needles and syringes). Data may be more limited in this context, but even case studies or targeted firm-level analyses could shed light on how cost absorption, pricing strategy, and margin compression unfold in practice—and whether the operational features of these supply chains yield systematically different pass-through patterns.

A second opportunity is to explore how pass-through dynamics evolve over time. The case of washing machines, where prices remained flat for several months before rising sharply, illustrates that firms may initially absorb costs but eventually adjust prices. Understanding the operational and structural conditions under which this shift occurs—particularly in multi-tiered or highly regulated supply chains like pharmaceuticals—would deepen our understanding of firms' intertemporal cost management strategies.

A third direction involves extending the model beyond linear supply chains. Many pharmaceutical and healthcare supply networks involve multiple components, overlapping channels, and contractual constraints. Generalizing the model to capture these complexities—such as multi-input cost structures or negotiated pricing with payers—could yield richer insights into real-world pricing frictions.

Finally, there is room for deeper methodological development. Game-theoretic models could be used to study how firms interact strategically in setting pass-through policies, particularly in concentrated markets or under uncertainty. Optimization frameworks could also be employed to identify optimal pass-through strategies under constraints on demand elasticity, regulatory pressure, or buyer power. Each of these directions offers meaningful opportunities to connect policy-relevant questions with foundational tools in operations research and supply chain modeling.

In conclusion, tariffs do increase costs, but the route from import tariffs to consumer wallets is indirect and dampened by the multi-layered nature of modern supply chains. The phrase "hidden tax" is often used for inflation (see, e.g., Kelly 2024); in the case of tariffs, it appears the "hidden" part looms large—hidden in supplier margins, in corporate tax statements, and in insurance premiums, rather than glaringly visible on price tags at the pharmacy or supermarket. Understanding this nuance is crucial for making informed decisions in both business strategy and public policy when navigating an era of rising protectionism and global supply chain recalibration.

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