



One of the most visible ways that Canada responded to President Donald Trump's tariffs was by sharply restricting U.S. alcohol sales. AP Photo/Jill Colvin

Canada is kicking its US booze habit as trade tensions persist

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<https://theconversation.com/canada-is-kicking-its-us-booze-habit-as-trade-tensions-persist-279918>

Almost a year and a half after President Donald Trump began slapping tariffs on nearly all U.S. trading partners, Canada's pushback has reordered the economic relationship between Ottawa and Washington.

Canadians are pulling back on U.S. travel, boycotting U.S. goods and protesting in droves - further galvanized by Trump's call for Canada to become the 51st U.S. state.

But the example of one sector in particular, U.S. alcohol, shows how quickly access to an important market can disappear - and how difficult it can be to regain.

From 2022 through 2024, Canada accounted for roughly 35% of U.S. wine exports, more than 15% of U.S. beer exports and as much as 13% of U.S. distilled spirits exports. Within just one year of Trump returning to office, Canada's imports of U.S. alcohol cumulatively have plunged over 70%, thanks to a mix of both tariff and nontariff retaliatory measures.

It's a sharp reversal from Canada's traditional role as a top foreign destination for American beer, wine and spirits. That relationship reflected both long-standing consumer preferences as well as geographic proximity and largely tariff-free access through agreements like the North American Free Trade Agreement and its successor, the United States-Mexico-Canada Agreement.

As an agricultural economist working on trade issues related to alcohol, I see Canada's alcohol sector as a textbook example of how market access for politically exposed goods can quickly unravel. And for American beer, wine and spirits producers - and for the farmers who grow the barley, grapes and corn that go into these products - the recent experience highlights how trade disputes often hit food products hardest. If a trade ban becomes entrenched, it opens a way for consumers to develop a taste for domestic as well as other foreign alternatives.



President Donald Trump's tariffs and talk of Canada as the 51st U.S. state have sparked a sustained backlash by Canadians. These protesters gathered near the Peace Bridge border crossing in Buffalo, N.Y., on April 2, 2025. AP Photo/Adrian Kraus

The Trump tariff shock

Before Trump's tariffs and talk of Canada as the 51st U.S. state, U.S. alcohol occupied substantial shelf space in major alcohol-consuming provinces such as Ontario, British Columbia and Quebec. In 2024, these exports to Canada constituted more than 20% of Canada's alcohol imports, totaling US\$744 million. For most U.S. producers, Canada served not only as a key export destination but as a stable and relatively low-risk entry point into international markets.

That changed in February 2025, when Trump, citing a national security emergency, imposed 25% tariffs on Canada and Mexico. Those tariffs - which were overturned by the Supreme Court in February 2026 - marked the first time that law was used to authorize broad tariffs.

Canada responded by slapping retaliatory tariffs of 25% on roughly \$30 billion of U.S. goods and signaling it would significantly expand countermeasures if tensions persisted. It also enacted nontariff countermeasures, most notably by letting provincial liquor authorities remove U.S. beer, wine and spirits from store shelves. These tools, which fall within Canada's system of shared federal and provincial powers, sharply restricted market access for American producers.

Immediately after Trump's announcement, eight of Canada's 10 provinces imposed partial or full bans on U.S. alcohol imports by instructing their liquor boards to stop importing and selling U.S. alcohol altogether. In many cases, American products were physically removed from store shelves and online platforms - sometimes with instructions to target imports from U.S. "red" states that had supported Trump.

U.S. wine exports were hit hardest, plunging from \$460 million to just \$103 million, while distilled spirits fell from \$238 million to \$89 million and beer exports from \$47 million to \$17 million. Collectively, these declines slashed total U.S. alcohol exports to Canada from \$744 million to \$208 million, wiping out \$536 million in trade.

US alcohol exports to Canada dropped in Trump's 2nd term

Shortly after Donald Trump took office in 2025, he announced sweeping tariffs on Canadian products. Canadians responded by shunning beer, wine and liquor from the U.S.

- Beer - Wine - Spirits

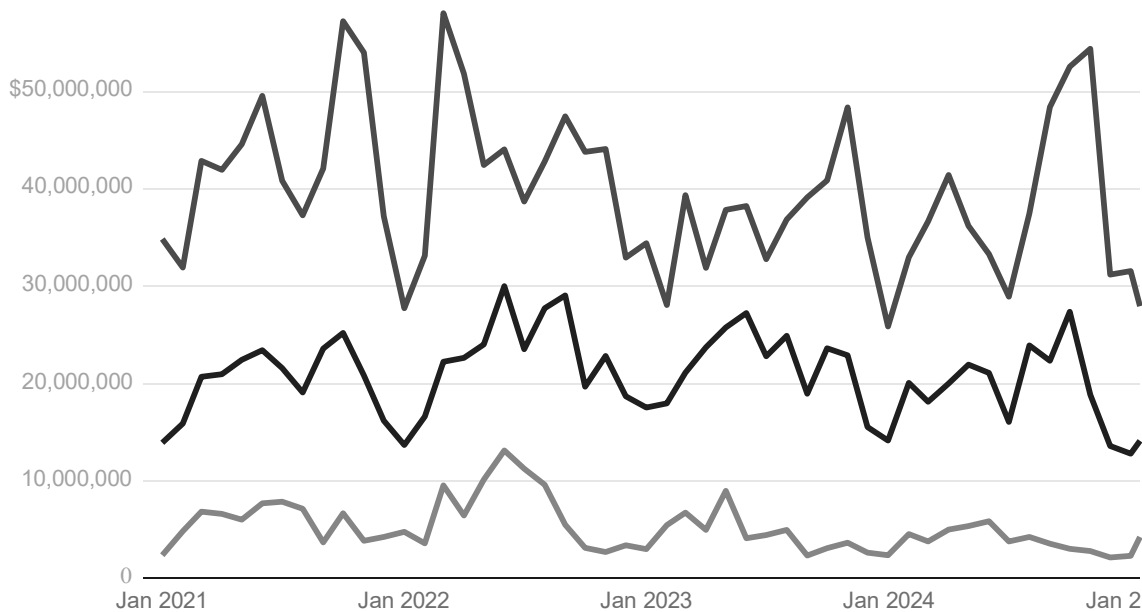


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The spat quickly became testy. The alcohol boycott is one of the reasons Trump and White House officials have called Canada "mean and nasty to deal with," in the words of U.S. Ambassador to Canada Pete Hoekstra.

The trade war's latest turn

Those provincial restrictions remained in place even after the two countries reached a partial deal exempting about half of USMCA-compliant goods from ongoing tariffs in summer 2025, leading Canada to scale back some retaliatory levies. However, the de facto trade bans on U.S. alcohol remain in place.

Alcohol resurfaced again recently as a flash point, when the top U.S. trade official, Jamieson Greer, said in April 2026 that existing U.S. levies on Canadian industrial goods would stay in place and might even be toughened until Canada walked back its alcohol restrictions. That threat drew a sharp retort from Canadian Prime Minister Mark Carney.

Meanwhile, the trade dispute hasn't prompted Canadians to drink less alcohol overall. Instead, their consumption has largely shifted to other countries, especially for wine. United Nations trade data shows that in 2024, American wine accounted for 21% of all imported wine in Canada before dropping to only 5% in 2025. That year, imports from major wine exporting countries not only increased but roughly offset the decline in imports from the U.S. For distilled spirits, the U.S. slipped from 24% in 2024 to only 10% in 2025, while beer has dropped from 13% to 5%. At the same time, Canadian imports of beer, wine, and spirits from other countries increased by 9%, 15%, and 7%, respectively.

Canadians bought less US alcohol, and more from elsewhere

In 2025, as Canadian purchases of alcohol from the U.S. plummeted, the country's consumers bought more wine, beer and spirits from other parts of the world.

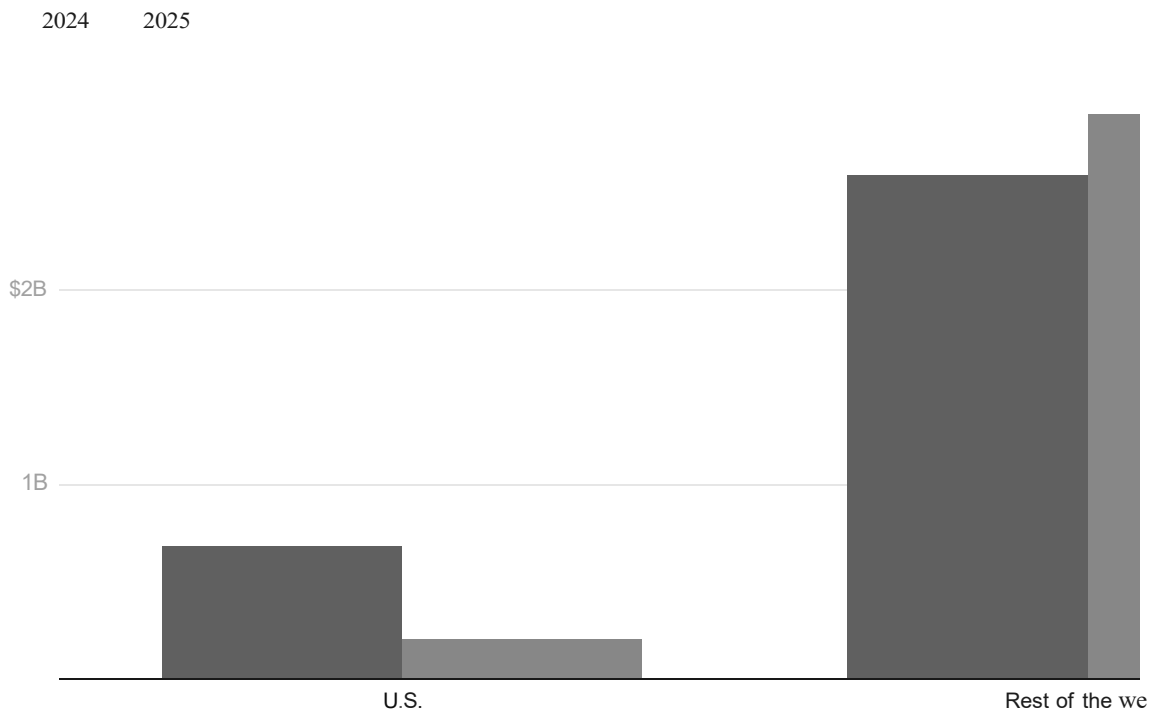


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"What's different this time is that people aren't just swapping one bottle, they're rethinking the whole bar," said Craig Peters, CEO of Canada's Barnburner Whiskey, in an interview with the online magazine VinePair. "Traditionally, those rail spots were locked up by big U.S. brands for decades. Now, we're seeing bars, especially independents, completely reset and go Canadian across the board."

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THE CONVERSATION

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The Trans-Pacific Partnership agreement covers a broad range of goods and services, including food safety standards. Simon Fanger/Unsplash, CC BY-SA

What American farmers could gain by rejoining the Asia-Pacific trade deal that Trump spurned

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<https://theconversation.com/what-american-farmers-could-gain-by-rejoining-the-asia-pacific-trade-deal-that-trump-spurned-152148>

The Eiden administration has an opportunity to recalibrate American global trade by rejoining the influential Trans-Pacific Partnership trade agreement. Signing on to this partnership has the potential to deliver powerful diplomatic and economic gains yet politically, the odds appear slim that there will be political consensus to agree to this partnership.

The U.S. began Trans-Pacific Partnership negotiations in 2008 during the Bush administration, efforts that were intensified during Barack Obama's presidency. Hammered out between the U.S. and 11 Pacific Rim countries, the intention of joining the partnership was to set trade policy and greatly expand U.S. trade and investment in the Asia-Pacific region. President Obama signed the agreement in 2016 and less than a year later, immediately after Donald Trump's inauguration, the U.S. withdrew from the agreement.

Rejoining the partnership, renamed the Comprehensive and Progressive Agreement for Trans-Pacific Partnership in 2018, could signal to the world that the U.S. is back in the global engagement arena. It would also strike a stark contrast to the previous administration's bilateral and nationalistic approach, which has resulted in tensions with major U.S. trading partners. Aside from improved trade relations, rejoining the this agreement would counter China's economic and geopolitical influence in the Asia-Pacific region.

Both of us have worked extensively with the U.S. Department of Agriculture on trade policy issues. As economists specializing in international agricultural trade, our research demonstrates that the U.S. would benefit from rejoining the trade accord and, in particular, American agriculture.

Pathway to a Southeast Asia trade agreement



International trade agreements can reduce uncertainty for trading partners in the marketplace. Marco Pregolato/Unsplash

Regional trade agreements like the Trans-Pacific Partnership can go far beyond tariffs to tackle deeper trade and domestic issues such as investment, labor, migration, competition, intellectual property and, in some cases, key regulatory issues governing food safety standards.

Although agriculture comprises only about 10% of total U.S. exports, the agricultural sector in the U.S. and other countries account for a large share of trade policy considerations. Rejoining the accord has the potential to establish economic ties with emerging economies like Vietnam and Malaysia and embrace the need for improved trade relations in Southeast Asia overall.



Shipping cranes at the Port of Seattle. Andy Li/Unsplash

The Comprehensive and Progressive Agreement for Trans-Pacific Partnership could be the easiest path forward if the U.S. wanted to improve trade relations with Southeast Asia. Joining this partnership could be especially beneficial based on the volume of agricultural trade and expected growth in these markets. At an approximate US\$14.3 billion annually, Southeast Asia accounts for a significant amount of U.S. agricultural exports, making it the fourth-leading destination behind China, Canada and Mexico.

US agricultural and related exports to Southeast Asia

Country	2019 trade	RCEP member	CPTPP member
Vietnam	\$4.0 billion	Yes	Yes
Philippines	\$3.0 billion	Yes	No
Indonesia	\$2.9 billion	Yes	No
Thailand	\$1.9 billion	Yes	No
Malaysia	\$1.2 billion	Yes	Yes
Singapore	\$1.0 billion	Yes	No

Burma, Cambodia, Brunei, Laos and Timor-Leste are not listed. Together, these countries account for approximately \$250 million in U.S. agricultural and related product exports. RCEP is the Regional Comprehensive Economic Partnership. CPTPP is the Comprehensive and Progressive Agreement for Trans-Pacific Partnership.

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A return to global engagement

The Trans-Pacific Partnership was seen as an opportunity for the U.S. to shape regional and global trade rules, potentially influencing economic policies and practices in China. However, there are concerns that need to be addressed if the U.S. were to join the Comprehensive and Progressive Agreement for Trans-Pacific Partnership.



Colorful Japanese wine barrels in Tokyo. Manuel Velasquez/Unsplash

There are important differences between the agreement signed under Obama in 2016 and the Comprehensive and Progressive Agreement for Trans-Pacific Partnership. Provisions important to the U.S. were changed in the subsequent agreement, such as the investment and intellectual property provisions that offered improved standards on intellectual property relative to past trade agreements. The provisions fall short of the more stringent requirements in the earlier Trans-Pacific Partnership.

What are the odds?

Like all trade agreements, joining the partnership would require congressional approval. Historically, Republicans have been more supportive of trade agreements. But President Trump's rhetoric, that past trade agreements have been "disastrous" for the U.S. economy, may have lessened Republican support for an agreement like the Comprehensive and Progressive Agreement for Trans-Pacific Partnership.

President Joe Biden quickly rejoined the Paris Climate Agreement and reversed President Trump's decision to withdraw from the World Health Organization, showing that the U.S. is back in the global engagement area.

Mega-regional trade agreements offer more than a forum for negotiating trade barriers. They establish procedures that reduce uncertainty in international transactions, make rules that are clear to members and provide an institutional framework to remedy trade concerns or disputes. If the Biden administration wants to signal to the world that the U.S. is pivoting to a more expansive global engagement, joining the Comprehensive and Progressive Agreement for Trans-Pacific Partnership could be an initial step.

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THE CONVERSATION

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Trump's tariffs on Canada and Mexico could spell trouble for distilled spirits

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Bottles of tequila are displayed at a California Safeway store on March 3, 2025.
Justin Sullivan/Getty Images

<https://theconversation.com/trumps-tariffs-on-canada-and-mexico-could-spell-trouble-for-distilled-spirits-251583>

If [all the tariff drama](#) in the news lately has you reaching for a stiff drink, you're not alone.

Unfortunately, those same tariffs might make it harder to get your hands on your favorite brand of tequila.

In early March 2025, U.S. President Donald Trump levied import tariffs of 25% on [goods from Canada and Mexico](#), following through on a promise he made back in November 2024. While he later partially reversed course, [suspending tariffs on some goods](#), tensions remain high. Mexico is largely [holding off on retaliation](#), but Canada [quickly fired back with counter-tariffs](#) on billions of dollars' worth of U.S. products.

These trade tensions spell trouble for numerous industries, including the booming spirits market. Canada and Mexico - two of the [top U.S. trading partners](#) - accounted for nearly half of the [US\\$ 9 billion](#) in distilled spirits the U.S. imported in 2024.

As an [agricultural economist](#), I've analyzed how a 25% tariff could [affect tequila, whiskey and other distilled spirits](#) - and the results weren't pretty. I found that these tariffs would cost distilled spirit importers over \$1 billion in lost trade, with tequila alone taking a more than \$800 million hit.

Americans' thirst for imported liquor

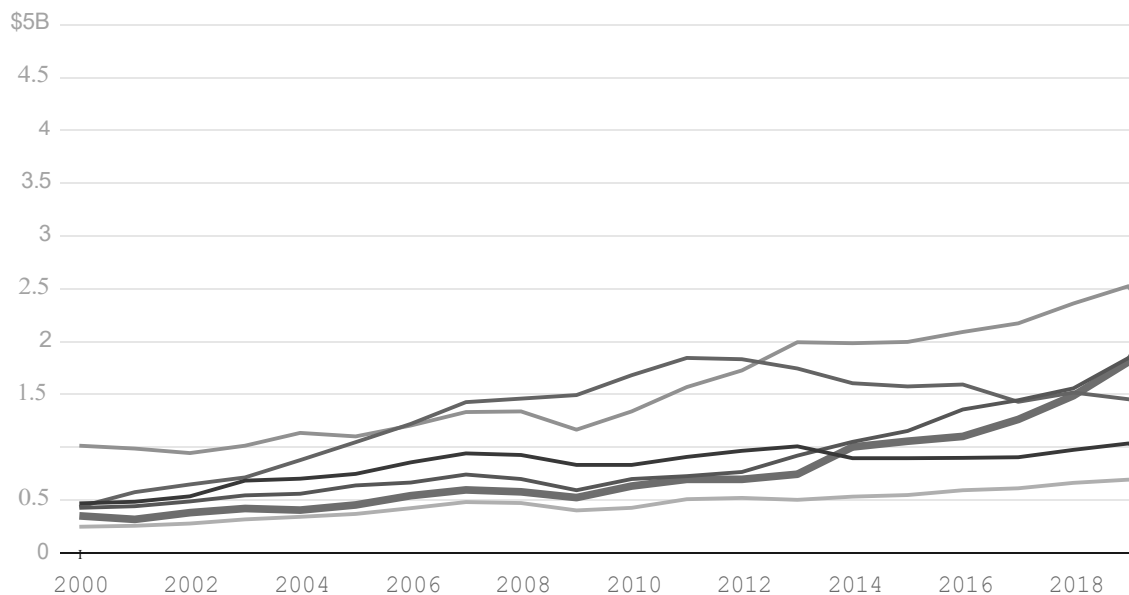
The U.S. imports far more distilled spirits than it exports - five times as much by value, as of 2024.

Since 2000, U.S. imports of distilled spirits have surged by more than 300%, driven largely by the explosive rise in tequila consumption. Between 2000 and 2024, tequila imports rose by 1,400%, skyrocketing from \$350 million to \$5.4 billion.

Americans increasingly love imported liquor

A comprehensive look at U.S. distilled spirits imports by category suggests the U.S. has developed a taste for tequila since the Obama years.

- Tequila - Whiskey - Liqueurs and cordials - Brandy - Vodka - Other spirits



Note: Tequila includes mescal, brandy is from grapes only, and "other spirits" includes gin, rum and distilled spirits not specified elsewhere. All figures in billions of dollars.

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While imports of whiskey, liqueurs, vodka and brandy also grew, none matched tequila's explosive rise. Tequila now represents 45% of all spirits imported into the U.S., up from 12% in 2000.

Not surprisingly, 99% of tequila and mezcal is imported from Mexico, making it the leading foreign supplier of distilled spirits to the United States. Meanwhile, Canada has supplied between 4% and 6% of U.S. spirits imports over the past two decades, primarily whiskey and liqueurs.

Since distilled spirits are classified as agricultural products, their rising imports have significantly contributed to the U.S. agricultural trade deficit. However, this isn't necessarily a problem. Imports help meet demand from U.S. consumers, generate value-added opportunities for U.S. companies, and support economic activity in bars, liquor stores, restaurants and beyond.

A 25% tariff on Mexican goods is a 25% tax on tequila

In my study, published in February in [the peer-reviewed journal Agribusiness](#) and in a follow-up [policy brief](#), I found that 25% tariffs on Mexico and Canada could reduce imports of distilled spirits by \$1.2 billion. This loss exceeds the total amount of tax revenue those tariffs can expected to bring in.

How 25% tariffs on Mexico and Canada could change the spirits industry

The Trump administration's plan could deal a big hit to the tequila market.

Product	2024 imports by value	2024 share of imports	Projected imports after tariffs	Projected change in imports after tariffs	Projected tariff revenue
Tequila	\$5.358	45%	\$4.548	-\$810M	\$910M
Whiskey	\$1.838	15%	\$1.738	-\$1QOM	\$70M
Vodka	\$1.21B	10%	\$1.088	-\$130M	\$0
Liqueurs and cordials	\$1.418	12%	\$1.238	-\$1B0M	\$70M
Brandy	\$1.298	11%	\$1.288	-\$10M	0
Other imported spirits	\$810M	7%	\$BOOM	-\$10M	\$20M
Total	\$11.908	100%	\$10.68 billion	-\$1.238	\$1.068

Unsurprisingly, tequila imports would be the hardest hit, falling by \$810 million. I found that the tariff revenue from tequila - \$910 million - could actually exceed the corresponding fall in imports. That's because demand for tequila, like most [alcoholic beverages](#), is what economists call "inelastic," meaning that when prices rise, consumers are unlikely to change their purchasing decisions by very much.

However, it would be a mistake to consider tequila in isolation. When I factored in other notable decreases, such as a \$100 million drop in whiskey imports, I found that the value of total trade losses, in the form of decreased imports, would outweigh the total tariff revenue. I also found that no product category would come out ahead.

In fact, even products like vodka, which are mostly exempt from these tariffs, would be indirectly affected. This is because tariffs can [increase the overall cost of importing](#), leading businesses to reduce all imports, tariffed or otherwise. My research suggests that this "trade destruction" effect, to use an economics term, will be quite significant.

A new era of tariffs

The Trump administration has argued that tariffs will generate a lot of money for the federal government. But my research suggests those gains may not outweigh the economic costs to businesses and consumers.

Contrary to common belief, trade losses don't just affect exporting countries. Domestic consumers also face higher prices and fewer choices - hurting their overall economic welfare. Reducing imports also affects U.S. businesses involved in marketing, distribution and sales.

Trade is more complex than a simple formula of "exports good, imports bad." Research makes it clear that tariffs have negative consequences, including higher consumer prices, reduced product availability and downstream economic disruption. Policymakers would be wise to take those effects seriously. Otherwise, they might find themselves with a serious economic hangover.

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Canadian lumber waits for shipment in a sawmill's yard. Andrej Ivanov/Getty Images

Why higher tariffs on Canadian lumber may not be enough to stimulate long-term investments in US forestry

Published: October 15, 2025 8:52am EDT

<https://theconversation.com/why-higher-tariffs-on-canadian-lumber-may-not-be-enough-to-stimulate-long-term-investments-in-us-forestry-265713>

Lumber, especially softwood lumber like pine and spruce, is critical to U.S. home construction. Its availability and price directly affect housing costs and broader economic activity in the building sector. The U.S. imports about 40% of the softwood lumber the nation uses each year, more than 80% of that from Canada.

President Donald Trump says that the U.S. has the capacity to meet 95% of softwood lumber demand and directed federal officials to update policies and regulatory guidelines to expand domestic timber harvesting and curb the arrival of foreign lumber.

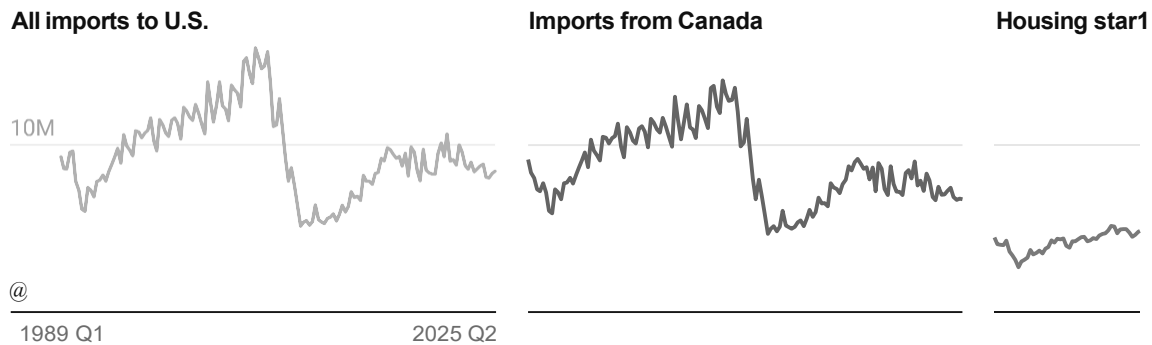
On Sept. 29, 2025, he announced new tariffs on imported timber and wood products, including an additional 10% tariff on Canadian lumber. Those were added to 35% tariffs imposed on Canadian lumber in August. It was the latest phase in a long-standing dispute over the supply of lumber to builders in the U.S., which dates back to the 1980s, when U.S. producers began arguing that Canadian companies were benefiting from unfair subsidies from their government. Starting on Oct. 15, Canadian softwood lumber imports could face tariffs exceeding 45%.

As researchers studying the forestry sector and international trade, we recognize that the U.S. has ample forest resources. But replacing imports with domestic lumber isn't as simple as it sounds.

There are differences in tree species and quality, and U.S. lumber often comes at a higher cost, even with tariffs on imports. Challenges like limited labor and manufacturing capacity require long-term investments, which temporary tariffs and uncertain trade policies often fail to encourage. In addition, the amount of lumber imported tends to mirror the boom-and-bust cycles of housing construction, a dynamic that tariffs alone are unlikely to change.

US lumber imports and housing starts rise and fall together

Since 1989, federal data shows that trends in lumber imports - the vast majority of which are from Canada - track closely with construction of new housing.



Lumber imports data in cubic meters, using Harmonized System classification 4407.

Chart: The Conversation, CC-BY-ND • Source: Lumber imports: U.S. Department of Agriculture, Global Agricultural Trade System; Housing starts: Federal Reserve Bank of St. Louis • Get the data • Embed • Download image • Created with

Trump's moves

To boost U.S. logging, in March, Trump issued an executive order telling the departments of Interior and Agriculture to ease what he called "heavy-handed" regulations on timber harvesting. The executive order and a follow-up memo from Agriculture Secretary Brooke Rollins do not spell out specifics, but officials say more details are in the works that will simplify the timber harvesting process, with the goal of boosting domestic timber production by 25%.

That same month, Trump ordered the Commerce Department to assess how imports of timber, lumber and related wood products affect U.S. national security.

While that assessment was underway, in July, the Commerce Department published findings from a trade review of 2023 Canadian lumber imports. That inquiry alleged that Canadian companies were selling lumber to the U.S. at unfairly low prices, potentially leaving U.S. producers with lower sales or depressed prices. That finding was cited as the basis for the 35% August tariff announcement.

In its national security investigation initiated in March, the Commerce Department concluded that an overreliance on imported wood products means "the United States may be unable to meet demands for wood products that are crucial to the national defense and critical infrastructure." The September tariff announcement is based on those findings.



Canadian timber harvesting continues, despite uncertainty about trade with the U.S. Artur Widak/NurPhoto via Getty Images

Canadian lumber in the US market

In 1991, the U.S. imported 11.5 billion board feet (27 million cubic meters) of Canadian lumber. Those imports rose to a high of 22 billion board feet (52 million cubic meters) by 2005.

But as housing construction declined - especially during the Great Recession from 2007 to 2009 - imports dropped sharply, to less than 8.4 billion board feet (20 million cubic meters) in 2009. The current volume has not recovered to prerecession levels, rising only to 12 billion board feet (28 million cubic meters) in 2024.

The value of Canadian lumber has also fluctuated. Historically, prices for Canadian lumber have averaged about US\$330 per thousand board feet (\$140 per cubic meter). During and after the COVID-19 pandemic, import prices soared to almost \$800 per thousand board feet (\$340 per cubic meter). But since peaking in 2021 and 2022, prices have dropped significantly to \$436 per thousand board feet (\$185 per cubic meter) by 2024.

In total, in 2024, the U.S. imported more than \$11 billion in forest and wood products from Canada. Softwood lumber accounted for almost half of that.

Lumber and housing

As personal income rises and populations grow, people seek to build new homes. As new home construction - called "housing starts" in economic data - increases, so does demand for softwood lumber to build those homes. And when housing starts slow, so does lumber demand.

For instance, housing starts fell during the Great Recession. They declined from a January 2006 peak of 2.3 million to less than 500,000 in January 2009 - a decrease of nearly 80%. In that same period, imports of Canadian lumber fell by more than 60%. Domestic softwood lumber production fell by more than 40%.

Both domestic and imported lumber prices can directly influence the overall cost of building homes, which in turn affects housing affordability. That said, lumber used for framing usually accounts for less than 10% of the total cost to build a new home. The effects of tariffs on new home construction may be significantly less than other factors, such as rising labor costs.

There are different kinds of wood commonly used in building lumber.

A matter of choice

The U.S. has a lot of potential lumber available. Especially in the South, the inventory of harvestable lumber has grown significantly over many years.

However, the types of wood available in the U.S. are not always the same as what's available from Canadian imports. For framing, contractors may prefer spruce, northern pines and fir, naturally abundant in Canada, because they are lighter and less likely to warp than southern yellow pine, which is abundant in the southern U.S. Southern yellow pine is more commonly used to make utility poles and preservative-treated lumber for outdoor construction projects, such as decks.

Lumber from Idaho, eastern Oregon and eastern Washington, however, does share characteristics with Canadian species and could take the place of at least some Canadian lumber.

As the Trump administration seeks to boost domestic lumber, buyers will be looking not only at where their lumber came from, but what it costs and what type of lumber is best for what they need to accomplish.

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The US Beef Industry in a Time of Trade Tensions

Andrew Muhammad, Charles Martinez, and Parker Wyatt

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Since his inauguration in January 2025, President Trump has systematically raised tariffs on imports from nearly all major trading partners. These measures have been enacted under authorities such as the International Emergency Economic Powers Act and Section 232 of the Trade Expansion Act (Burkhart and Hammond, 2025). Tariffs can reduce trade, investment, and output by increasing costs and disrupting supply chains, often leading to long-term inefficiencies. Trade policy uncertainty further amplifies these effects by discouraging business investment and slowing economic decision-making—even in the absence of new tariffs (Luckstead and Devadoss, 2025). For the US beef sector, already grappling with supply constraints and global competition, these trade actions have added pressure to an already strained industry.

The beef sector remains a cornerstone of American agriculture, having undergone notable transformations over the past decade. Both imports and exports play a crucial role in shaping the US beef industry and agricultural trade overall. Although imports account for only 17% of US beef consumption and exports represent 10% of domestic production (USDA-FAS, 2025a), beef consistently ranks among the top 10 agricultural imports and top 5 agricultural exports in the United States (USDA-FAS, 2025b).

Figure 1 shows US beef consumption and trade from 2010 to 2024. Consumption has remained relatively stable, with modest growth, from around 26 billion pounds in 2010–2012 to almost 29 billion pounds in 2024. During this period, imports have grown significantly, rising from about 2.3 billion pounds to 4.6 billion pounds, with the fastest growth occurring in the last few years. Exports also increased overall but at a slower pace, peaking around 2018 before slightly declining. The widening gap between imports and exports in recent years suggests increasing reliance on foreign countries for US demand. It is important to note, however, that most beef imports are different from exports. The US usually imports leaner and lower-cost

cuts used for ground beef production, while exports are mostly high-value, grain-fed cuts like steaks and ribs that appeal to premium markets abroad (Brower, 2022).

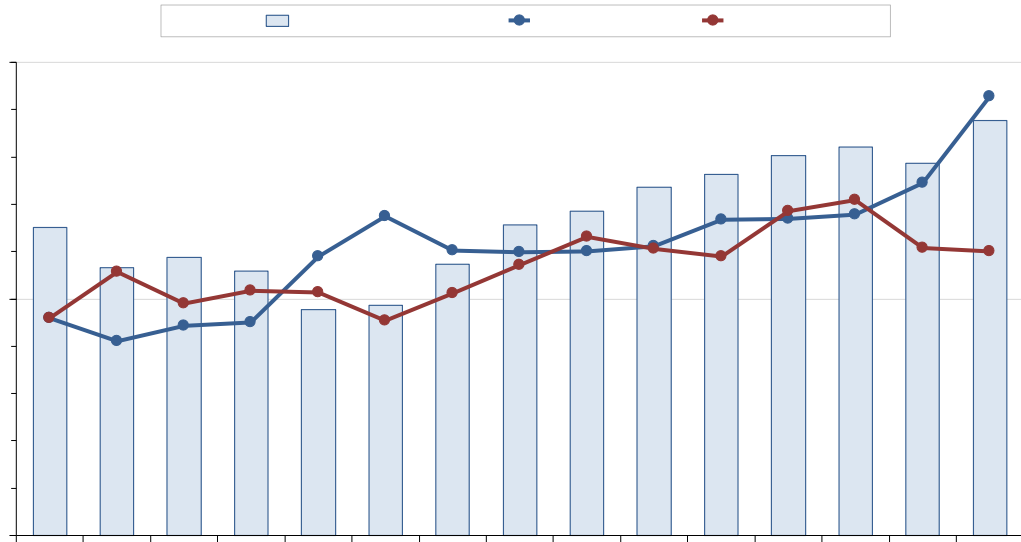
In this article, we examine recent trends in US beef production and trade, highlighting how the sector has adapted to shifting global consumption patterns and domestic supply constraints. We also assess the impact of recent tariffs and trade tensions on US beef imports from key suppliers such as Canada, Mexico, and Brazil. While these policies are often framed as protective measures for American producers, they may inadvertently raise costs for processors and consumers. On the export side, we explore the effects of current trade tensions and how major beef-producing countries like Brazil have expanded their global market share, outcompeting US beef in key international markets.

This article provides a comprehensive overview of how trade tensions, international competition, and shifting supply and demand have collectively influenced the structure and performance of the US beef industry in recent years. Understanding these shifts is essential not only for policymakers and industry stakeholders but also for consumers, whose choices and costs are increasingly shaped by international trade.

Shrinking Herds and Rising Prices

Understanding the current state of US cattle inventory and beef production is essential to evaluating trade dynamics, as domestic supply levels directly influence imports, exports, and prices. The US cattle herd has continued to shrink, marking sixth straight years of decline. According to the USDA January 2025 cattle report (USDA-NASS, 2025), the total number of cattle and calves dropped by about 1% from the previous year, bringing the herd inventory to its lowest level since 1952. This ongoing reduction is part of a broader cattle cycle that began in 2014 and has now lasted 11 years, resulting in the third-longest decline in US history.

Figure 1. US Beef Consumption and Trade, 2010–2024



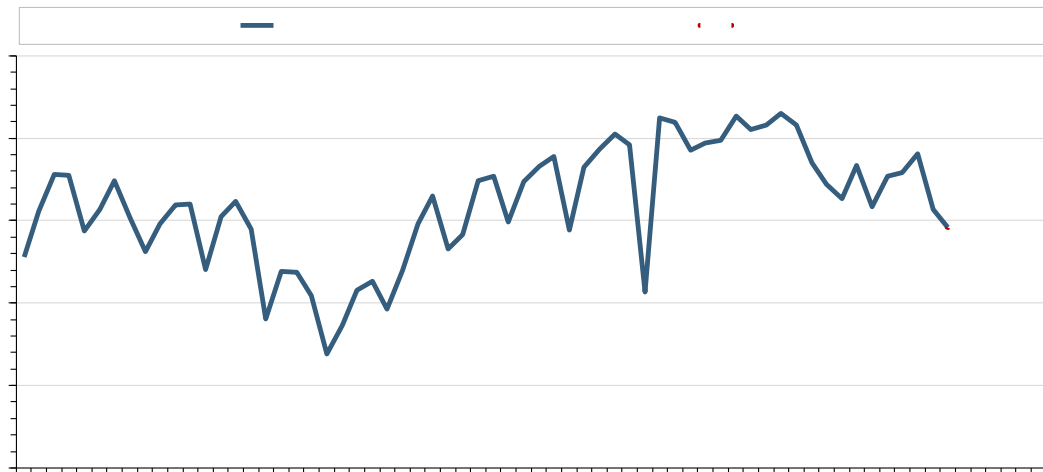
Source: USDA-FAS (2025a).

As expected, lower cattle inventories translate directly into reduced beef production. Figure 2 shows quarterly US beef production from the first quarter of 2010 through the second quarter of 2025, with forecasts extending through the third quarter of 2026 (LMIC, 2025; USDA-AMS, 2025). Production peaked in the third quarter of 2022 at 7.1 billion pounds and has since trended downward. Over the past 15 years, the average quarterly production has been approximately 6.5 billion pounds. The most recent data from the second quarter

of 2025 show production at less than 6.4 billion pounds, slightly below the long-term average.

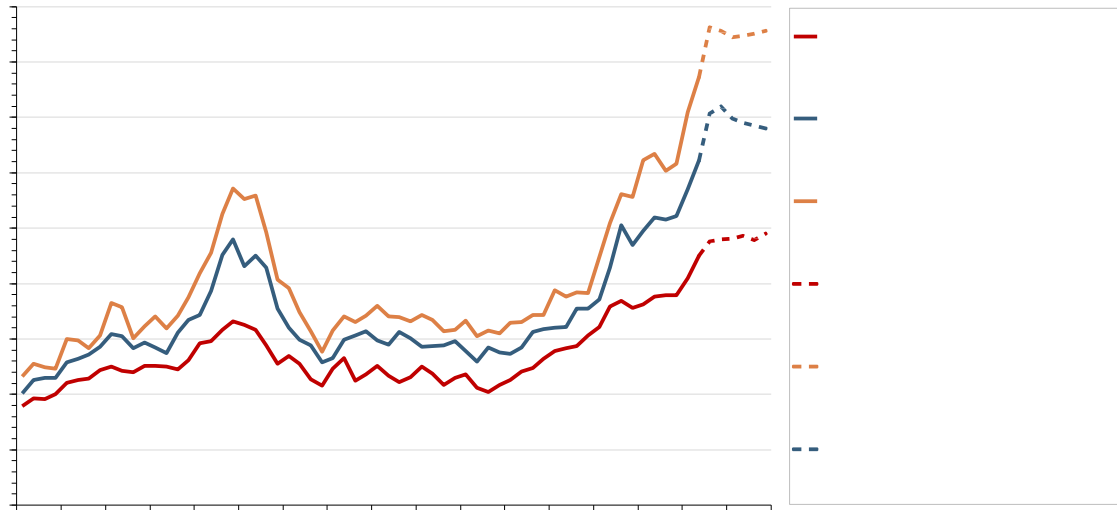
Forecasts for 2025 and 2026 suggest continued declines in production due to two key factors: heifer retention and overall herd reduction. Both contribute to fewer cattle available for slaughter, reinforcing the downward trend in beef supply. These production levels are not surprising given the persistent liquidation of the cattle herd and the structural constraints facing producers (Figure 2).

Figure 2. US Beef Production and Forecasts, 2010:Q1–2026:Q3



Source: USDA-AMS (2025), LMIC (2025).

Figure 3. US Feeder and Slaughter Steer Prices and Forecasts, 2010:Q1–2025:Q3



Source: USDA-AMS (2025), LMIC (2025).

Reduced production has led to noticeable price increases at the retail level. During the first half of 2025, the average price for all fresh beef rose from \$8.15 per pound in January to \$8.90 per pound in July (USDA-ERS, 2025). Ground beef, a highly consumed product, increased from \$5.50 to \$6.25 per pound over the same period. These price movements reflect tightening supply and signal broader inflationary pressures within the beef supply chain.

Historically, the US beef industry has relied on the live cattle trade to supplement domestic supply. Imports of feeder calves from Mexico and Canada help offset tight cattle inventories but have faced recent disruptions. In November 2024, the Animal and Plant Health Inspection Service announced restrictions on livestock imports from Mexico due to an outbreak of New World screwworm (NWS) in Mexico's southern region. Feeder cattle typically enter the United States in the spring and fall and account for roughly 5% of total placements annually (Anderson, Maples, and Martinez, 2024). In southern states, that figure rises to approximately 18% (Anderson, 2025).

The November ban resulted in the loss of one month of feeder cattle imports in 2024 and two months in early 2025. Although the border reopened briefly in March, imports were suspended again in May due to rising NWS cases. As of this writing, the ban remains in effect, effectively nullifying a key source of supply for the US beef industry. Live cattle imports from Canada also declined, albeit slightly, in 2025 (USDA, 2025; USDA-FAS, 2025b).

The shortage of domestic and imported feeder cattle has driven prices to record highs. Figure 3 shows quarterly prices for feeder and slaughter steers from the first quarter of 2010 through the second quarter of 2025, with projections through the third quarter of 2026. Steer prices (500–600 lb) rose from around \$116 per hundredweight in the first quarter of 2010 to almost \$286 in 2014, driven by drought and tight supply. That year also marked the beginning of the current cattle cycle.

Improved prices during the early years of the cycle led to herd expansion, followed by a correction and price declines from 2017 to 2020. Since then, prices have rebounded sharply. In the second quarter of 2025, 500–600 lb steers reached a record \$386.73 per hundredweight—a 179% increase over 9 years. Similar trends are observed for 700–800 lb steers and slaughter cattle (Figure 3).

With record-high beef prices and higher costs for replacement cattle, producers are likely to continue liquidating herds rather than rebuilding. This trend is expected to sustain high cattle prices in the near term. Ultimately, factors such as weather conditions, feed costs, and consumer willingness to pay for beef will determine when herd expansion resumes.

Trade Tensions and US Beef Imports

Next, we examine US beef import trends to determine whether recent trade tensions have influenced imports. In 2024, the United States was the second-largest beef-importing country in the world (United Nations, 2025). Beef imports supplement the domestic supply, especially during periods of low cattle inventory or shortages,

Table 1. US Fresh and Chilled and Frozen Beef Imports: 2024 and 2025 Year-to-Date (January–July) Comparison

Source	Fresh and Chilled			Source	Frozen		
	Jan.–July 2024	Jan.–July 2025	%Δ		Jan.–July 2024	Jan.–July 2025	%Δ
	Value (\$ billions)				Value (\$ billions)		
World (total)	3.21	3.62	12.6	World (total)	2.45	4.05	65.5
Canada	1.36	1.41	3.9	Australia	0.74	1.20	62.6
Mexico	0.96	1.07	11.0	Brazil	0.42	0.89	112.3
Australia	0.56	0.74	31.1	New Zealand	0.69	0.82	18.4
	Quantity (000 MT)				Quantity (000 MT)		
World (total)	387.56	405.14	4.5	World (total)	439.18	655.11	49.2
Canada	183.54	174.34	-5.0	Australia	126.32	178.51	41.3
Mexico	114.60	124.60	8.7	Brazil	86.51	177.50	105.2
Australia	50.08	61.56	22.9	New Zealand	121.61	123.09	1.2
	Unit Value/Price (\$/kg)				Unit Value/Price (\$/kg)		
World (total)	8.29	8.93	7.7	World (total)	5.58	6.19	10.9
Canada	7.41	8.10	9.4	Australia	5.83	6.71	15.1
Mexico	8.38	8.55	2.1	Brazil	4.84	5.00	3.4
Australia	11.25	12.00	6.6	New Zealand	5.71	6.67	17.0

Note: Fresh and chilled beef is defined according to HS 0201: meat of bovine animals, fresh or chilled; frozen beef is defined according to HS 0202: meat of bovine animals, frozen.
Source: USDA-FAS (2025b).

ensuring consistent availability for consumers (Calil, 2024). Imports of lean beef trimmings are essential for producing ground beef, while feeder cattle from Mexico and Canada support feedlot operations (Brower, 2022; USDA-FAS, 2025b). Imports also help stabilize prices and buffer market disruptions such as droughts and disease outbreaks. While almost all live cattle imports are from Canada and Mexico, beef imports are more diversified (USDA-FAS, 2025b).

Table 1 presents a year-to-date comparison of US imports of fresh and chilled and frozen beef from January to July in 2024 and 2025, detailing changes in import value, quantity, and unit value (price) across major trading partners. Despite recent trade tensions, US beef imports experienced significant growth in 2025, with both fresh and chilled and frozen beef increasing in value and volume. Fresh and chilled beef imports rose by 12.6% in value and 4.5% in quantity, driven by moderate gains from Mexico and Australia. Canada remained the largest supplier in this category, though its volume slightly declined. In contrast, frozen beef imports surged by 65.5% in value and 49.2% in volume, with Brazil and Australia showing the most significant increases. Brazil’s frozen beef exports to the US more than doubled in both value and volume, reflecting its growing competitiveness in the global market.

Prices—as measured by unit values—also increased for most sources, suggesting rising demand and possible supply constraints. For example, frozen beef from New

Zealand saw a 17% increase in price, while fresh and chilled beef from Canada rose by 9.4%.

The sharp rise in frozen beef imports from countries like Brazil reflects both a response to domestic supply challenges and a shift toward more competitive international suppliers. However, recent trade tensions may begin to dampen this trend. Earlier in 2025, Mexico and Canada faced tariffs of 25% and 35%, respectively, largely due to concerns over border security and drug trafficking. Australia, New Zealand, and Brazil were impacted by the “Liberation Day” tariffs, which began at approximately 10%, while Brazil was hit with an additional 40% tariff due to the prosecution of former President Bolsonaro. Imports from Canada and Mexico may be exempt under USMCA origin provisions, and tariffs on Australia, New Zealand, and Brazil had not yet been implemented at the time of this article (Burkhart and Hammond, 2025). However, we are starting to see the impact of these policies take effect. For instance, frozen beef imports from Brazil and New Zealand in July 2025 were down 25% and 14%, respectively, compared to July 2024 (USDA-FAS, 2025b). This decline suggests that tariffs and resulting trade tensions are starting to impact beef imports.

Recent Trends in US Beef Exports

The United States is one of the largest beef-exporting countries in the world, ranked third in value behind Brazil and Australia in 2024 (United Nations, 2025). While

Table 2. US Fresh and Chilled and Frozen Beef Exports: 2024 and 2025 Year-to-Date (January–July) Comparison

Destination	Fresh and Chilled			Destination	Frozen		
	Jan.–July 2024	Jan.–July 2025	%Δ		Jan.–July 2024	Jan.–July 2025	%Δ
	Value (\$ billions)				Value (\$ billions)		
World (total)	2.61	2.37	-9.1	World (total)	2.70	2.55	-5.4
South Korea	0.54	0.53	-1.5	South Korea	0.68	0.82	20.6
Mexico	0.52	0.52	-1.1	Japan	0.32	0.40	24.8
Japan	0.54	0.43	-20.1	China	0.70	0.38	-46.0
Canada	0.40	0.36	-9.6				
	Quantity (000 MT)				Quantity (000 MT)		
World (total)	231.00	199.59	-13.6	World (total)	331.67	316.81	-4.5
South Korea	39.88	40.32	1.1	South Korea	87.36	101.12	15.8
Mexico	53.80	47.13	-12.4	Japan	62.17	74.11	19.2
Japan	60.39	47.07	-22.1	China	79.12	43.94	-44.5
Canada	36.35	31.66	-12.9				
	Unit Value/Price (\$/kg)				Unit Value/Price (\$/kg)		
World (total)	11.29	11.88	5.2	World (total)	8.13	8.05	-0.9
South Korea	13.56	13.22	-2.5	South Korea	7.83	8.16	4.2
Mexico	9.74	11.00	12.9	Japan	5.20	5.44	4.7
Japan	8.89	9.12	2.5	China	8.82	8.58	-2.7
Canada	10.90	11.32	3.8				

Note: Fresh and chilled beef is defined according to HS 0201: meat of bovine animals, fresh or chilled; frozen beef is defined according to HS 0202: meat of bovine animals, frozen.

Source: USDA-FAS (2025b).

export values are comparable across the three countries—\$9.1 billion in fresh, chilled, and frozen beef exports for the United States versus \$11.7 billion for Brazil and \$9.3 billion for Australia—both Brazil and Australia export significantly more than the United States in terms of quantity. This was due to US beef prices (\$9.48/kg) being significantly higher than Brazil (\$4.58/kg) and Australia (\$6.52/kg) (United Nations, 2025). US beef is grain-finished and is considered higher value in global markets, whereas beef from countries such as Australia, New Zealand, and Brazil is mostly grass-finished, which can reduce quality and consumer appeal (Melton et al., 1982).

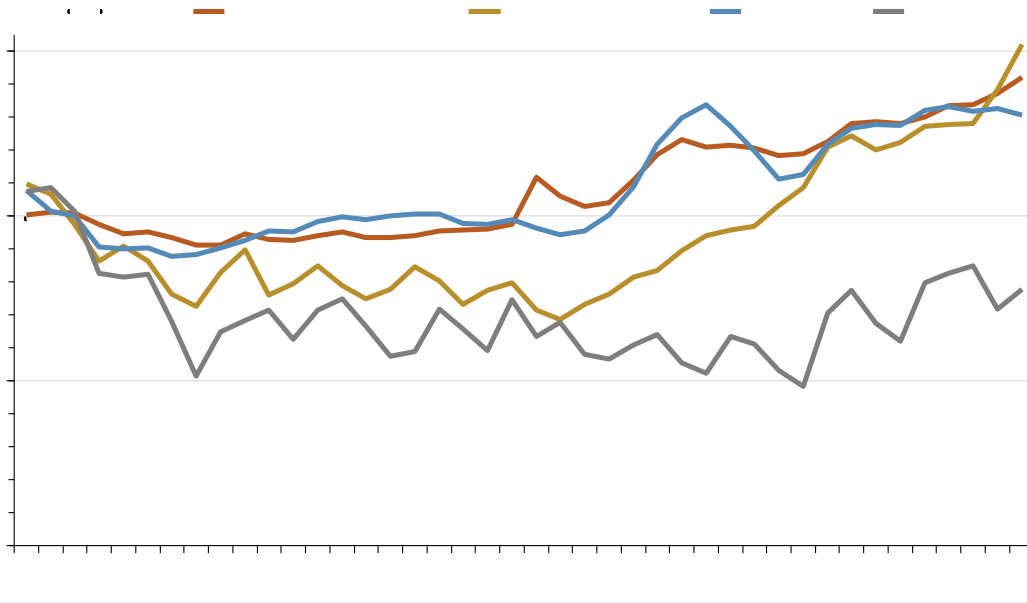
Unlike US beef imports, export trends have been more negative in 2025, particularly for fresh and chilled beef and frozen beef exports to China. This may be the result of rising global competition and shifting consumer preferences, but it could also be due to US trade policies, which have introduced uncertainty and increased costs for foreign buyers of American beef.

Table 2 presents a year-to-date comparison of US exports of fresh and chilled, and frozen beef from January to July in 2024 and 2025, detailing changes in import value, quantity, and unit value (price) across major destination countries. US beef exports declined in early 2025, with both fresh and chilled and frozen categories showing year-to-date decreases in value and

volume compared to the same period in 2024. Fresh and chilled beef exports fell by 9.1% in value and 13.6% in volume, with notable declines to Japan (–20.1% in value; –22.1% in volume) and Canada (–9.6% in value; –12.9% in volume). Frozen beef exports dropped 5.4% in value, driven largely by a sharp 46% decline in exports to China. However, some markets showed growth in value in 2025: South Korea increased its frozen beef imports by 20.6%, and Japan by 24.8%. Export prices, on the other hand, have been relatively stable compared to import prices.

The significant decline in frozen beef exports to China warrants further discussion. In response to US tariffs, China imposed retaliatory tariffs exceeding 100% earlier this year. Although those tariffs have since been reduced to around 33% (Bown, 2025), the ongoing trade tensions appear to have negatively impact US beef in the Chinese market. In addition, in March 2025, the Chinese government allowed export registrations for nearly 400 beef processing facilities to expire, effectively revoking market access for about 60% of all US facilities authorized to export to China (Marianetti, 2025). According to China customs data, total beef imports from January to July rose by 5.1% compared to the same period last year. Notably, imports from Brazil increased by 19.1%, while imports from the United States declined over the same period (Trade Data Monitor, 2025).

Figure 4. Selected Beef and Cattle Price Indexes and CPI, 2015:Q1–2025:Q2



Source: CPI, both all goods and beef and veal, Bureau of Labor Statistics; Slaughter Steer, USDA Agricultural Marketing Service; Exports and Imports, USDA, Foreign Agricultural Service.

Price Comparisons and Inflation

In this final section, we compare import and export prices, domestic beef prices, and cattle prices to overall inflation. This is important for understanding how trade dynamics and broader economic pressures are influencing costs throughout the beef supply chain. Price indexes from 2015–2025 are reported in Figure 4. Early in the period, retail beef prices (beef and veal CPI) and export prices closely tracked overall inflation (CPI), while slaughter steer prices fell below the inflation rate. Import price indexes also dipped during these years. By 2018–2019, retail beef prices stabilized near CPI, but export prices lagged slightly. The pandemic years (2020–2021) brought sharp disruptions: Retail beef prices climbed above CPI, and export prices rose even faster, driven by strong foreign demand and supply chain constraints. Notably, the most significant increase was observed in steer prices post-pandemic. In contrast, import prices remained relatively flat. From 2022 onward, consumer, export, and steer prices all outpaced CPI, reflecting persistent inflationary pressures and tightening supply in the industry.

Closing Remarks

In this article, we examined the evolving dynamics of the US beef trade, focusing on how domestic production trends, global competition, and trade policy have collectively shaped market outcomes. Recent shifts reflect broader changes in global supply and demand, the emergence of competing exporters, and trade policies dating back to President Trump’s first term. The US beef industry continues to face significant challenges, including declining cattle inventories, rising production costs, and shifting trade relationships. Imports have played a vital role in stabilizing domestic supply amid record-high prices and supply chain disruptions. However, recent trade tensions and disease-related restrictions have complicated access to key sources of imported beef, raising concerns about long-term resilience. Retaliatory tariffs and evolving trade partnerships have redirected global beef flows, with countries like China seeking alternative markets to the United States.

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Annual Review of Resource Economics

Global Food Demand: Overcoming Challenges to Healthy and Sustainable Diets

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Keywords

economic models, food security, global food demand, least-cost diet, sustainability

Abstract

We review the research on global food demand and examine modeling efforts to address the complexities of dietary transitions. We also highlight challenges affecting the economic feasibility of dietary targets aimed at promoting both human health and environmental sustainability (e.g., *EAT-Lancet*). The relationships among income, prices, and food demand play an important role in understanding how economic growth impacts nutrition and sustainability. As countries become more affluent, and food accounts for a smaller share of income, dietary transitions often lead to increased consumption of both resource-intensive and energy-dense foods. Modeling strategies must account for these dynamics to accurately project future resource needs and nutritional outcomes. Research should also consider the cost of healthy diets within the context of both food and nonfood expenditures. When both are considered, considerably fewer people can afford proposed sustainable diets. Economic, environmental, and health perspectives should all be integrated when developing strategies to promote healthy and sustainable diets.

1. INTRODUCTION

Transforming food systems to address public health and environmental challenges calls for a comprehensive understanding of the factors driving global food demand. While the consumption of healthy foods has improved globally, there has also been an increase in the consumption of unhealthy foods, as well as animal-based proteins and vegetable oils, which are only considered healthy at lower intake levels (Costlow et al. 2025, Imamura et al. 2015). This trend has contributed to global health issues, including the simultaneous rise of undernutrition and obesity. Micronutrient deficiencies affect more than 5 billion people (Passarelli et al. 2024), contributing to child stunting and wasting (WHO 2023). Simultaneously, the prevalence of overweight and obesity among children has surged, primarily due to increased intake of highly processed, energy-dense foods (Lopez Barrera & Shively 2022, WHO 2023). Dietary patterns are also fueling a rise in adult obesity, particularly in middle- and low-income countries (NCD-Risk Factor Collab. 2016), contributing to the increased risk of noncommunicable diseases such as cardiovascular disease and diabetes (Afshin et al. 2019, Murray et al. 2020). Addressing these challenges requires that individuals choose healthier diets. However, healthy food choices depend on both access and affordability (Headey & Alderman 2019, Wallingford et al. 2024).

As health and nutrition issues have intensified, global patterns have increasingly impacted the environment. The intensification of agricultural production to meet growing demand places pressure on natural resources, undermining global environmental resilience (Campbell et al. 2017, Cordell & White 2014, Rockstrom et al. 2009). The global food system also relies heavily on freshwater resources, and nutrient runoff from farming activities further compounds environmental challenges (Foley et al. 2005, Hoekstra & Wiedmann 2014). If unchecked, production trends could threaten ecosystems and biodiversity, highlighting the need for sustainable practices and policies to mitigate environmental degradation. In this context, food loss and waste pose another challenge (30-40% of food production) (FAO 2013, Lopez Barrera & Hertel 2021). This waste accounts for about 24% of freshwater use and 23% of global cropland (Kummu et al. 2012).

When addressing the critical goal of providing a growing global population with safe and nutritious foods, it is essential to consider the economic and social factors that shape global food demand (**Figure 1**). These factors are important for promoting healthy food choices and mitigating the environmental degradation caused by food production (Fan et al. 2021). Understanding these factors is pivotal for the following:

- Projecting future food needs (Bodirsky et al. 2015, Valin et al. 2014),
- Addressing global food security (Regmi & Meade 2013),
- Managing natural and agricultural resources to meet growing demand (Keating et al. 2014, Sands et al. 2023),
- Assessing the environmental consequences of increased demand (Tilman et al. 2011),
- Evaluating how economic instability and prices impact vulnerable populations (Kallruhl et al. 2016), and
- Structuring incentives and policies aimed at promoting healthier diets and improving associated public health and environmental outcomes (Bodirsky et al. 2015).

Without a clear understanding of what people eat and why, along with the economic and cultural influences affecting food choices globally, we cannot effectively address food-related challenges such as malnutrition and food insecurity. This knowledge is also essential for developing sustainable diet solutions.

In this article, we review the research on global food demand and dietary transitions and examine past and current modeling efforts to address the complexities of these transitions. In this

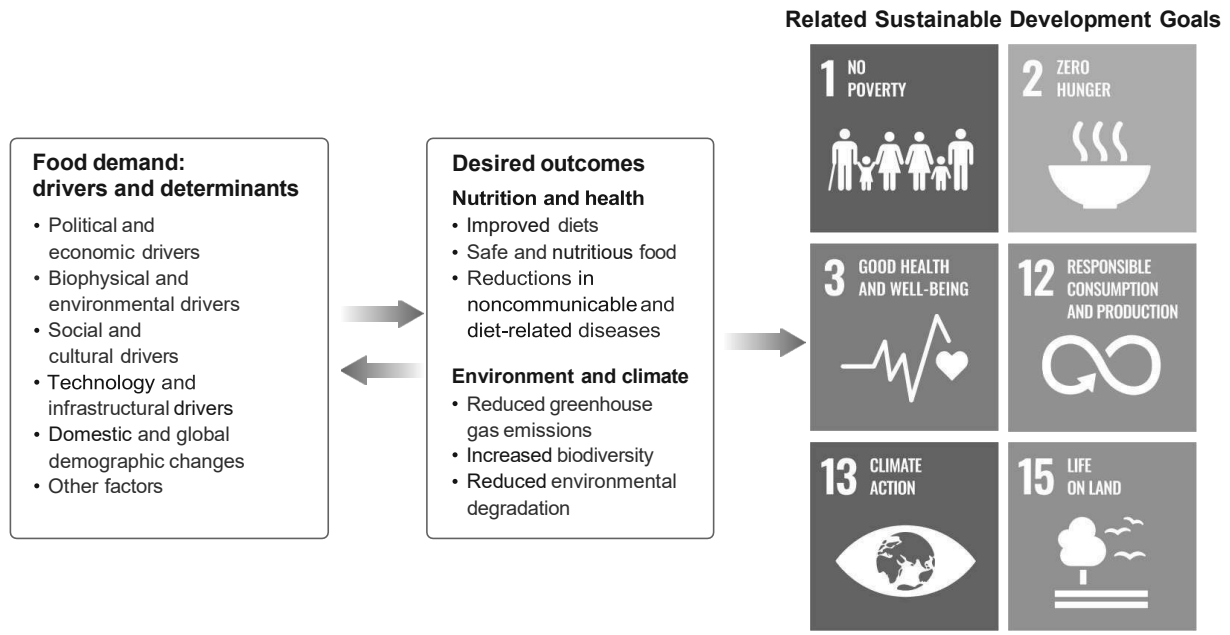


Figure 1

Overview of food demand drivers, desired outcomes, and related United Nations Sustainable Development Goals. Information is based on the various studies reviewed in the article. Related Sustainable Development Goals reproduced from the United Nations Department of Economic and Social Affairs, Sustainable Development (<https://sdgs.un.org/goals>).

context, we also review research on challenges impacting the economic feasibility of dietary targets designed to promote both human health and environmental sustainability (e.g., *EAT-Lancet*). Economic and cultural factors shaping food demand globally can work against sustainable diet solutions. Regarding this issue, we discuss the economic factors that determine dietary choices around the world, considering the primary drivers of affordability and access: income and prices. Here we consider how income or national affluence and prices have shaped food spending and consumption across the full spectrum of countries, from the least-developed to the highest-income nations.

Economic growth can lead to dietary shifts toward more resource-intensive foods, with notable implications for economic, environmental, and health dimensions. Modeling frameworks that effectively integrate these dimensions offer valuable insights for addressing these challenges. We review the traditional modeling approaches to assessing the impacts of dietary transitions and consider how modeling frameworks have been used to assess the impacts of diets on human health and environmental wellbeing.

We then discuss the economic feasibility of sustainable dietary frameworks. Drawing from the planetary boundaries framework, the *EAT-Lancet* Commission used "the latest available science to make a global assessment of the food system and set global scientific targets for healthy diets and sustainable food production" (Willett et al. 2019, p. 452). We discuss the affordability of nutritionally adequate diets with a focus on the affordability of the *EAT-Lancet* diet (henceforth the *Lancet* diet). We point out challenges as well as potential ways forward for achieving sustainable and nutritious diets globally.

We close the review with a discussion of policy interventions—such as taxes on resource-intensive foods, subsidies for sustainable alternatives, and incentives to reduce food waste—and their potential to promote healthier, more sustainable food consumption bundles. We further critique computable general equilibrium (CGE) and partial equilibrium (PE) models in this context,

assessing their ability to simulate complex dietary transitions and highlighting future directions for analysis and model refinement.

2. ECONOMICS OF GLOBAL FOOD DEMAND

The factors affecting food demand within and across countries include income, prices, culture, tastes, and preferences, among others. These factors must also be considered in the context of anthropometric food requirements (i.e., dietary needs based on body dimensions) (Bodirsky et al. 2020). The literature has been consistent on issues of income and prices. Individuals in higher-income countries allocate a significantly smaller share of their total budget to food compared to those in the poorest countries (less than 10% versus more than 50%). For example, US food expenditures account for about 5% of gross domestic product (GDP), whereas in countries such as South Sudan, Nepal, and Somalia, this figure can exceed 50% (World Bank 2024). Consequently, income and prices can exert a stronger influence on food demand and diets in lower-income countries than in higher-income countries (Clements et al. 2006; Cranfield et al. 1998; Muhammad et al. 2011, 2017; Regmi & Meade 2013; Seale et al. 2003; Selvanathan & Selvanathan 2003). "Whereas in the lowest-income countries, a percentage increase in income will cause an increase in spending on starchy staples by more than half the proportional increase in income, the resulting increase in higher-income countries is usually negligible and can even be negative (Muhammad et al. 2011, Seale et al. 2003).

Identifying global consumption patterns due to tastes and preferences or noneconomic factors has proven to be more elusive (Clements et al. 2006, Gao 2012). However, studies have identified changing cultural trends such as consumers in lower-income countries adopting more westernized diets (Liang et al. 2024). For example, recent data show significant shifts in dietary patterns in countries such as China and Brazil, where rising incomes have led to increased consumption of meat and dairy products (Delgado 2003, Parlasca & Qaim 2022, Vecchia & Majem 2015). Evidence also shows that diet quality and healthy food choices increase with education in most world regions (Miller et al. 2022).

Other factors such as taste and preferences are, in part, reflected by changing demand estimates related to income and price (Gao 2012, Lusk 2017, Selvanathan & Selvanathan 2003). For instance, food demand responsiveness to income and prices has been found to vary with age, sex, and regional influences (Muhammad et al. 2017). The notion that preferences and other factors could affect demand estimates has important implications for the effectiveness of taxes and subsidies in different populations and countries and how other policies such as information campaigns and nutrition education might influence structural change in food demand responsiveness (Guthrie et al. 2015).

In this section, we review studies of global food demand and discuss the economic factors that determine dietary choices around the world. Although we primarily focus on the effects of income and national affluence, as they are considered important drivers of food demand (Fukase & Martin 2020), we also consider how prices have shaped demand. Fundamental to this discussion is how food spending and consumption vary across the full spectrum of countries, from the least-developed to the highest-income nations. On this point, the literature has focused on food demand overall, i.e., the demand for food relative to other major spending categories such as health care, education, and housing (Clements et al. 2006, Selvanathan & Selvanathan 2003, Theil 1996), as well as the demand for individual food categories (Cranfield et al. 1998, Liang et al. 2024, Muhammad et al. 2011, Seale et al. 2003). By exploring these various factors, we gain a comprehensive understanding of how income and prices shape global food demand.

2.1. Country Affluence and Global Diets

Understanding the relationship between food demand and income can inform how economic growth and national affluence might contribute to (or undermine) nutrition and sustainability goals. Data suggest that income growth does not necessarily lead to greater demand for healthier and more nutritious foods, nor does it ensure a reduced intake of foods associated with negative health and environmental outcomes (Finaret & Masters 2019, Herforth & Ahmed 2015, Masters et al. 2022). In fact, when considering the factors that influence overall diet quality and sustainability, policy interventions have been argued to be necessary even in the highest-income countries (Steenenson & Buttriss 2021).

How does income influence food spending across countries and food categories, and what are the implications for global nutrition and sustainable diets? Evidence suggests that income growth could result in dietary changes that are not consistent with sustainability goals. For instance, sustainable diet recommendations outlined by Willett et al. (2019) suggest reduced intake of red meat and dairy products and increased consumption of fruits and vegetables. However, rising incomes worldwide often result in food trends that contradict these recommendations.

Using recent data from the International Comparison Program (ICP) of the World Bank, a global initiative that collects detailed price and expenditure data at the country level (World Bank 2024), we estimate the predicted food shares for selected food categories for countries included in both the 2017 and 2021 ICP data round. Predicted food shares are derived using a conditional demand model following Working (1943), $\ln(E_i/c) = \alpha_i + \beta \ln(L_i/E_i/c)$, where E_i/c is the expenditure on the i th food category in country c .¹ Results are reported in **Figure 2**. As the figure shows, the share of food expenditures allocated to meat and dairy significantly rises with national affluence, particularly at the early stages of income growth. Meat expenditure shares increase from less than 15% in the lowest-income countries to more than 20% when per capita income reaches US\$10,000 [adjusted for purchasing power parity (PPP)]. Dairy expenditure shares increase from less than 1% to more than 10% when per capita income reaches \$20,000.

According to Willett et al. (2019) and Lang & Barling (2013), even small increases in red meat or dairy consumption could hinder sustainability goals. Unfortunately, rising incomes lead to substantial increases in spending on these products, particularly at the lower end of the income spectrum. Note that 43% of the global population is in countries where annual per capita income is less than \$10,000. Depending on the country, this translates to only \$3,000 to \$5,000 on a market exchange rate basis (i.e., not adjusted for PPP) (World Bank 2024). The increase in spending on meat and dairy as countries become more affluent is most significant among these lower-income countries and tends to level off in the early stages of the global income distribution. For instance, meat expenditure increased from around 13% in the lowest-income countries (approximately \$65 per person) to about 20% as per capita income reaches \$5,000 (around \$113 per person in lower-middle-income countries) but remains around 20% thereafter.

Although dietary recommendations include increased consumption of fruits and vegetables, fruit expenditure shares remain constant across countries regardless of income (< 10% globally), with only a modest increase at the lower end of the income spectrum. The share of spending on vegetables tends to decline with a country's affluence, decreasing from around 30% in the lowest-income countries (around \$132 per person) to less than 15% in the highest-income countries (around \$319 per person). Spending on vegetables decreases mainly at lower-income levels, yet the decline also continues throughout the middle-income level (**Figure 2**). The results for vegetables

¹The above specification was estimated using a maximum likelihood procedure for equation systems. We assumed average or fixed prices for estimation.

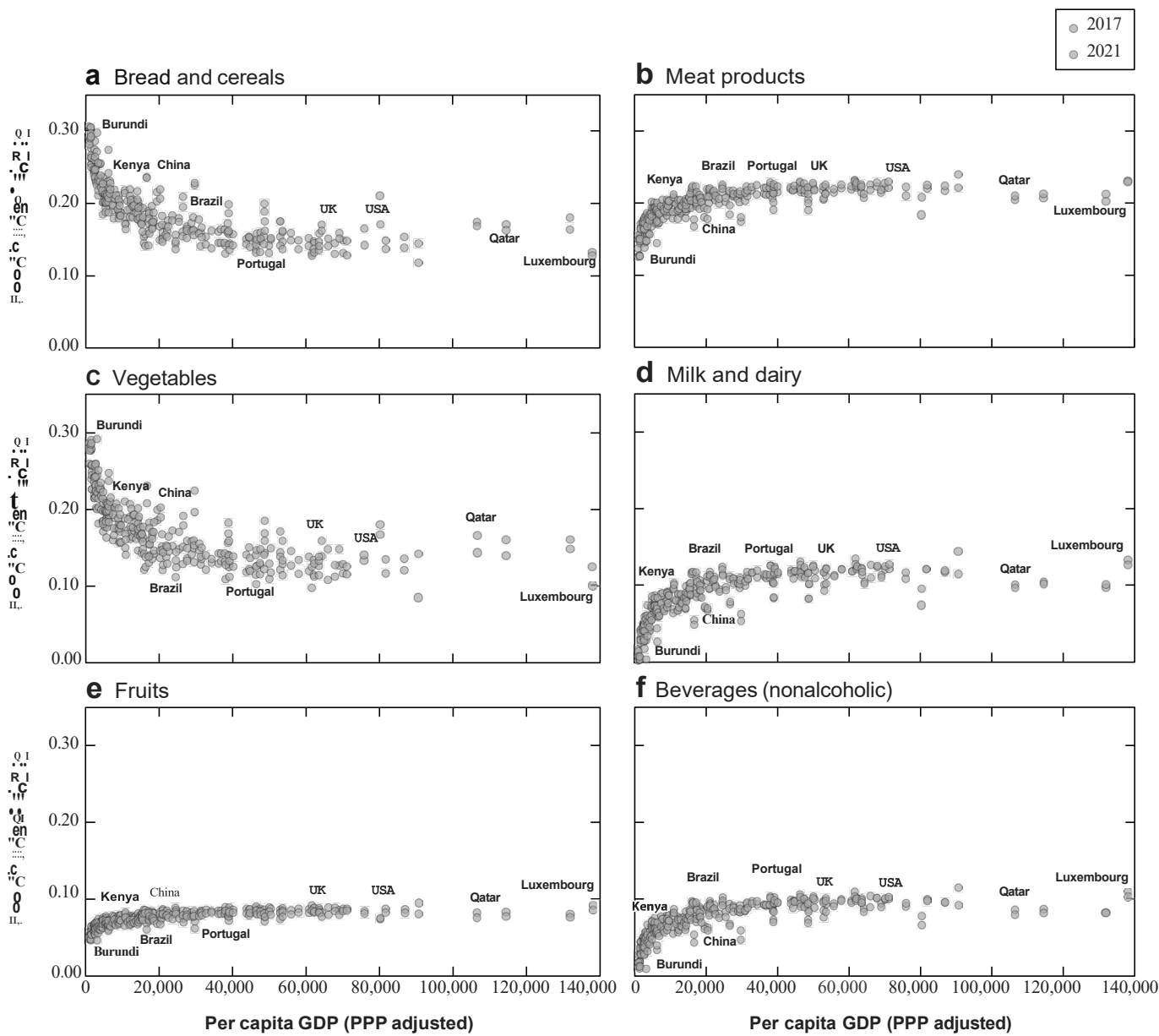


Figure 2

Predicted food budget shares for selected categories across 162 countries. Spending shares and gross domestic product (GDP) are purchasing power parity (PPP) adjusted. Predicted food shares are derived using a conditional demand model by Working (1943), $(\frac{E_i}{L} = a_i + A \ln(L; E_i))$, where E_i is the expenditure on the i th food category and L is total food spending in country c . Estimates are derived using data from the International Comparison Program (ICP), World Bank (2024) (<https://www.worldbank.org/en/programs/icp/data>).

could be misleading because tubers and legumes are included among vegetables (World Bank 2020). Observed declines could be due, in part, to decreased spending on these categories.

Expenditures on breads and cereals, being the most staple-dominated category, decline as national affluence increases, ranging from approximately 30% in Burundi (the lowest-income country according to our data) to 13% in Luxembourg (the highest-income country), with most of this reduction happening at lower-income levels (Figure 2). This category includes basic staples such as rice and grains (World Bank 2020), so the overall decline is not surprising. However, this

category also includes whole grains, which are considered nutritionally beneficial (Willett et al. 2019).

2.2. Income Elasticities Across Countries

Income elasticities are widely used measures of food demand responsiveness. They quantify the percentage change in the quantity demanded for a specific good or consumption category in response to a percentage change in income. Because elasticities are based on percentage changes rather than unit changes, they are comparable across spending categories and countries.

Food, as an aggregate, is both a normal good (income elasticity > 0) and a necessity ($1 >$ income elasticity > 0), as noted in studies going back more than a half century. For example, Tobin (1950) examined US urban and rural households as early as 1918 and found income elasticity estimates ranging from as low as 0.35 for farm households in 1941 to 0.68 for urban households in 1927-1928. Similarly, Houthakker (1957) reported estimates ranging from 0.71 for blue collar households in The Netherlands and in the western United States to 0.34 for middle-class households in the United Kingdom. This phenomenon, known as Engel's (1857) law, suggests that as income grows, the proportion of income spent on food decreases (Engel 1857, Houthakker 1957). This relationship has been repeatedly confirmed within and across countries (Bodirsky et al. 2015, Chai & Monera 2010, Clements et al. 2006, Cranfield et al. 1998, Fukase & Martin 2020, Goldberger & Gamaletsos 1970, Liang et al. 2024, Muhammad et al. 2011, Regmi & Meade 2013, Seale et al. 2003, Selvanathan & Selvanathan 2003, Theil 1996).

While understanding the impact of income on aggregate food demand is important, knowing the demand responsiveness of individual food categories (e.g., fruit, meat, dairy) to income changes is even more important for developing sustainable diet solutions. The demand for individual food categories is often estimated as a function of total food expenditures (conditional demand), which can result in expenditure elasticities that differ notably from corresponding income elasticities. However, we can indirectly assess how an individual food category will respond to income changes by multiplying the conditional expenditure elasticity for a category by the income elasticity for food (Seale et al. 2003). Given that the income elasticity for food tends to be less than one, income elasticities for individual food categories are usually smaller than the expenditure elasticities reported in the literature.

Income elasticity estimates throughout the literature provide further evidence that rising incomes will result in dietary changes that are inconsistent with sustainability goals. On average, income elasticities are higher for meat (0.73) and dairy products (0.72) compared to cereals and grains (0.45) (Femenia 2019). Income elasticities can also vary by national affluence. In lower-income countries, estimates are around 0.80 for meat and dairy products, but 0.50 for cereals. However, in higher-income countries, estimates are around 0.50 for meat and dairy products and near zero or even negative for cereals (Muhammad et al. 2011, Seale et al. 2003). Income elasticities for fruits and vegetables average around 0.60 but can be as low as 0.30 in higher-income countries. The most sensitive category to income changes is nonalcoholic beverages, with elasticities greater than one in poor countries, implying that nonalcoholic beverages are luxury goods in these countries (Femenia 2019, Muhammad et al. 2011, Seale et al. 2003). When food intake is considered (as opposed to food spending), income growth still has a significantly larger effect on milk, red meat, and sugar-sweetened beverages, especially in lower-income countries, but no significant effect on staples and vegetables (Muhammad et al. 2017).

Worldwide, individuals tend to diversify away from starchy staples and consume more animal products as their incomes rise (Gouel & Guimbard 2019). The difference in income elasticities for

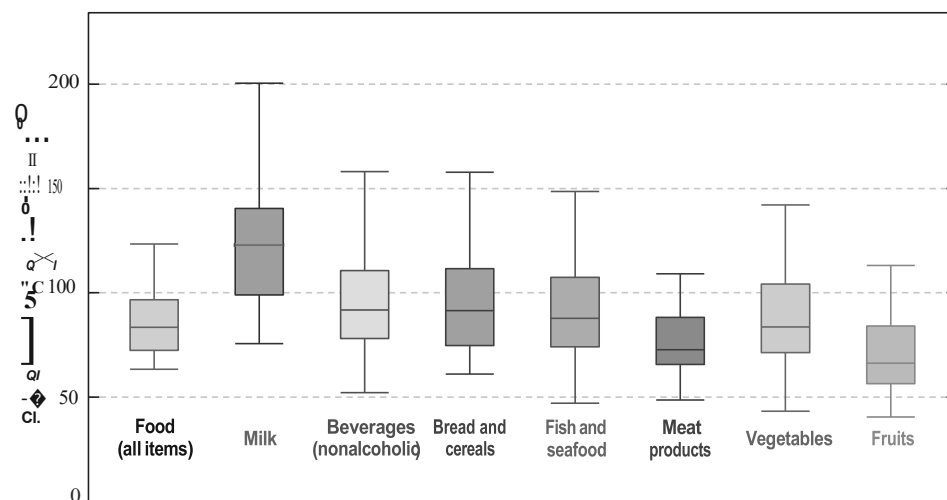


Figure 3

Price level indices by selected food categories in lower-income countries. Data are based on countries in the bottom quartile according to purchasing power parity (PPP)-adjusted per capita gross domestic product (GDP). Data from the International Comparison Program (ICP), World Bank (2017 data; <https://www.worldbank.org/en/programs/icp/data>).

meat and dairy versus cereals supports this notion and conforms Bennett's law; that is, the share of starchy staples in diets tends to decrease with income (Bennett 1941, Timmer et al. 1983).

2.3. Price Elasticities Across Countries

How do food prices vary around the world? **Figure 3** shows box and whisker plots for selected food price indices (world= 100) in the poorest countries (lowest-income quartile). While median prices for food overall and most food categories in low-income countries are below the global average (< 100), the interquartile range exceeds the global average for beverages, breads and cereals, fish and seafood, and vegetables. Interestingly, the interquartile range for meat products and fruits is less than 100, indicating that these products tend to be less expensive in lower-income countries. Milk and dairy stand out as being considerably more expensive in poor countries, with an interquartile range above 100 and extreme values, indicating that dairy products can be twice as expensive in the lowest-income countries. The values in **Figure 3** do not account for PPP differences across countries. Food prices are even higher in lower-income countries when PPP differences are considered (World Bank 2024).

Price elasticities can inform strategies to promote healthier and more sustainable diets. For instance, if the demand for an unhealthy food category is highly elastic, meaning consumers are very sensitive to price changes, then even a small price increase (e.g., through taxes) could reduce spending and consumption. Overall, the demand for food (as an aggregate) is inelastic ($|\text{elasticity}| < 1$) throughout the world but can vary by affluence. Income and national affluence directly affect how sensitive food demand is to price changes; elasticities range from approximately -0.70 in lower-income countries to approximately -0.30 in countries such as the United States (Muhammad et al. 2011, Seale et al. 2003).

Price elasticities can vary notably across food categories and countries, indicating that low-income countries would be the most impacted by taxes or subsidies (Cornelsen et al. 2015). However, most studies have found the demand to be inelastic, with a few noted exceptions (e.g., beverages and food away from home in lower-income countries) (Andreyeva et al. 2010,

Green et al. 2013, Muhammad et al. 2011). A meta-analysis of more than 130 studies and 160 countries, comprising more than 3,000 data points, identified differences in own-price elasticities between low-income and high-income countries (Green et al. 2013). Across studies, the own-price elasticity for cereals ranged from around -0.61 in low-income countries to about -0.43 in high-income countries; for meat, from -0.78 to -0.60; for fruits and vegetables, from -0.72 to -0.53; and for dairy, from about -0.78 to approximately -0.60 (Green et al. 2013). A recent study of consumers in selected African countries (Malawi, Niger, Nigeria, Tanzania, and Uganda) found food demand to be highly elastic for the poorest consumers (e.g., -1.38 for rice, -2.44 for poultry, and -3.94 for dairy in Malawi). However, demand became significantly more inelastic as incomes increased from less than \$2.00/day to more than \$5.50/day (McCullough et al. 2024).

Price responsiveness across countries can differ when considering intake instead of expenditures. In the poorest countries, some products (e.g., processed meat, fruit, fruit juice) are highly elastic. However, as national income increases, price sensitivity mostly declines. Although milk spending can be highly elastic, actual milk intake across countries has relatively lower price sensitivity, whereas fruit juice intake is highly sensitive to price changes (elastic demand) regardless of national income or global region (Muhammad et al. 2017).

Overall, research findings highlight the importance of economic factors in determining food choice. Both income and price estimates suggest dietary transitions that are inconsistent with nutrition and sustainability goals. This must be considered when developing sustainable diet solutions.

3. ASSESSING HEALTH AND ENVIRONMENTAL IMPACTS

In the previous section, we explored how dietary shifts are driven by income and prices. This section examines key methodologies used to assess the environmental and health effects of food demand. We synthesize methodologies that connect diets, health, and environmental sustainability. These include lifecycle assessments (LCAs), which provide detailed insights into environmental impacts, and CGE and PE models, which capture broader economic and policy dynamics. Together, these approaches underscore critical dimensions of food systems, revealing the prevalence of unhealthy and unsustainable food consumption trajectories and contributing to discussions on global food system challenges.

3.1. Quantifying Environmental and Health Impacts of Diets

LCAs provide essential insights into the environmental and health impacts of food systems by quantifying emissions, resource use, and dietary health outcomes. For instance, Drewnowski & Popkin (1997) examine dietary shifts in low-income countries, identifying the rising prevalence of obesity and chronic diseases. Their findings underscore how these changes contribute to unhealthy and unsustainable diets, particularly in developing regions, and highlight the need to align dietary recommendations with both environmental and health objectives. With the rise of environmental concerns, researchers began integrating health and sustainability factors into food system analyses.

Horrigan et al. (2002) expand the scope of analysis by connecting sustainable agriculture practices to both environmental and health outcomes. They emphasize how industrial farming exacerbates ecological degradation and public health challenges, underscoring the importance of transitioning to sustainable agricultural practices. Similarly, Eshel & Martin (2006) evaluate energy use and greenhouse gas (GHG) emissions linked to various diets, quantifying the environmental costs of resource-intensive dietary choices, particularly those involving animal-based products. This pioneering work laid the foundation for subsequent data-driven studies,

illustrating the outsized impact of meat-heavy diets on sustainability metrics. Building on this foundation, Stehfest et al. (2009) and Friel et al. (2009) employ global climate models and health impact assessments to explore the effects of reduced meat consumption. These studies demonstrate how plant-based diets not only reduce GHG emissions but also improve public health by addressing issues such as cardiovascular diseases. This convergence of health and environmental modeling has opened new avenues for understanding global food system transitions.

LCAs have since become indispensable tools for systematically comparing the environmental impacts of various food products. Nijdam et al. (2012) conduct a meta-analysis of LCAs, emphasizing the environmental benefits of reducing animal product consumption. Their findings consistently demonstrate that plant-based diets have lower environmental footprints, particularly regarding emissions and resource use. Similarly, Scarborough et al. (2012) use epidemiological data to model the health impacts of sustainable diets, illustrating how dietary changes benefit both human health and the environment.

Westhoek et al. (2014) apply scenario modeling to examine regional effects of reducing meat and dairy consumption in Europe, identifying solutions tailored to local contexts. Their research highlights the importance of targeted interventions that address region-specific environmental and health challenges. Tilman & Clark (2014) extend this analysis by projecting future dietary patterns and illustrating their potential to reduce emissions and prevent chronic diseases. These findings underscore the interconnectedness of local and global scales in addressing food system challenges. Springmann et al. (2016) build on this by using comparative risk assessment and LCA-based emissions data to quantify the health and environmental impacts of dietary shifts, highlighting their potential to reduce mortality rates and food-related GHG emissions.

Godfray et al. (2018) present a detailed analysis of the trade-offs between meat consumption, health, and environmental sustainability. Their work acknowledges the complexity of dietary transitions, balancing the benefits of plant-based diets with the cultural and economic factors influencing meat consumption. In a more comprehensive global context, Springmann et al. (2018) propose the planetary health diet (PHD), integrating health and environmental objectives to provide a practical framework for balancing human nutritional needs with planetary boundaries.

LCAs and aggregate-level analyses provide robust methodologies for quantifying the environmental and health impacts of dietary choices. By consistently exposing the unsustainable and unhealthy nature of current consumption patterns, these approaches offer a critical foundation for understanding the global implications of food demand. Furthermore, this evidence-based framework highlights the potential of aligning dietary recommendations with sustainability and public health objectives, paving the way for actionable strategies to transform food systems.

3.2. Insights from Broader Economic Models

Although LCAs excel at capturing detailed environmental and health metrics, they often fall short of addressing broader economic and social dynamics, such as impacts on food prices, employment, or market interactions. This necessitates the use of more comprehensive frameworks. CGE and PE models address these gaps by offering complementary strengths in simulating economic and policy impacts. As Valin et al. (2014) emphasize, CGE models provide economy-wide perspectives, capturing cross-sectoral and regional interactions, while PE models deliver detailed, sector-specific analyses. This complementarity is particularly valuable for understanding variations in food demand projections influenced by income elasticities, price responses, and regional contexts. By complementing LCAs, these economic modeling techniques provide a more holistic understanding of the systemic implications of dietary transitions and their broader socioeconomic impacts.

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The integration of environmental outcomes into economic models began with pioneering work such as the dynamic integrated climate-economy (DICE) and regional integrated climate-economy (RICE) models (Nordhaus 1992, Nordhaus & Yang 1996). These models represent a breakthrough in general equilibrium (GE) modeling by linking economic activity with environmental and climate dynamics. They enable policymakers to explore the long-term effects of climate change and evaluate mitigation strategies, such as carbon pricing, on a global scale (Nordhaus 2017). By incorporating environmental externalities into the broader economic framework, Nordhaus's work illustrates the potential for GE models to extend beyond traditional economic analysis, addressing pressing global challenges and providing a foundation for subsequent advancements in economic-environmental modeling.

Building on this foundation, GE models have evolved to explore critical intersections between economic systems and sustainability, including their application to the diet-health-environment trilemma. Economic modeling techniques, particularly the CGE and PE models, have proven essential in capturing complex market interactions and assessing the broad effects of dietary changes, public health policies, and environmental sustainability initiatives. CGE models simulate economy-wide impacts, considering interlinkages across sectors, making them ideal for analyzing the broader effects of policies or shocks (Hertel 1997). In contrast, PE models focus on specific sectors, holding others constant, offering more targeted and detailed insights into sector-specific changes (Hertel & Baldos 2016). Together, these models not only complement LCAs by extending their scope to broader systemic impacts but also build on earlier advances such as DICE and RICE to provide a more integrated view of how policies influence individual sectors and the wider economy.

Baldos & Hertel (2014) develop the SIMPLE (simplified international model of agricultural prices, land use, and the environment) PE model, incorporating a food security module based on the Food and Agriculture Organization of the United Nations (FAO) Prevalence of Under-nourishment methodology. Their projections for global food security up to 2050 under various agricultural productivity and climate change scenarios suggest that sustained productivity growth plays a key role in reducing undernutrition. Conversely, stagnation or adverse climate impacts are associated with exacerbated food insecurity. This analysis complements the broader findings of Frank et al. (2019), showing how productivity and environmental interventions are interlinked in addressing food security. Together, these studies highlight the multifaceted nature of food system challenges.

By addressing both supply-side and demand-side dynamics, these studies emphasize the multidimensional nature of food system challenges. The integration of CGE and PE models with other methodologies, such as LCAs, strengthens the analytical framework for understanding interdependencies between dietary choices, environmental sustainability, and food security. This integrative approach also allows for policy interventions that account for systemic trade-offs and cobenefits, enabling more informed decision-making.

3.3. Integrating Insights for Policy and Practice

LCAs can highlight the health and environmental burdens of current dietary trajectories, capturing detailed metrics such as emissions, resource use, and dietary health outcomes. Broader economic models, such as CGE and PE frameworks, complement these analyses by examining systemic dynamics, including market interactions, policy trade-offs, and socioeconomic impacts. Together, these methods provide a comprehensive perspective on the challenges posed by dietary trends, emphasizing their contribution to ecological pressures and public health challenges. The insights derived from these methodologies emphasize the prevalence of unhealthy and

unsustainable diets, offering valuable tools for understanding the multifaceted impacts of food demand. These tools lay a foundation for identifying key leverage points in global food systems, setting the stage for further examination of targeted solutions in subsequent sections.

4. GLOBAL FOOD DEMAND: TOWARD SUSTAINABLE AND HEALTHY DIETS

One of the key leverage points is to develop potential diets that balance sustainability concerns and human health. For example, the *EAT-Lancet* Commission developed scientific targets based on the planetary boundaries framework (Steffen et al. 2015) to recommend healthy diets from sustainable food production and consumption (Willett et al. 2019). The key takeaway from the Commission's findings is that the world should aim to reduce the consumption of unhealthy foods, such as red meat and sugar, by at least half and double the intake of healthy foods, namely fruits, vegetables, legumes, and nuts, with some regional variations.

The Commission's efforts are part of a long-standing initiative to acknowledge the interdependence of sustainable diets, climate change, and human health through the promotion of a PHD (Blackstone et al. 2018; Chaudhary & Krishna 2019; Gephart et al. 2016; Gussow & Clancy 1986; Myers et al. 2014; Scarborough et al. 2012; Springmann et al. 2016, 2018; Tilman & Clark 2014; Vermeulen et al. 2012). Overall, research suggests that climate change reduces the nutritive value of foods, red meat decreases human health and produces GHGs, and fruits and vegetables are healthy, with lower environmental harm. The studies, as mentioned in the Commission's effort (Willett et al. 2019), do not include economic or social aspects (such as culture and animal welfare) of the food system. Critically, food access is not a prominent outcome across these studies. The lack of focus on food access in PHDs raises important questions about how to interpret and assess these diets.

4.1. Food Access

The clearing of global food and agricultural markets is neither a necessary nor a sufficient condition for food security where "all people, at all times, have physical and economic access to sufficient, safe and nutritious food to meet their dietary needs and food preferences for an active and healthy life" (FAO 1996). The FAO et al. (2023) report that in 2022, 29.6% of the global population was moderately or severely food insecure, which was more than the share of 25.3% before the COVID-19 pandemic. The *2024 Global Report on Food Crises* notes that the outlook for food insecurity looks bleak in 2024 in countries/territories with an identified food crisis because of conflict, weather (El Nino), high food prices, and decreasing humanitarian funding (FSIN & Glob. Netw. Against Food Crises 2024). In the United States, the prevalence of food insecurity has risen since the pandemic, reaching 13.5% in 2023 (Rabbitt et al. 2024). As noted across these reports, food markets, namely prices, are critical to food security and poverty. However, this narrative is complicated depending on whether households are net producers of foods, where net producers are often the cause of, and can benefit from, high food prices (Deaton 1989, Headey & Fan 2008, Headey & Martin 2016). In addition to food prices, low income is a critical reason for food insecurity. Thus, efforts to address the sustainability of food markets must consider the influence of income, especially in the most vulnerable populations.

The previous section highlighted modeling results that could inform how global agricultural and food markets could adjust to achieve various sustainability or climate goals. However, this literature does not consider how solutions address the equity or feasibility of policies for all consumers. To incorporate the needs of these consumers, the burgeoning literature on affordability,

and the cost of a healthy diet, could serve as a benchmark for evaluating the social implications of these sustainability efforts (Herforth et al. 2020).

4.2. Least-Cost Diet Developments

The least-cost diet is one of the ways economists have determined whether markets provide foods that meet nutritional adequacy and affordability. George Stigler, who is often cited as one of the earliest progenitors of the least-cost diet, took a production economics approach to determine the least-cost diet that is nutritionally adequate (Stigler 1945). His work appears to be a retort to the work of dietitians from the US Department of Agriculture (Carpenter & Stiebeling 1936, Rose 1938, Stiebeling & Clark 1939), who estimated a higher minimum cost for a nutritionally adequate diet. These early measurements of an affordable, nutritious diet were mostly descriptive, but they pointed to the expenditure levels necessary to provide a nutritionally adequate diet.

Stigler (1945, p. 313) argues that "dietitians take account of the palatability of foods, variety of diet, prestige of various foods, and other cultural facets of consumption." Potgieter (1947, p. 768) counters Stigler (1945), stating that he "neglected to consider certain important physiological, chemical, dietetic, geographical, seasonal, and cultural factors." While the inclusion of these factors may appear unscientific and more expensive, they made the diet nutritionally adequate and tolerable (Potgieter 1947). These early debates point to the ongoing tensions in developing least-cost diets: complex diets that reflect dietary patterns and localized market prices versus tractable, replicable models of nutrients in foods given standardized, comparable prices across regions.

Subsequent economists have worked to incorporate constraints into the least-cost dietary framework to move the optimal diet closer to what people actually eat (O'Brien-Place & Tomek 1983, Smith 1959, Wilde & Llobrera 2009). Nevertheless, the debate about the palatability and appropriateness of the selected foods in a least-cost diet persists today (e.g., Allen 2017, Babb 2024, Bai et al. 2021, Davis & You 2011, Maillot et al. 2010, Rose 2007, Schneider et al. 2023, Wilde & Llobrera 2009, Zhao et al. 2025).

Underlying the least-cost diets is nutrition research leveraging household-level surveys of foods consumed, national or international guidelines of dietary needs, and national or subnational prices. The data used in international comparative studies are usually food prices from the World Bank's ICP. The nutrient content of foods is based on the US Department of Agriculture's National Nutrient Database for Standard Reference, while the dietary reference intake requirements for 20 nutrients and energy balance are from the US National Academy of Medicine (Bai et al. 2020, 2021, 2022; FAO et al. 2020; Herforth et al. 2020; Hirvonen et al. 2020). Researchers model commonly consumed baskets of foods at the lowest cost to construct the least-cost diet (Gupta et al. 2021, Headey et al. 2023, Herforth et al. 2024). However, following the agricultural economics literature more closely (O'Brien-Place & Tomek 1983, Smith 1959, Stigler 1945), researchers have used a linear programming approach to develop the lowest-cost combination of foods that meet the nutrition needs of a healthy, active person. Least-cost diet calculations serve as a benchmark to delineate unaffordability from other barriers against nutritional access (Bai et al. 2022). The medical and nutrition literature has also used a linear programming approach to determine nutritional adequacy at least cost (Briend & Darmon 2000, Briend et al. 2003, Darmon et al. 2006). The modeling of foods was not intended to represent ideal diets (Hirvonen et al. 2020, Stigler 1945), but the cost necessary for survival (Allen 2017). To this end, Allen (2017) calculates the least-cost diet to establish a more accurate poverty line, representing the minimum amount of money needed to cover essential food and nonfood items for basic living.

Many least-cost diet models use a minimization model of costs within the country (price times quantity) subject to constraints that represent upper and lower limits of nutrients and energy

needs (Bai et al. 2020, 2021, 2022; Bai & Masters 2024; Hirvonen et al. 2020; Schneider 2022; Schneider et al. 2023). The authors of this literature seek to identify global or national variation in nutritional needs caused by cost5, i.e., the cost of nutrient adequacy (CoNA), to determine the least-cost diets. This CoNA provides "a cost metric of nutrient adequacy," not a recommended diet, which would require further constraints to capture variety and cultural relevance (Schneider 2022, p. 5). Nutritional adequacy is useful for survival but inadequate to reflect the complex food environments and cultural foodways. Further, researchers must make simplifying assumptions that may not fully capture the market inefficiencies such as externalities and transaction costs.

In both global and national comparisons, the overarching theme is that a nutritionally adequate diet remains unaffordable for significant portions of the population. Schneider (2022) focuses on Malawian households, documenting a least-cost diet of \$2.32/person/day, which is above the \$1.90 poverty line and available for only 60% of households. Schneider et al. (2023) highlight differences in affordability for individuals versus households and the seasonality of foods affecting the affordability of nutrients over time. Using "high-frequency, high-density price observations," Bai et al. (2020, p. 6) show that the variability of prices due to seasonality of crops affects affordability of nutritional adequacy in Malawi, Tanzania, and Ethiopia.

The cross-country comparisons of Bai et al. (2020) point to the power of the least-cost method using the CoNA index. By comparing the CoNA with the cost of calorie adequacy across 177 countries, Bai et al. (2021) find that the world's poorest cannot afford a nutritionally adequate diet at \$1.35 per day. The cost of the diet is more than twice the cost of starchy staples at \$0.57, with little variation by national income. Relatedly, using ICP data, Bai et al. (2022) find the median cost of a healthy diet in 2017 to be \$2.32, with variation by demographic groups across 172 countries. The median cost for low-income countries was above the international poverty line of \$2.10.

Under the banner of least-cost diets is the related cost of a healthy diet (CoAHD) construct. Herforth et al. (2024, p. 2) define the CoAHD as "the minimum cost of purchasing a healthy diet in the market, defined as a diet that adheres to food-based dietary guidelines (FBDG)." The CoAHD is not derived from an optimization model; rather, it is the collection of least-cost foods across categories that meet dietary requirements, given market prices or indices. The country case studies, conducted with national statistical services, in Herforth et al. (2024) highlight differences in national and subnational CoAHD versus global metrics because of country-specific prices, healthy diet standards, and income/affordability data.

4.3. Least-Cost Diets and Sustainability

Prior to the release of the *Lancet* diet, researchers have used the least-cost diet method to address nutritionally adequate diets that mitigate GHG emissions. Macdiarmid et al. (2012) combine data from LCAs of foods to minimize GHG emissions subject to cost and nutrient constraints for an adult woman in the United Kingdom. They find a so-called acceptable diet, with less meat and more fruits and vegetables, that meets all nutrient requirements with a 36% reduction in GHG emissions relative to a 1990 baseline at a cost of \$46 per week. This cost was 89% of UK food expenditures, excluding products such as tea, coffee, and alcohol. For New Zealand, Wilson et al. (2013) report a "more familiar meals" diet that lowers GHG emissions by nearly half and is nearly 40% of the cost of the typical New Zealand diet. Perignon et al. (2016) minimize the difference of optimized and observed cost of consumption to simulate in the least-cost framework lower GHG emissions. They find reductions of GHG emissions of 30% that produce culturally acceptable diets in France at equivalent or lower costs of the observed diet. Higher reductions in GHG emissions would require drastic changes in diets compared to current consumption at lower costs. In contrast, He et al. (2021) find a least-cost diet that lowers GHG emissions but is

not affordable for lower-income households, particularly for Black and Hispanic households in the United States. These findings suggest that in developed countries, a nutritionally adequate diet with reduced GHG emissions may be affordable, but it is important to consider household diversity and income differences within these countries.

For developing countries, researchers use least-cost diets to illustrate the challenges of affording a base level of nutrients generally. Specifically, a cadre of researchers uses the least-cost diet to address the affordability of the *Lancet* diet (Willett et al. 2019). Drawing attention to the *EAT-Lancet* Commission's self-recognized omission of cost and affordability in their diet, Hirvonen et al. (2020) demonstrate that the *Lancet* diet has an estimated cost of \$2.84 per day in international dollars. The *Lancet* diet costs 6.1% of high-income countries' per capita income and 89.1% of low-income countries' per capita income. The cost of the *Lancet* diet exceeds the incomes of 1.6 billion people, 80% of whom live in middle-income countries. The *Lancet* diet is 1.6 times more expensive than the minimum CoNA. Although the least-cost diet and *Lancet* diet emphasize fruits, vegetables, and legumes, the cost difference is driven by the demand for more animal source proteins in the *Lancet* diet, which are not required based on nutrient adequacy in the least-cost diet. In a related study using similar methods shaping *The State of Food Security and Nutrition in the World 2020* (FAO et al. 2020), Herforth et al. (2020) find that 3 billion people in the world cannot afford a nutritionally adequate diet, with a global median cost of \$3.75 per person per day and the *Lancet* diet costing \$3.31-\$3.61.

Given the cost and affordability studies (FAO et al. 2020, Herforth et al. 2020, Hirvonen et al. 2020), Gupta et al. (2021) extend the method of the cost and affordability of a healthy diet and reevaluate the *Lancet* diet specifically for rural India. The extension centers on the data used. Gupta et al. (2021) argue that the ICP data are at the national level and do not account for subnational prices that rural people actually face. Further, these studies do not address the seasonality and regionality of prices. "While these differences in data can matter, Gupta et al. (2021) find that the *Lancet* diet costs \$3.30/day relative to the \$0.60 to \$1.00 cost of local diets. Fruits, vegetables, and animal proteins are substantial cost factors in the *Lancet* diet. The cost of the *Lancet* diet ranges from \$2.90 to \$3.70 depending on the season. Further, Herforth et al. (2024) extend this effort to country-level analysis around the world. Although several studies point to the unaffordability of PHDs, Springmann et al. (2021) find a that PHD-which incorporates different dietary patterns, food waste, and full cost accounting-is up to one-third lower in cost than current consumption in most countries. Thus, the affordability of prescribed diets such as the *Lancet* diet or other PHDs is more challenging and nuanced than indicated in previous global comparison studies.

Headey et al. (2024) further the critique of the least-cost method while reinforcing the importance of evaluating the cost of a nutritionally adequate diet. Focusing on methods developed by FAO et al. (2020), Herforth et al. (2020), Hirvonen et al. (2020), and Headey et al. (2024) point out innovations in the least-cost method that would more accurately estimate the number of people who are unable to afford a nutritionally adequate diet. The authors' innovation is to simulate demographic differences to more accurately develop the cost of the diet. This innovation lowers the number of people who cannot afford the *Lancet* diet by 143 million (a 2.1-percentage-point difference) compared to replicated values informed by Hirvonen et al. (2020), updated with the 2017 ICP data.

Across the PHD and least-cost diet literature, when the affordability of the diets is mentioned, cost and food prices are the central concern. However, prices are only part of the economics story, as consumers must have an adequate income to afford foods given market prices. Consumers in low-income households have challenges with food access beyond economic access to food such as crop failures, disasters, political and social conflict, and war. Thus, a critical literature to consider

focuses on interventions to increase incomes or subsidy programs to support families from low-income households assessed through CGE and PE models.

5. ADVANCING MODELS FOR DIETARY TRANSFORMATION: POLICY INTERVENTIONS AND FUTURE DIRECTIONS

5.1. Insights from CGE and PE Modeling

Gatto et al. (2023) use the MAGNET CGE model to explore the spillover effects of transitioning to sustainable diets, such as the *Lancet* diet. They find that while such dietary shifts reduce GHG emissions and agricultural land use, they can also lead to economic disparities, particularly for agricultural workers in low-income regions, who might experience wage declines. Their findings emphasize the importance of designing policies that simultaneously promote environmental sustainability and mitigate social inequities. Similarly, Gatto & Chepeliev (2024) employ an environmentally extended multi-regional input-output (MRIO) model to assess the public health and environmental impacts of reducing global food loss and waste. They demonstrate that reducing food loss significantly lowers air pollutants, such as sulfur dioxide (SO₂) and fine particulate matter (PM_{2.5}), resulting in substantial public health benefits. However, they caution that rebound effects—where savings from reduced food consumption are redirected toward more environmentally harmful activities—could offset these gains, highlighting the need for integrated policy frameworks.

Recent studies increasingly explore dietary shifts using various policy tools within CGE models, including differentiated value added taxes (VATs), subsidies at the consumer and value chain levels, and trade policies. For example, using a CGE framework, Springmann & Freund (2022) analyze the effects of increasing VAT on high-impact foods such as meat while reducing it for low-impact foods such as fruits and vegetables in the United Kingdom and Germany. Bouyssou et al. (2024) examine the potential impact of a GHG tax on food consumption through country-specific scenarios, considering cross-price effects, GE responses, and associated GHG and health outcomes. Additionally, Springmann & Freund (2022) explore the reform of agricultural subsidies to promote healthier and more environmentally sustainable food options. Their findings suggest that reallocating subsidies could lower GHG emissions, improve health outcomes globally, and enhance sustainable food systems without negatively affecting economic welfare.

Focusing on food waste, Lopez Barrera & Hertel (2021) apply the SIMPLE PE model to evaluate how reducing food waste improves food affordability and reduces environmental pressures, particularly in emerging economies. Their analysis demonstrates that cutting food waste reduces land use and GHG emissions, underscoring the environmental benefits of addressing food waste. Expanding on this, Lopez Barrera & Hertel (2023) introduce the prevalence of overacquisition in the SIMPLE PE model to better capture overconsumption and food waste. They assess the health and environmental impacts of shifting to sustainable diets, such as healthy dietary guidelines and flexitarian diets, breaking down the effects into three components: changing diet composition, reducing food waste, and cutting excessive intake. Their findings reveal that food waste reduction has the greatest impact on lowering natural resource pressures, reinforcing its critical role in improving global health and sustainability. Moreover, these findings contribute to an evolving understanding of the interplay between food purchasing reductions, dietary transitions, and sustainability outcomes, offering innovative perspectives compared to prior research.

CGE and PE models offer valuable insights into the economic, social, and environmental impacts of policies such as taxes, subsidies, and food waste reduction, highlighting pathways for dietary transitions. However, key limitations in these models remain, warranting further advancements to better simulate complex, large-scale dietary transformations.

5.2. Rethinking Economic Models for Dietary Shifts and Policy Design

A key challenge faced by CGE and PE models lies in their limited ability to capture heterogeneous policy impacts across diverse populations and regions. Bourguignon & Spadaro (2006) highlight the transformative potential of microsimulation models in addressing this limitation by accounting for individual-level differences and behavioral responses to policy changes. They emphasize the importance of incorporating dynamic elements, such as life-cycle impacts and evolving preferences, to improve long-term predictions and policy assessments. As Peichl (2008) suggests, integrating microsimulation with CGE and PE models enables more detailed, disaggregated analyses. This approach provides critical insights into the distributional effects of dietary policies, particularly for vulnerable populations, while enhancing the granularity and relevance of policy evaluations.

Another significant notable of CGE and PE models is their reliance on relatively rigid assumptions about consumer preferences, which often fail to capture behavioral adaptations and evolving consumption patterns. This restricts their ability to accurately simulate large-scale dietary shifts over time. Addressing these limitations requires rethinking demand structures and incorporating advanced policy frameworks. Latka et al. (2021) highlight that although market-based instruments such as taxes and subsidies are effective, achieving significant dietary shifts necessitates substantial tax levels and more sophisticated frameworks, such as nested demand systems, to account for food group interactions and substitution effects. They emphasize the importance of coherent policy packages that integrate nutrition and sustainability goals. Complementing this perspective, Bodirsky et al. (2022) advocate for structural transformations—such as transitioning to needs-based food systems, implementing equitable income distribution, and integrating GHG pricing—as essential strategies for creating GHG-neutral food systems and improving nutritional outcomes. Together, these studies underscore the need for advancing economic models to design and evaluate policies that align health and sustainability objectives effectively.

Beaussier et al. (2019) underscore the transformative potential of coupling economic models with environmental tools, such as LCAs and material flow analysis, to enhance the granularity and comprehensiveness of policy evaluations. They emphasize the importance of incorporating feedback loops and systemic interactions to capture the multidimensional impacts of policies on socioeconomic and environmental outcomes. These advanced frameworks address a critical gap by prioritizing regional and sectoral granularity, enabling more targeted and equitable policy interventions. Building on these principles, spatially explicit biophysical-economic models integrate high-resolution geographic data, allowing localized assessments of policy impacts and systemic interactions (Haqiqi & Hertel 2025). In this context, advanced computational techniques further enhance these models' capabilities. Artificial intelligence-driven tools and deep learning methods, such as deep equilibrium nets (Azinovic et al. 2022), can improve parameter estimation and predictions under uncertainty, bridging gaps between technical advancements and practical applications to support policies aligned with health and sustainability goals.

6. SUMMARY AND CLOSING

In this article, we provide a comprehensive review addressing key aspects of global dietary issues such as how economic factors influence food demand and diets across countries, the need for modeling frameworks that adequately capture the complexities of dietary transitions, and the feasibility of dietary solutions that are both nutritionally sufficient and environmentally sustainable. If policymakers are to develop effective strategies to promote sustainable diets and mitigate the negative impacts of dietary changes on both human health and the environment, economic, environmental, and health perspectives must be considered.

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The relationship between income, prices, and food demand plays an important role in understanding how economic growth impacts nutrition and sustainability. Despite the relatively high cost of foods in lower-income countries, global income growth has outpaced the rise in food prices. However, higher incomes and increased affordability do not always lead to healthier food choices. As nations grow wealthier, diets improve, but they also shift toward more resource-intensive foods. Adopting healthier and more sustainable diets is crucial for addressing global health and sustainability challenges. However, the key question is how economic trade-offs will unfold. To achieve a balance between health and environmental sustainability, interventions are needed to address the complex challenges within global food systems in a way that is economical and equitable.

Economic modeling frameworks have substantially advanced our understanding of the interactions between diets, health, and the environment. These models have highlighted how dietary shifts and policies influence economic, environmental, and health outcomes, showcasing synergies and trade-offs between health and sustainability goals. However, to better capture the complexities of the diet-health-environment trilemma, future research should enhance model flexibility by incorporating more refined representations of consumer behavior and regional heterogeneity. Expanding the use of microsimulations and integrating advanced computational techniques, such as artificial intelligence-driven tools like deep equilibrium nets, can improve parameter estimation and uncertainty reduction, strengthening the predictive capacity of CGE and PE frameworks in dietary policy analysis.

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Why Are Eggs so Expensive? Understanding the Recent Spike in Egg Prices

Andrew Muhammad, Charles Martinez, and Abdelaziz Lawani

JEL Classifications: Q02, Q11

Keywords: Avian influenza, Eggs, Energy, Feed, Prices

Throughout 2022, U.S. consumers faced persistent increases in egg prices. According to the Bureau of Labor Statistics (BLS), the average retail price of eggs (grade A, not seasonally adjusted) reached a record high of \$4.25/dozen in December 2022, up 138% from December 2021 (\$1.79/dozen) (BLS, 2023). Comparable increases have been observed in the egg producer price index (PPI), which is a measure of the average price paid to U.S. egg producers (see Figure 1). Soaring egg prices have garnered attention from policy makers and researchers and have been the subject of recent news reports including the *Wall Street Journal*, *New York Times*, and *The Economist*. Further indication of increased interest is the intensity of Internet searches: Over the last year, the number of searches on egg-price-related terms increased by more than 5,000% (Google Trends, 2023).

Noted causes of the recent surge in egg prices include supply-chain disruptions due to the COVID-19 pandemic, increased egg demand during the holiday season, and overall inflation (Malone, Schaefer, and Lusk, 2021; Oh and Vukina, 2022). However, most articles have cited recent outbreaks of highly pathogenic avian influenza (HPAI) (i.e., bird flu) as the primary cause (Lusk, 2023). Overall, the price of eggs has increased significantly more than food prices (USDA, 2023b), which raises the question: Why are eggs currently so expensive? Egg prices have been so high, in fact, that policy makers and advocacy groups have called on the Federal Trade Commission to investigate whether producers have improperly manipulated prices (e.g., Funk and the Associated Press, 2023). Although one could never rule out nefarious actions or collusion on the part of suppliers, we do not have to resort to conspiracy theories to explain the recent surge in egg prices. In this article, we show that economic factors—particularly on the production side—adequately explain the current situation, even beyond the oft-cited cause: unprecedented bird losses due to avian influenza.

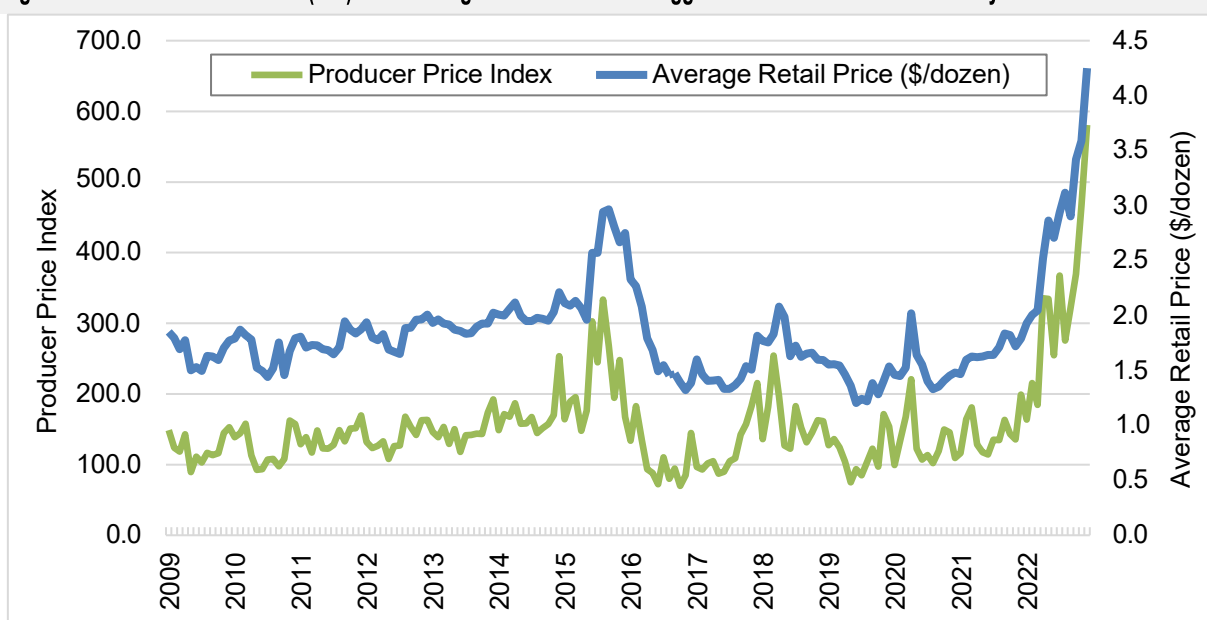
HPAI Outbreaks and Bird Loss

Since current reports have cited bird loss due to avian influenza as the primary cause of rising egg prices, it is important to provide some background on recent outbreaks and their consequences. As part of its safeguarding mission, the USDA manages the national response to major animal disease events like HPAI outbreaks to reduce disease spread and to limit negative economic impacts on the poultry sector. Since HPAI is highly contagious and can affect humans, the USDA euthanizes both infected birds and affected flocks to prevent spread. Thus, avian influenza outbreaks have significant impacts on commercial bird populations in affected areas.

Specific to the U.S. commercial table egg layer flock, the first reported HPAI case was on February 22, 2022, in New Castle County, Delaware, affecting over a million birds. Since late February, more than 44 million commercial layers have been lost due to the disease and related depopulation protocols, accounting for about 77% of all depopulated birds for commercial use in 2022 (e.g., layers, broilers, meat birds, turkeys) (USDA, 2023a).

Figure 2 shows the monthly bird loss (actual and five-period average) and the U.S. table egg layer flock from January 2009–December 2022. The monthly bird loss data from USDA-NASS include all commercial layers (table eggs and otherwise). Thus, the bird loss numbers in Figure 2 are somewhat higher than reported losses for table egg layers only. Bird loss is a natural occurrence and simply a cost of doing business. Since January 2009, average bird loss was about 9.5 million layers per month. Prior to the last major outbreak in 2015, averaged monthly losses were about 7.8 million layers. Thereafter (2016–2021), monthly losses averaged 10.7 million layers. However, this increase in the latter period was in proportion to increases in overall flock size.

Figure 1. Producer Price Index (PPI) and Average Retail Prices for Eggs in the United States: January 2009–December 2022



Note: PPI for eggs for fresh use, not seasonally adjusted (1984:12 = 100). The average retail price (\$/dozen) is the U.S. city average price for large grade A eggs per dozen, not seasonally adjusted.

Source: Producer Price Index and Average Price Data databases from the U.S. Bureau of Labor Statistics (2023).

Periods of major disease outbreaks and resulting bird loss (e.g., 32 million birds lost in May 2015 and 27 million birds lost in March 2022) have had significant impacts on overall flock size (Figure 2). Figure 2 also shows that replacing lost birds is not a fast process and takes time. Following the 2015 HPAI outbreak, the table egg laying flock shrunk to 276 million birds by June 2015. Flock sizes then increased to 342 million birds in March 2019, which was the largest monthly average during this period. As a result of HPAI outbreaks in 2022, the table egg laying flock shrunk to 299 million birds. Disease response protocols reduced the size of the U.S. egg laying flock in 2022 by about 5% compared to the previous year.

Month-to-month fluctuations in flock size are due to various market dynamics. Historically, the U.S. egg laying flock expands in the winter and early spring due to increased demand around Christmas and Easter, then contracts when demand declines during the summer months. More recently, the downward trend in flock size was due to the COVID-19 pandemic and supply chain issues that altered grocery store demand. Although grocery demand rose during the pandemic, the egg supply chain was not initially set up to shift large volumes into the retail space. Compounding the pandemic challenges was an increase in the egg PPI, which was due to higher input costs (Malone, Schaefer, and Lusk, 2021).

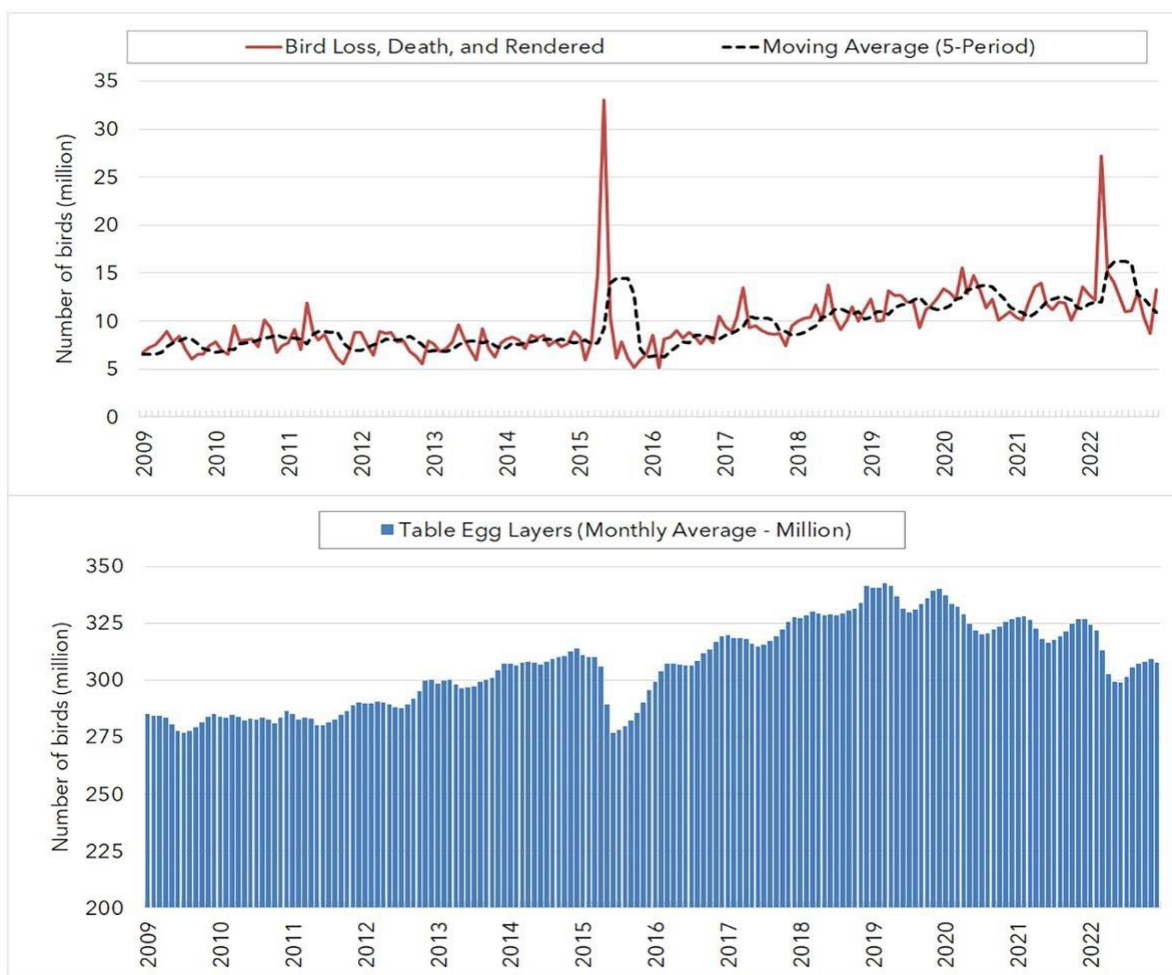
Data and Analysis

Using data from January 2009–December 2022, we estimated a basic vector autoregression (VAR) model of egg prices at both the producer and retail level. While the details of the VAR model and resulting estimates are beyond the scope of this article, there are a few issues

that we considered for the analysis, requiring a brief discussion for clarity. First, the prices paid to U.S. egg producers (as measured by the egg PPI) and average retail prices (measured in cents per dozen for the VAR procedure) were determined by the model, while the commercial bird feed cost index, natural gas price index, and relative bird loss were treated as predetermined. Depending on the U.S. region and season, natural gas is the primary energy input in egg production, although electricity is also used (Matthews and Sumner, 2015). Since natural gas and electricity prices are highly correlated, we did not include electricity prices in the model. Since bird loss is a routine monthly occurrence, we used a five-period moving average of relative bird loss for the analysis (i.e., bird loss relative to the size of the egg laying flock). This allowed for smoothing out routine month-to-month changes and negated changes in bird loss due to changes in overall flock size and allowed for significant bird losses to still have an impact, even beyond the month of occurrence.

Table 1 reports the VAR estimates. Based on the Schwartz BIC, we assumed two-period lags for the producer price index (PPI) and average retail price (ARP). The lag estimates indicate that producer prices have a positive and significant effect on average retail prices, which is to be expected. However, the effect of average retail prices on producer prices is insignificant when both lag periods are considered (note that the sum of $ARP(t-1)$ and $ARP(t-2)$ is not significant in the PPI equation). The effects of the predetermined (exogenous) variables on producer and retail prices are all positive, which is to be expected, and highly significant. Since these variables directly affect production, the estimates are relatively larger in the PPI equation. Note that Bird Loss has the largest estimated impact on producer

Figure 2. Bird Loss and Table Egg Layer Inventories in the United States: January 2009–December 2022



Source: USDA (2023c) and LMIC (2023).

prices (18.79) and average retail prices (4.28), significantly higher than the estimates for the natural gas price index and feed cost index. Although our analysis was limited to just three exogenous variables (feed cost index, natural gas price index, and relative bird loss), these variables—along with two-period lagged dependent variables—adequately explained 74% and 94% of the variation in producer price index and average retail prices, respectively.

Responsiveness of Egg Prices to Input Prices and Bird Loss

Table 2 reports elasticity estimates (percentage responsiveness of egg prices to a percentage change in natural gas prices, feed cost, or relative bird loss). For the long-run elasticities, we set $y(t) = y(t-1) = y(t-2)$ (y is either PPI or ARP). Consequently, the long-run estimates account for the total effects of the predetermined variables on egg prices. For instance, the long-run elasticity for average retail prices with respect to changes in relative bird loss includes

Table 1. VAR Model Estimates for Producer and Retail Egg Prices

	Constant	$PPI(t-1)$	$PPI(t-2)$	$ARP(t-1)$	$ARP(t-2)$	P_{NG}	P_{FEED}	$Bird\ Loss$
PPI	-110.64 (27.2)***	0.74 (0.11)***	0.12 (0.11)	-0.74 (0.31)**	0.79 (0.23)***	0.12 (0.05)**	0.25 (0.10)**	18.79 (4.98)***
ARP	-20.96 (8.84)**	0.31 (0.04)***	-0.06 (0.04)	0.23 (0.10)**	0.46 (0.08)***	0.05 (0.02)***	0.10 (0.03)***	4.28 (1.62)***

Note: Single, double, and triple asterisks (*, **, ***) denote significance at the 10%, 5%, and 1% level, respectively. Standard errors are in parentheses. Schwarz BIC = 1,474.43. The R^2 for the PPI and ARP are 0.74 and 0.94, respectively. PPI is the producer price index, ARP is the average retail price (measured in cents per dozen), P_{NG} is the natural gas price index, P_{FEED} is the feed cost index, and $Bird\ Loss$ is the five-period moving average of relative bird loss.

	Producer Price Index	Average Retail Prices
Short Run		
Natural Gas Index	0.08**	0.03***
Feed Cost Index	0.30**	0.12***
Bird Loss Share	0.40***	0.09***
Long Run		
Natural Gas Price Index	0.30*	0.32**
Feed Cost Index	1.15*	1.27**
Bird Loss Share	1.51**	1.46***

Note: Estimates can be interpreted as the percentage responsiveness of producer or retail prices to a percentage change in the exogenous variables. Single, double, and triple asterisks (*, **, ***) denote significance at the 10%, 5%, and 1%, respectively.

the effect through producer prices in addition to any direct effect. Like the VAR estimates, relative bird loss is the most important determinant of producer and retail egg prices, particularly in the long run. Note that a 1% increase in bird loss (relative to flock inventories) results in a 1.5% increase in both producer and retail egg prices. The responsiveness of producer and retail prices to feed costs is also relatively large (1.2% and 1.3%, respectively), albeit smaller than the bird loss estimates. Although statistically significant, natural gas prices had the smallest effect on egg prices (0.3% at both the producer and retail level).

To break down the impact of natural gas prices, feed costs, and bird loss on the recent surge in egg prices, we first compare all variables in 2022 to their 3-year averages (2019–2021) (See Table 3). Then we apportion the increase in retail egg prices based on the observed percentage changes in the exogenous variables. The benefit of doing an annual comparison (versus a monthly comparison) is that we can ignore month-to-month changes due to seasonal factors affecting supply and demand. In comparing 2022 to the previous period (2019–2021), the egg producer price index rose from 131 to 323, which is a 146.6% increase, and retail prices increased to \$2.86/dozen in 2022, up 87.3% compared to the previous period average (\$1.53/dozen). Note that during the same period, the natural gas price index increased by 143.3% and feed cost by 37.4%, and relative bird loss increased by 19.4%. Taking a much longer view on commercial bird

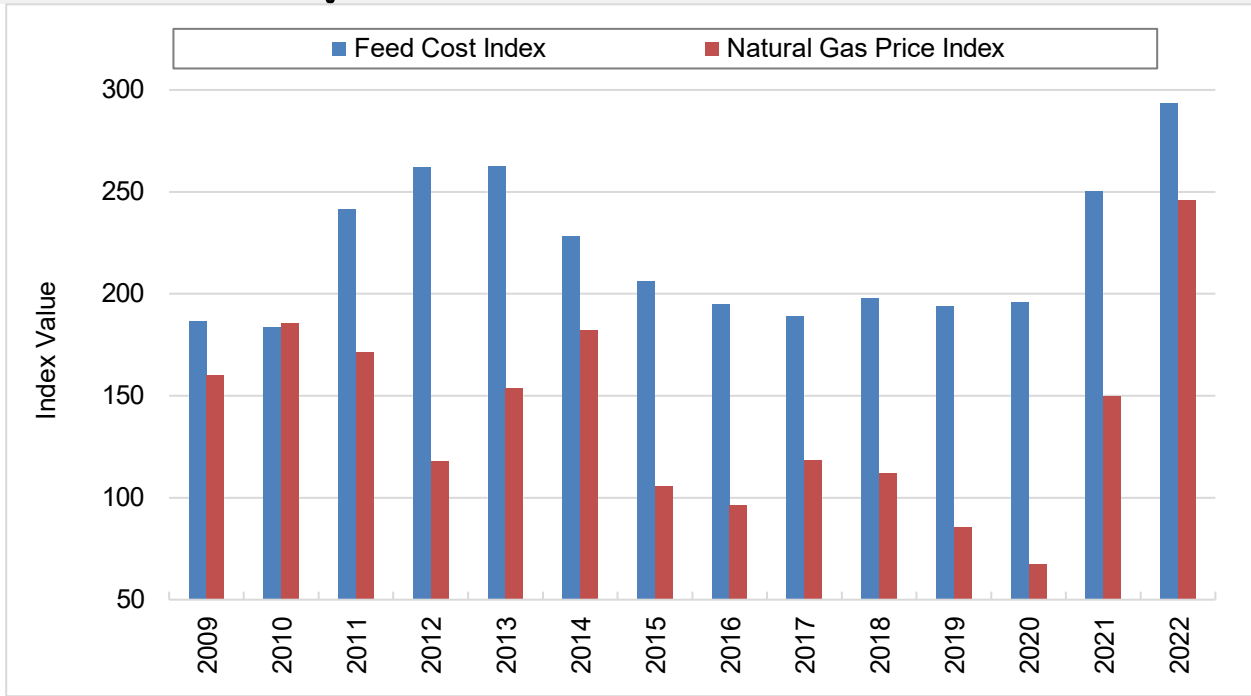
feed and natural gas prices, we see that both reach record levels in 2022 (see Figure 3). Interestingly, both natural gas prices and feed cost were significantly lower in 2015, when the last major HPAI outbreak occurred. This could explain why egg prices did not increase as much in 2015 despite significant bird loss that year.

We break down the change in retail egg prices for each exogenous variable (natural gas prices, feed cost, and bird loss) (see Figure 4). Using the long-run elasticity estimates for average retail prices (Table 2) and the corresponding percentage changes in the determining variables, we find that 38.0% of the total price increase is due to the increase in natural gas prices, 38.8% is due to the increase in feed cost, and 23.1% in due to relative bird loss. Applying these percentages to the increase in average retail egg prices in 2022 relative to the 3-year average (2019–2021) (\$1.33 = \$2.86 - \$1.53) we can apportion this increase by determining factor. Based on our estimates, \$0.31 of the overall price increase was due to relative bird loss, \$0.51 was due to natural gas prices, and \$0.52 was due to the increase in feed cost (all three increases combined is slightly higher by \$0.01 due to rounding error). While bird loss was the most important determinant based on the estimated impact, it was not most important in explaining the annual increase in prices. Of the three exogenous variables, the change in bird loss was smaller overall, 19.4% versus 37.4% and 143.3% for feed cost and natural gas prices, respectively.

Variable	3-Year Average (2019–2021)	2022	Percentage Change
Egg Producer Price Index (1991 = 100)	131.03	322.56	146.2
Average Retail Price (\$/dozen)	1.53	2.86	87.3
Natural Gas Price Index (1982 = 100)	100.99	245.74	143.3
Feed Cost Index (1986 = 100)	213.42	293.29	37.4
Bird Loss Share (loss ÷ inventory × 100)	3.65	4.36	19.4

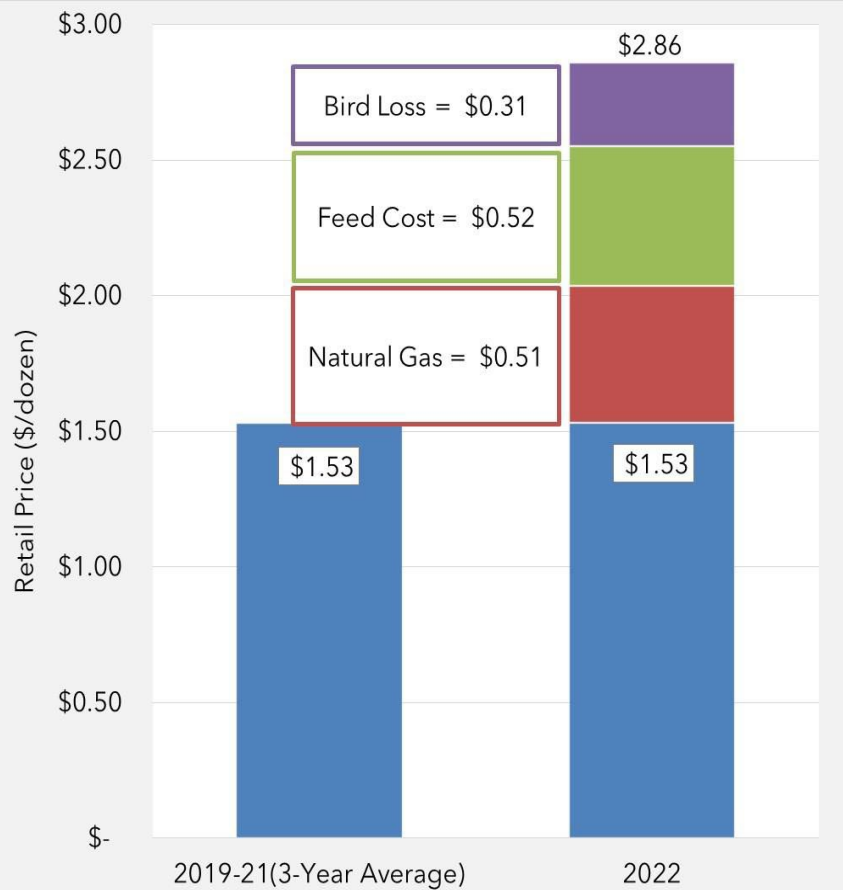
Source: Data are based on estimates derived using USDA (2023c) and BLS (2023) databases.

Figure 3. Feed Cost Index and Natural Gas Price Index: 2009–2022



Note: 1984:12 = 100 for the feed cost index, and 1982 = 100 for the natural gas price index.
 Source: U.S. Bureau of Labor Statistics (2023), Producer Price Index database.

Figure 4. Retail Egg Prices in 2022 versus 2019–2021 (3-Year Average) and Change by Determining Factor



Note: The sum of the based price (\$1.53) and determinant-specific price increases is \$2.87, due to rounding error.
 Source: Based on elasticity estimates derived from USDA (2023c) and BLS (2023).

Conclusion

The goal of this article was to assess the causes of high egg prices. Our analysis indicated that claims of price gouging may not be warranted given the influence of the price of natural gas, feed cost, and bird loss on both producer and retail egg prices. Although, the elasticity for natural gas prices was only 0.30, natural gas prices increased by 143.3% in 2022 compared to the previous period 3-year average (2019–2021), resulting in a relatively larger estimated impact on egg prices. In 2022, input prices were high overall, putting upward pressure on egg prices. Recent reports and news articles often cite avian influenza and bird loss as the primary cause of high prices. These reports are not necessarily wrong. However,

our analysis reveals a very important issue that has not been thoroughly discussed. That is, current decreases in flock size due to avian influenza may be compounding the effects of higher input prices.

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Uncovering the Impacts of Steel Tariffs on the Canned Foods Sector: Reevaluating Trade Policy Winners and Losers

Andrew Muhammad and Carlos J.O. Trejo-Pech

JEL Classifications: F13, Q11, Q17

Keywords: Canned foods, Steel, Tariffs, Trade war

Producers and users of steel are a perfect example of competing special interests: Both groups have lobbied the government on behalf of their sectors, respectively arguing for and against the tariffs on imported steel imposed by the Trump administration in 2018. One group on the “against” side is the U.S. canned food sector, which has relied on imported tinplate (tin-plated steel) for production. Tin-plated steel has been subject to both tariffs and quotas since 2018. In this article, we explore the impacts of these tariffs and their implications for canned food prices and domestic food security.

Economists are more likely to argue for complete trade liberalization (i.e., free and open trade) than for the protectionist policies favored by President Trump. As noted by Friedman and Friedman (1997), “Ever since Adam Smith there has been virtual unanimity among economists, whatever their ideological position on other issues, that free trade is in the best interests of trading countries and of the world.” However, arguments for trade liberalization are often framed in the context of *producers versus consumers*, where protection benefits special interests (producers) at the expense of the broader, general interest of society. Consequently, protectionism is often viewed through the concentrated benefits/diffused costs lens, where the concentrated group (i.e., producers) has far more incentive to lobby for protection than the diffused group (i.e., consumers) to lobby against it. However, this does not fully apply to specific trade actions where there are competing special interests and concentrated gains (or losses) and lobbying efforts on both sides of the issue.

The current tariff situation and lobbying efforts of the U.S. canned food and steel sectors provide an ideal case for examining trade protections in this context (i.e., competing special interests). In the United States, the canned food sector was valued at an estimated \$17.8 billion in 2019 (Statista, 2023), with tin-plated steel being the primary packaging material. The data suggest that the impacts of the section 232 tariffs on the canned food

sector have not been negligible. However, more research is needed for a more quantitative assessment of their impacts and implications.

Background

During his time in office, President Trump advocated for greater trade protections, imposing tariffs on a broad range of products. In March 2018, President Trump signed a proclamation to impose a 25% tariff on all imported steel, based on a Department of Commerce report that indicated that imports had the potential to threaten U.S. national security. Section 232 of the Trade Expansion Act of 1962 allows the president to use trade barriers for national security concerns (The White House, 2022). A major concern was the unprecedented growth in China’s crude steel production, which exceeded 1 billion metric tons in 2020, accounting for more than half of global production. Note that the next highest country (India) produced around 100 million metric tons and the United States produced around 70 million metric tons (World Steel Association, 2022). While higher prices via import quotas and tariffs benefited the U.S. steel sector, the negative impacts on downstream steel-consuming companies exceeded any gains. For instance, 75 times as many jobs were estimated to have been lost in downstream steel-consuming sectors compared to jobs gained in the steel-producing sector (Russ and Cox, 2020).

Food canning can be traced back to the 18th century in France, and the basic principles have not changed significantly since. Clearly, the direct benefit of canning is food preservation, in that the process allows for converting perishable food items into shelf-stable food, allowing for quality and nutritional properties to be maintained for years after being processed (Canned Food Alliance, 2023). The long-lasting nature of canned foods reduces food waste, common for fresh and perishable food items. Food waste and loss—caused by many factors from the farm through the final consumer and representing 30%–40% of the food supply—is a

problem because a significant amount of food is sent to landfills, which also contributes to greenhouse gas emissions from activities prior to and during disposal (U.S. Department of Agriculture, 2023).

Food preservation and convenience make canned foods suitable for food security in times of crisis, such as natural disasters or pandemics. For instance, at the beginning of the COVID-19 pandemic, households could secure food by increasing canned food purchases when restaurants were in lockdown and trips to grocery stores were less frequent (Hillen, 2021; Pigott, 2022). Unfortunately, the steel tariffs lasted throughout the pandemic, a time when consumers would have benefited from relatively lower prices for shelf-stable food items. As discussed in the next section, canned food prices significantly increased after the steel tariffs were imposed in 2018, exceeding overall inflation in recent years.

U.S. Steel Tariffs and the Canned Foods Sector

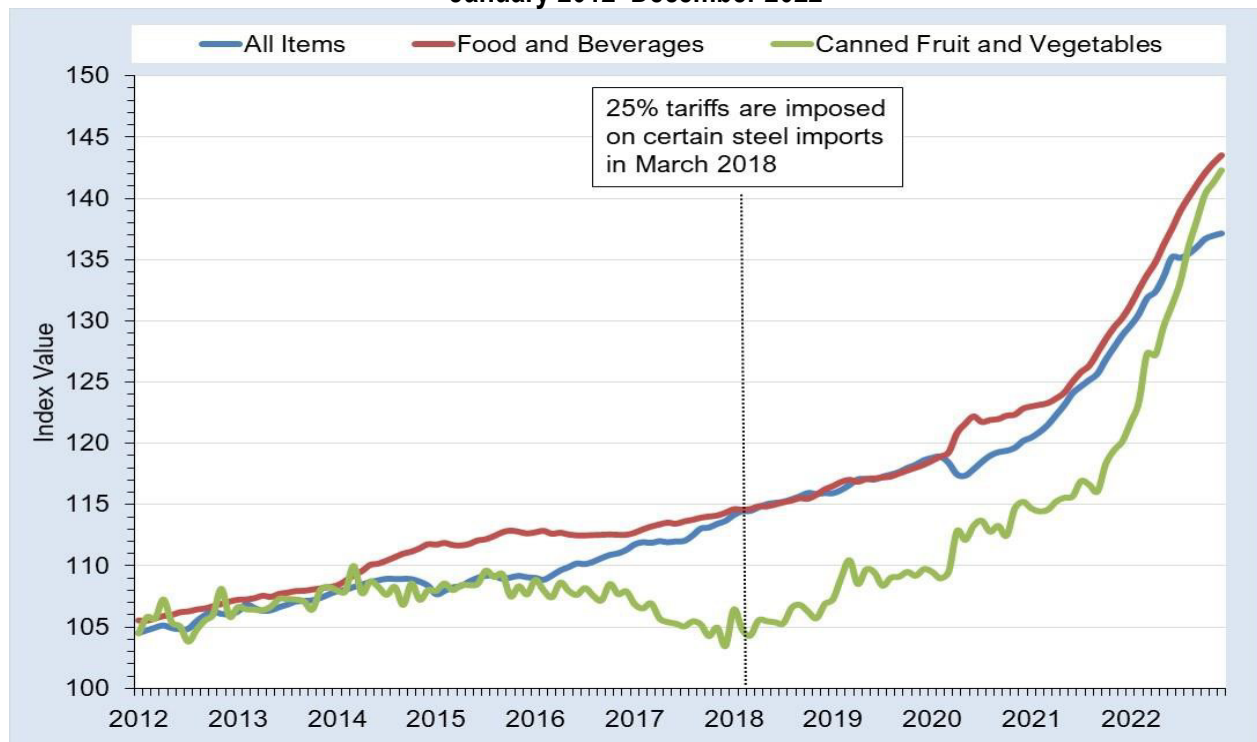
It was fitting that when the steel tariffs were first introduced, then-Commerce Secretary Wilbur Ross used a canned food item to defend the tariffs, suggesting a negligible impact on consumers and prices. In 2018, Secretary Ross noted (Horowitz, 2018),

This is a can of Campbell's soup, there's about 2.6 cents, 2.6 pennies, worth of steel. So, if that goes up by 25 percent, that's about six-tenths of one cent on the price of the can of Campbell's soup.

Interestingly, canned food prices increased by more than Secretary Ross speculated they would. We asked the CEO of a U.S. canned food company why have prices increased significantly more than “six-tenths of one cent.” He indicated that due to the tariffs, companies were paying significantly more for cans for several reasons. First, he noted the difficulties in transporting empty cans: shipping empty cans is tantamount to shipping air. Therefore, can manufacturing should be as close as possible to canning facilities. Import restrictions and tariffs make purchasing steel and producing cans more difficult, causing canned food companies to contract with can production facilities at greater and greater distances. Additionally, tinplate makes up a small share of U.S. steel production, and there is limited capacity to expand. This limited capacity has resulted in regional market power, allowing for higher mark-ups and putting additional upward pressure on prices.

To better understand how the steel tariffs might have affected canned food prices, we examined the consumer price indices for all items (CPI), food and beverages, and canned fruit and vegetables over the last decade

Figure 1. Consumer Price Indexes for All Items, Food and Beverages, and Canned Fruit and Vegetables, January 2012–December 2022



Note: Index values are the U.S. city average and seasonally adjusted. The indexes were rescaled based on the 2010 monthly average for comparison purposes.

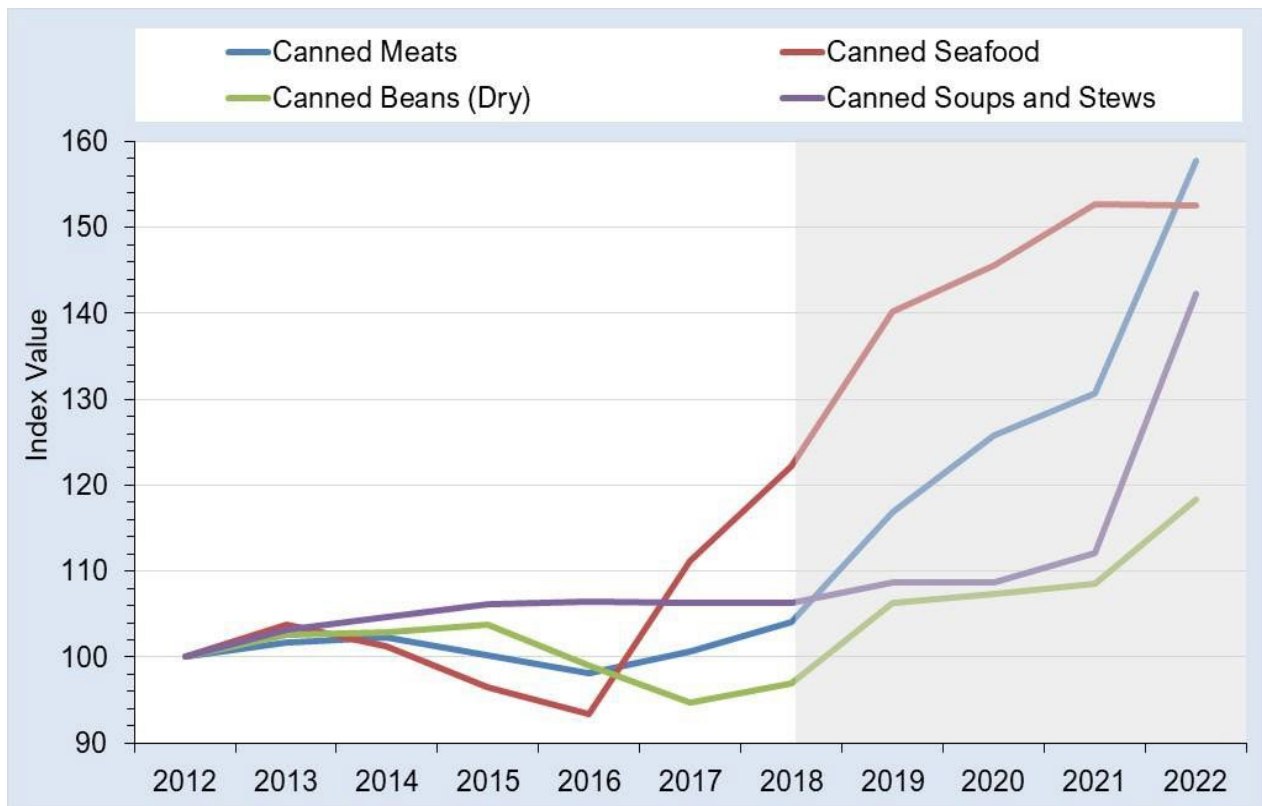
Source: Bureau of Labor Statistics (2023).

(January 2012–December 2022) (see Figure 1). If the steel tariffs were inconsequential, then it could be argued that canned food prices would have followed a similar pattern as the CPI or food prices overall. Interestingly, the canned fruit and vegetables price index decreased from 2015 to 2018, even as the price indices for all goods and food and beverages increased. Even more interesting, the canned fruit and vegetables price index persistently declined right up to the point when the steel tariffs were imposed in March 2018, suggesting that the steel tariffs resulted in relatively higher canned food prices. Since the COVID-19 pandemic also caused prices to rise, Figure 1 might be capturing both the effects of the pandemic and the tariffs. However, the relatively faster price growth and the increase during 2018 and 2019 are likely due to the steel tariffs. Note that similar patterns occurred for other canned foods. Figure 2 shows the producer price indexes for canned meats, seafood, beans, and soups and stews. Although canned seafood prices were rising before 2018 and the price of canned soups and stews did not significantly increase until 2022, both canned meats and canned bean prices (at the producer level) followed a similar pattern as the price index for canned fruits and vegetables: steady or decreasing prices until 2018, followed by a persistent upward trend thereafter. This

provides even further evidence that the steel tariffs increased canned food prices.

Last, we considered U.S. tin-plated steel imports since 2012, as defined by three Harmonized System (HS) categories (72101200, 72121000, and 72101100) (see Figure 3). The Netherlands, Germany, and Canada supply a major share of U.S. tinplate imports, but South Korea and China also account for a significant share. The data show that imports were trending upward until 2018 and then declined and remained low throughout 2020. Compared to 2017, U.S. tinplate imports during this three-year period (2018–2020) were down 19% overall and down 35% for imports from South Korea, 23% for Germany, 15% for China, 13% for the Netherlands, and 9% for Canada. The relatively smaller decline in imports from Canada could be due to their tariffs being lifted in 2019. Interestingly, imports have fully recovered in recent years, which could be due to the United States and European Union reaching an agreement that converted the steel tariffs to tariff-rate quotas (Fefer, 2021). Is it important to note that Figure 3 includes tin-plated steel for all uses, so it is not clear whether the recovery in imports benefited the canned food sector specifically.

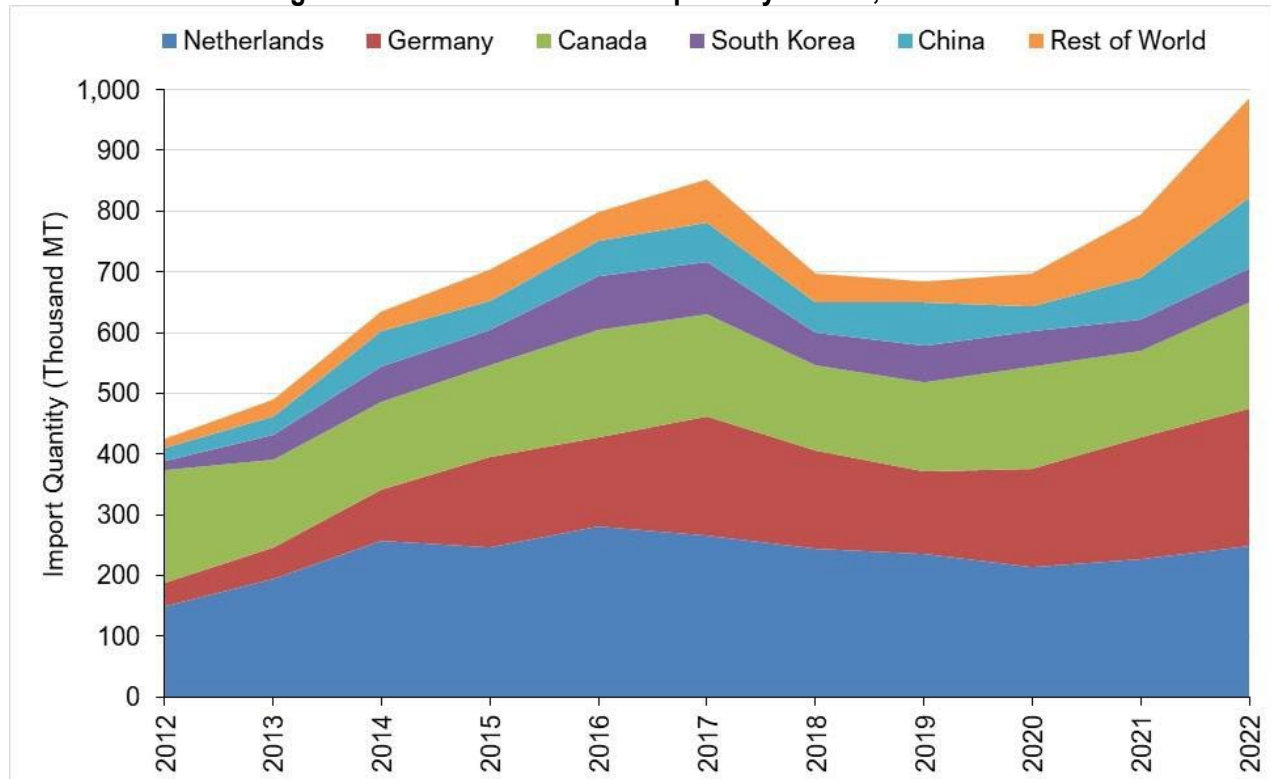
Figure 2. Producer Price Indexes for Select Canned Food Items, 2012–2022



Note: Index values were rescaled to 2012 for comparison purposes. Shaded area denotes the period when the steel tariffs were imposed.

Source: Bureau of Labor Statistics (2023).

Figure 3. U.S. Tin Plated Steel Imports by Source, 2012–2022



Note: Imports are an aggregation of the following Harmonized System (HS) categories: 72101200 *Iron/nonalloy steel, width ≥ 600 mm, flat-rolled products, plated or coated with tin, less than 0.5 mm thick*, 72101100 *Iron/nonalloy steel, width ≥ 600 mm, flat-rolled products, plated or coated with tin, thickness ≥ 0.5 mm*, and 72121000 *Iron/nonalloy steel, width ≤ 600 mm, flat-rolled products, plated or coated with tin*.

Source: U.S. International Trade Commission (2023).

Closing

Producers in the U.S. canned food industry compete on price, making the industry one of the lowest-margin sectors (Wood, 2023). Thus, the proclamation by President Trump imposing 25% tariffs on imported steel caused concern for the canned food sector. The data in this study show that sector was likely impacted beyond the negligible expectations of the previous

administration. This was in part evidenced by the relatively larger increases in canned food prices since 2018 compared to overall food prices and inflation. Downstream industries like the canned food sector that faced steel tariffs experienced declines due to higher production costs, decreased profits, and even decreased sales due to higher prices. However, a more quantitative assessment is needed to assess the degree to which all of these have occurred.

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How the Trade War Is Hitting American Beer, Wine, and Spirits in Canada

Thursday, April 9, 2026

We often forget that beer, wine, and spirits are fundamentally agricultural products, rooted in the cultivation of corn, barley, rye, wheat, grapes, and other farm commodities. As a result, disruptions to alcohol trade are not just shocks to beverage markets, but direct blows to farmers, rural communities, and the wider agricultural economy that supplies these products (Muhammad et al., 2025). This broader agricultural story now runs straight through Canada, where trade tensions transformed alcohol import demand into a geopolitical statement. Canada has long been an important export destination for U.S. beer, wine, and spirits, supported by geographic proximity, integrated supply chains, and decades of tariff-free trade. In 2024, for instance, Canada was the leading

market for U.S. wine exports and the second leading market for U.S. distilled spirits and beer exports (USDA, 2026). This relationship shifted abruptly in 2025 when trade tensions escalated beyond conventional tariff retaliation and entered the retail marketplace.

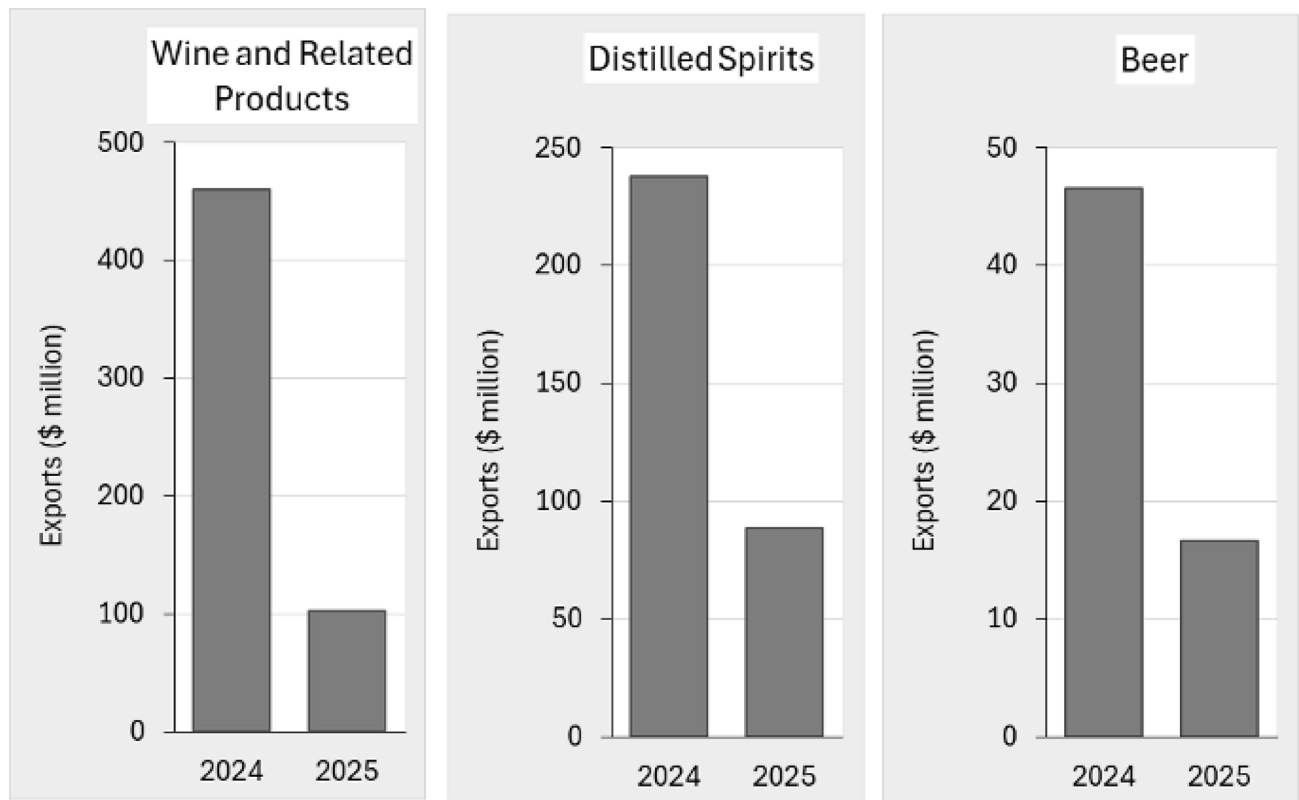
At the heart of the disruption was Canada's decision to remove American alcohol from store shelves entirely. Rather than relying solely on retaliation through tariffs, multiple provinces instructed their liquor authorities to stop purchasing and selling American beer, wine, and spirits. In early February 2025, the United States announced broad tariffs on Canadian imports. Canada responded in March with retaliatory tariffs on a range of U.S. goods, including alcohol (Kitamura, 2026). Provincial governments escalated further by directing liquor boards in Ontario, Quebec, British Columbia, Nova Scotia, and other provinces to halt purchases of U.S. alcohol and remove existing products from shelves and digital platforms. Throughout the spring and summer of 2025, these delistings remained largely in place, with only limited reversals in select provinces (DISCUS, 2026).

Figure 1 summarizes the year-over-year change in U.S. beer, wine, and distilled spirits exports to Canada between 2024 and 2025, reflecting the impact of the trade war on each product category. As shown in the figure, wine and related products experienced the largest decline, falling from \$460 million in 2024 to \$103 million in 2025, a 77.6% reduction or a \$357 million loss. Distilled spirits exports declined from \$238 million to \$89 million, a 62.7% decrease, resulting in a \$149 million loss. Beer exports also dropped sharply, falling from \$47 million to \$17 million, a 64.4% decline or \$30 million loss. Taken together, total U.S. alcohol exports to Canada fell from \$744 million to \$208 million, a 72% decrease amounting to an overall dollar loss of \$536 million.

These shelf removals sent a clear political signal to U.S. policymakers while simultaneously encouraging Canadian consumers to substitute toward domestic

or non-U.S. products. It also exposed the vulnerability of exporters operating in markets where governments control distribution infrastructure, demonstrating how trade wars can extend beyond borders and tariffs to reshape retail availability itself. Even as some punitive measures were later eased, this episode underscored how quickly trade relationships built over decades can be disrupted when retaliation targets market access rather than prices alone.

Figure 1. U.S. Beer, Wine, and Spirits Exports to Canada: 2024 and 2025



Source: U.S. Department of Agriculture, Foreign Agricultural Service, Global Agricultural Trade System (GATS) (USDA, 2026)

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U.S. Agricultural Export Trends: Stability, Growth, and a China-Driven Rollercoaster

Thursday, March 12, 2026

Now that the December 2025 trade data have been released, we can look back over the past fifteen years to evaluate how U.S. agricultural exports have evolved across major markets and how shifting global dynamics, especially the dramatic rise and subsequent decline of exports to China, have shaped overall performance. U.S. agricultural exports from 2010 through 2025 reveals a story of both stability and notable volatility. Total agricultural exports rose from \$119 billion in 2010 to a high of \$196 billion in 2022, before settling at \$171 billion in 2025. Exports in 2025 were more than \$5.0 billion lower than the previous year, driven primarily by reduced soybean shipments, along with declines in coarse grains, beef, wine, and rice. Much of the variation in U.S. agricultural trade can be

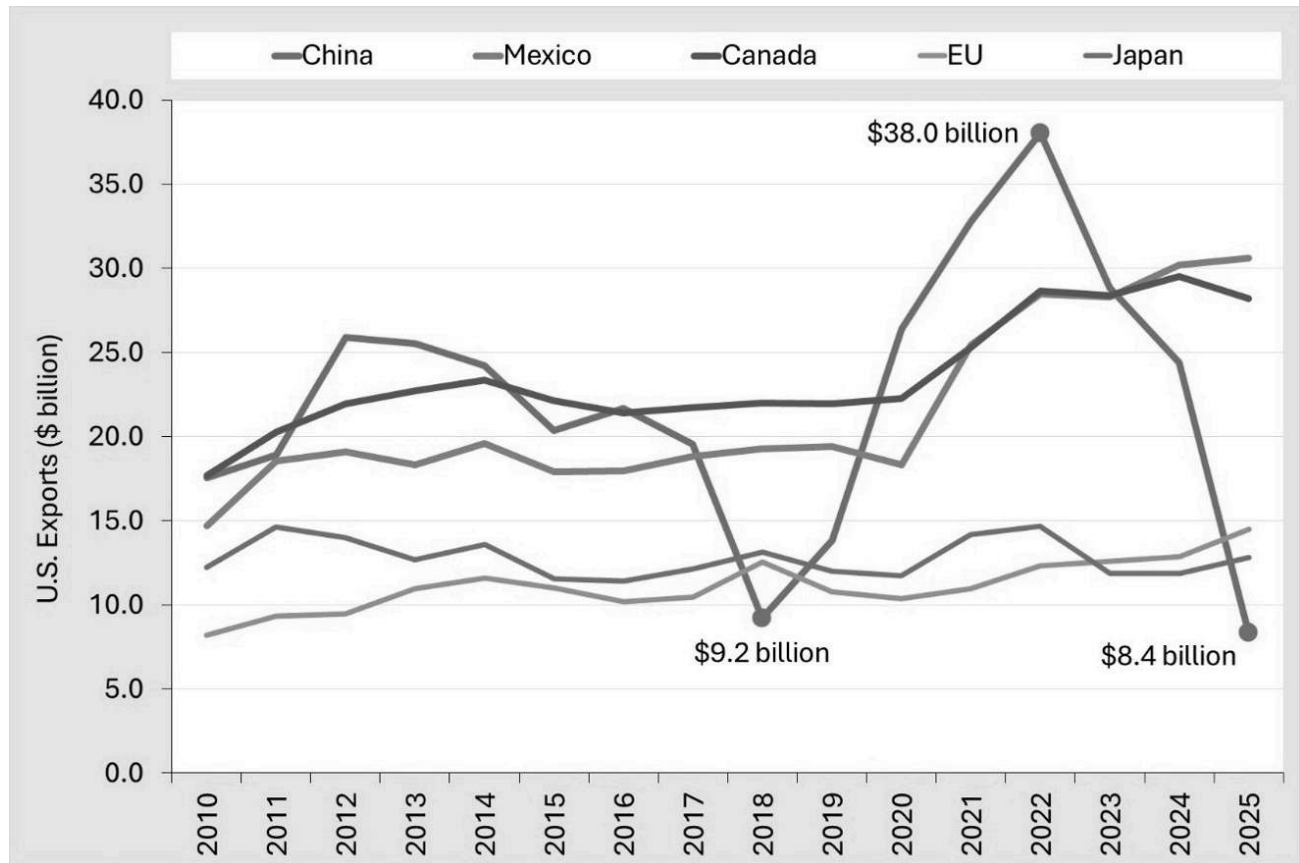
traced to the dramatic rise and fall of U.S. exports to China, a market that transformed from the leading U.S. destination to a source of sharp decline. Indeed, the widening U.S. agricultural trade deficit, which grew from -\$37.6 billion in 2024 to -\$41.7 billion in 2025, stems largely from the steep collapse in exports to China (USDA, 2026).

Figure 1 shows U.S. agricultural exports to the major destinations—China, Mexico, Canada, the European Union, and Japan. With the exception of China, most major U.S. export markets exhibit steady or gradually increasing demand, even during periods of heightened trade tensions and uncertainty. However, it's hard to ignore the extremely volatile path of U.S. agricultural exports to China. Beginning at \$18 billion in 2010, exports to China climbed substantially, peaking at \$38 billion in 2022, primarily due to rising exports from the Phase One Trade Agreement and relatively high commodity prices. However, exports to China have significantly declined since, falling to just \$8 billion in 2025, representing a loss of \$30 billion in only three years. No other major market exhibits such a rollercoaster pattern. This deterioration also helps explain why total U.S. exports fell from \$196 billion in 2022 to \$171 billion in 2025, despite persistent exports elsewhere.

In contrast, exports to nearly every other major destination remained stable or even trended upward. Mexico increased from \$15 billion in 2010 to \$31 billion in 2025. Canada remained consistently strong, rising from \$18 billion to \$28 billion over the same period. The EU and Japan both show moderate, incremental increases, with none experiencing sharp swings comparable to China. Overall, recent trends illustrate two simultaneous dynamics: the inherent volatility of U.S. agricultural trade with China and the remarkable stability of U.S. exports to virtually every other major market. While the collapse in Chinese demand resulted in a noticeable drop in total exports after 2022, the resilience of other destinations helped buffer the decline. These trends highlight both the

opportunities and the vulnerabilities that come with relying heavily on a single, now-unpredictable trading partner.

Figure I. U.S. Agricultural Exports to the Top Destination Markets: 2010-2025



Source: U.S. Department of Agriculture, Foreign Agricultural Service, Global Agricultural Trade System (GATS) (USDA, 2026)

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When China Stops Buying: Is this the New Reality for U.S. Cotton?

Thursday, February 26, 2026

U.S. cotton is among the most export-dependent agricultural commodities, with more than 80% of annual production moving into global markets rather than being used domestically (U.S. Department of Agriculture, 2026a). Although China has not always been a consistent buyer, importing less than 15% of U.S. cotton exports in some years and more than 30% in other years, it has nevertheless remained a somewhat reliable partner, accounting for nearly 30% of U.S. cotton exports in more recent years (2020-2024) (U.S. Department of Agriculture, 2026b).

Once the most important market for U.S. cotton, China has become a far less reliable partner in 2025, as recent import patterns show greater volatility and reduced engagement with the U.S. agricultural sector. In 2025, China's purchases of U.S. cotton fell from \$1.5 billion to just \$0.2 billion, an 85% decline, while its import volume dropped at nearly the same rate, from 0.8 million metric tons (MMT) to 0.1 MMT. In contrast, exports to markets outside China expanded substantially over the same period. The value of U.S. cotton exports to non-China destinations rose from \$3.5 billion to \$4.6 billion, a 32% increase, while quantities surged 51%, from 1.7 MMT to 2.6 MMT (Table 1) (U.S. Department of Agriculture, 2026b).

Why did China sharply reduce its imports of U.S. cotton? While the trade war and subsequent political tensions certainly accelerated the decline, the underlying shift runs deeper than tariffs. China's overall import strategy has fundamentally changed as its domestic cotton sector has undergone major structural adjustments since 2010. Over the past decade, China has increased production, drawn down its massive state-held stockpiles, and reduced its dependence on foreign fiber. Since 2021 alone, domestic output has risen by more than 30% (U.S. Department of Agriculture, 20250). As a result, China is increasingly able to meet the needs of its textile and apparel industry with domestic cotton rather than imports. Taken together, these developments suggest that China's reduced reliance on U.S. cotton is not simply a temporary response to trade tensions but part of a longer-term realignment.

Table 2 makes clear that the steep decline in U.S. cotton exports to China was not simply the result of tariffs or bilateral tensions, but part of a much broader contraction in China's overall import demand. China's total cotton import value fell from \$5.3 billion in 2024 to \$1.9 billion in 2025, while import volumes dropped from 2.6 million to 1.1 million metric tons. Every major supplier experienced significant losses: Brazil's shipments fell by more than 50%, India's collapsed by over 90%, and Australia also recorded substantial reductions.

The across-the-board declines underscore a structural shift in China's sourcing strategy rather than a U.S.-specific outcome.

Table I. U.S. Cotton Exports: 2024 and 2025

	2024	2025	Change	%Change
	Value (\$ billion)			
China	\$1.5	\$0.2	-\$1.3	-85.1%
Total (w/o China)	3.5	4.6	1.1	32.0%
Total (w/ China)	5.0	4.8	-0.1	-2.8%
	Quantity (million metric tons)			
China	0.8	0.1	-0.6	-84.6%
Total (w/o China)	1.7	2.6	0.9	51.0%
Total (w/ China)	2.5	2.7	0.2	9.6%

Source: U.S. Department of Agriculture (2026b)

Table 2. China's Cotton Imports (Major Exporting Countries): 2024 and 2025

	2024	2025	Change	%Change
	Value (\$ billion)			
Total	\$5.3	\$1.9	-\$3.4	-63.6%
Brazil	2.2	0.8	-1.4	-63.4%
U.S.	1.9	0.2	-1.6	-87.8%

Australia	0.7	0.6	-0.1	-13.8%
India	0.1	0.0	-0.1	-91.1%
Turkey	0.1	0.1	0.0	3.7%

Quantity (million metric tons)

Total	2.6	1.1	-1.5	-59.2%
Brazil	1.1	0.5	-0.6	-57.8%
U.S.	0.9	0.1	-0.8	-86.8%
Australia	0.3	0.3	0.0	0.2%
India	0.1	0.0	-0.1	-90.9%
Turkey	0.1	0.1	0.0	-4.1%

Source: Trade Date Monitor®(2026)

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Recent Trade Tensions Cause U.S. Beef to Lose Ground in China, Spurs Gains for Australia and Brazil

Thursday, October 30, 2025

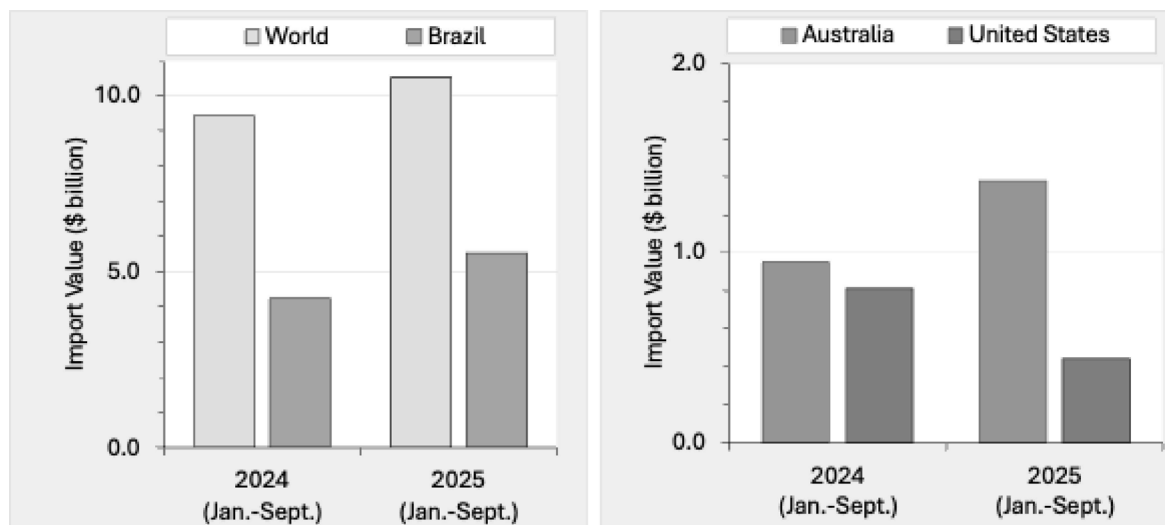
Over the past decade, China has gone from a minor player to the world's largest beef importer, with purchases rising from around a \$100 million in 2010 to nearly \$18 billion in 2022, which is a staggering increase of over 17,000%. This surge isn't just about spending more. The actual volume of beef purchased has grown by more than 8,000%, driven by rising incomes, urban lifestyles, and shifting diets that favor beef over traditional staples like pork. The outbreak of African Swine Fever in 2018, which devastated China's pig population, further accelerated the shift, while government dietary guidelines have promoted beef as a healthier

option. Due to rising demand and imports, coupled with lifting the import restriction on U.S. beef in 2017, China is now the third largest foreign market for U.S. beef-around \$1.5 billion in 2024. This rise has been highlighted in previous Southern Ag Today articles (For example, see: <https://southernagtoday.org/2025/04/17/high-tariffs-could-halt-u-s-beef-exports-to-china/>).

Rising trade tensions between the U.S. and China, which started earlier this year, raised concerns for U.S. beef exporters. Chinese tariffs on American beef soared as high as 145%, making it far more expensive than beef from countries like Brazil and Australia. Although those tariffs were later lowered to around 33%, the decline had already begun. On top of that, China let export approvals expire for nearly 400 U.S. beef processing plants in March, about 60% of all facilities allowed to ship beef to China, effectively blocking a large portion of U.S. supply (Marianetti, 2025). This move, seen as a non-tariff barrier, has created uncertainty, shaking confidence in the reliability of U.S. beef exports.

In 2025, rising trade tensions quickly took a toll on American beef in China (see Figure 1). From January to September, U.S. beef exports fell sharply-from \$814 million in 2024 to \$442 million in 2025-a 46% drop driven mostly by lower volumes. The decline was even steeper in the second and third quarters, after China let key export approvals expire, with U.S. beef falling nearly 70%. This happened even as China's overall beef imports grew in value. Meanwhile, Australia and Brazil gained ground: Australia's exports to China rose 42%, and Brazil's increased nearly 25%. In 2024, the U.S. held about 9% of China's beef import market, compared to Brazil's 48% and Australia's 9%. By the third quarter of 2025, the U.S. share had dropped to less than 1%, while Brazil and Australia accounted for 59% and 13%, respectively. It's a clear sign that when trade tensions rise, other suppliers are quick to take the lead.

Figure I. Chinese Beef Imports: 2024 and 2025 (Year-to-date: January-September)



Note: Imports are defined according to the Harmonized System (HS) classification HS 0202 *meat of bovine animals, frozen*. Frozen beef accounts for over 90% of China's beef imports.

Source: Trade Data Monitor®

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China's Agricultural Imports from U.S. and Brazil Decline in 2025 - But the U.S. Faces Sharper Losses

Thursday, October 2, 2025

The decline in U.S. agricultural exports to China has made headlines, most notably due to China's decision not to purchase U.S. soybeans this season. Soybeans are the largest agricultural export for the United States, and China has traditionally been the top foreign buyer of U.S. soybeans, making this shift particularly significant for American producers. While stories have been mostly about declines in U.S. exports to China, it is important to note that China's agricultural imports-including related products like forestry, biodiesel, and

seafood-are down overall in 2025 compared to 2024, reflecting a broader contraction in trade.

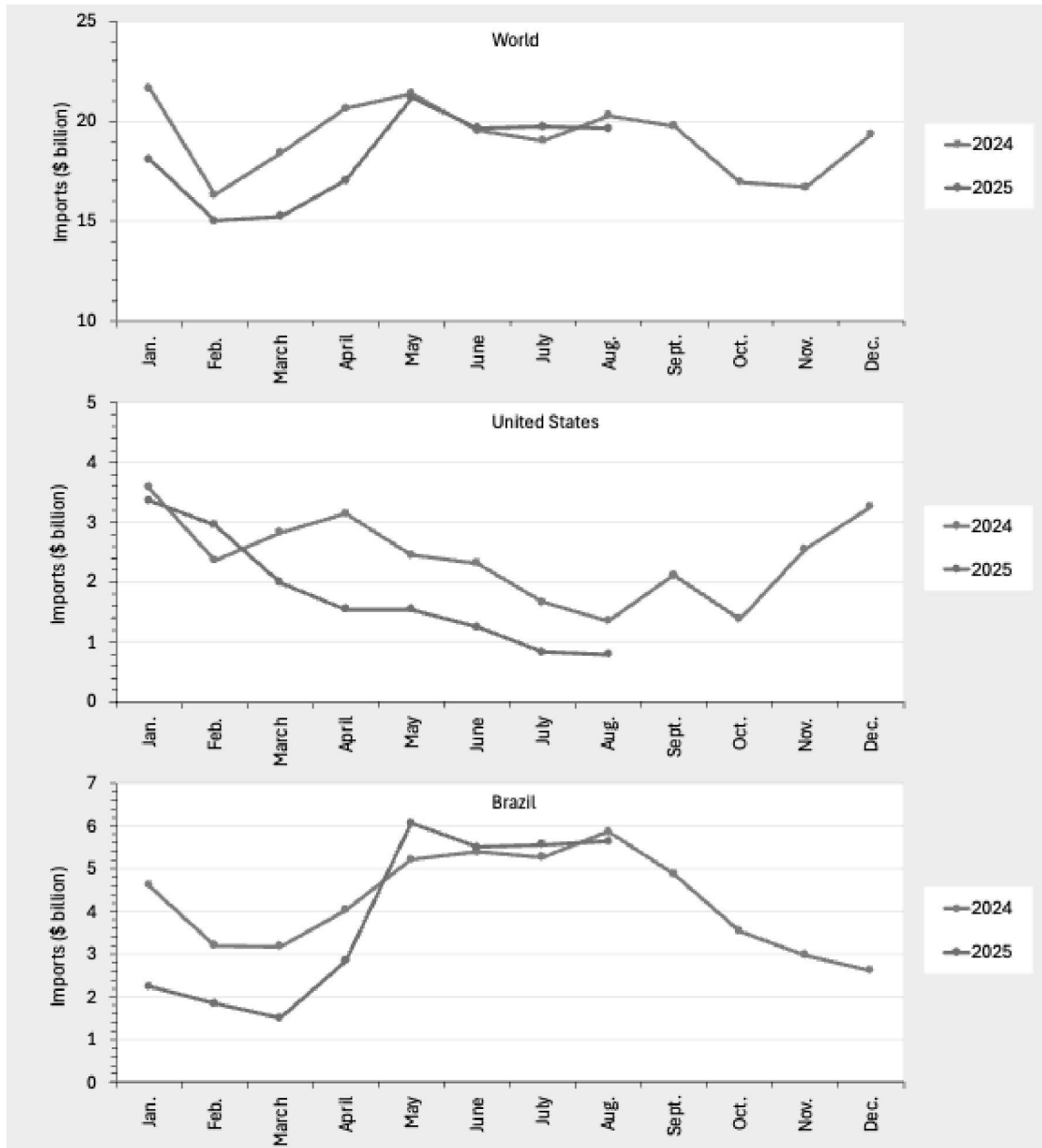
Figure I shows China's total agricultural imports from global sources, including the United States and Brazil. Overall, total imports declined in 2025 compared to 2024, with the most significant drop occurring during the first half of the year. For example, imports in January 2025 fell to approximately \$18 billion, down from \$22 billion in January 2024. A year-to-date comparison (January-August) shows total imports decreased from \$157 billion in 2024 to \$145 billion in 2025, a reduction of \$12.1 billion, or 7.5%. In terms of quantity or volume, the decline was even steeper-nearly 12% (Trade Data Monitor®, 2025), suggesting that lower import values were not solely driven by price changes but also by reduced quantities.

Although China's agricultural imports declined overall, imports from the United States experienced a sharper and more sustained drop, beginning later in the year. In January 2025, imports from the U.S. were down by only \$220 million compared to the previous year, and in February, they were up by nearly \$600 million. However, starting in March, imports consistently fell below 2024 levels. By August, year-to-date China's imports of U.S. agriculture and related products had dropped from \$20 billion in 2024 to \$14 billion in 2025, a decline of more than \$5 billion, or 27.5%.

Brazil also experienced a decrease in agricultural export sales to China in 2025, though the decline was less severe than that of the United States. As of August 2025, imports from Brazil fell from \$36.7 billion in 2024 to \$31.2 billion, representing a 15.0% decrease. Month-to-month comparisons show sharper early-year declines: imports were down 51% in January, 43% in February, and 53% in March compared to the same months in 2024. However, beginning in May 2025, import levels from Brazil became more comparable to the previous year and even exceeded 2024 figures in some months. This mid-year rebound

suggests that Brazil is benefiting from seasonal demand as well as favorable trade conditions.

Figure I. China's total agricultural imports from the World, United States, and Brazil: January 2024 - August 2025



Note: Agricultural import values include related products like forestry, biodiesel, and seafood.

Source: Trade Data Monitor® (2025)

Reference

Trade Data Monitor®. (2025). Retrieved from <https://www.tradedatamonitor.com>

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Outlook for U.S. Agricultural Trade in 2025: Exploring the Recent August Forecasts

Thursday, September 4, 2025

The August 2025 *Outlook for U.S. Agricultural Trade* provides a snapshot of the current challenges and opportunities in global markets (USDA, 2025a). The quarterly report has long been a valuable tool for understanding how international trends affect the U.S. farm economy. In the past, it included both data and written commentary to explain possible causes behind trade shifts. However, the May 2025 report sparked controversy when its release was delayed. The issue centered on explanatory text that linked rising agricultural trade deficits to tariffs (Ingwersen & Douglas, 2025). As a result, the USDA removed the commentary and now publishes only data tables. This change has

raised concerns about transparency and the loss of expert interpretation that helped make sense of complex trade dynamics.

The August report shows that the U.S. will continue to import more agricultural goods than it exports. However, the projected trade deficit for fiscal year (FY) 2025—running from October to September—was revised downward from \$49.5 billion in the May report to \$47.0 billion. This adjustment was driven by an upward revision in forecasted exports, while the import forecast remained unchanged from May at \$220 billion. For FY2025, exports are now expected to reach \$173 billion, with imports holding at \$220 billion.

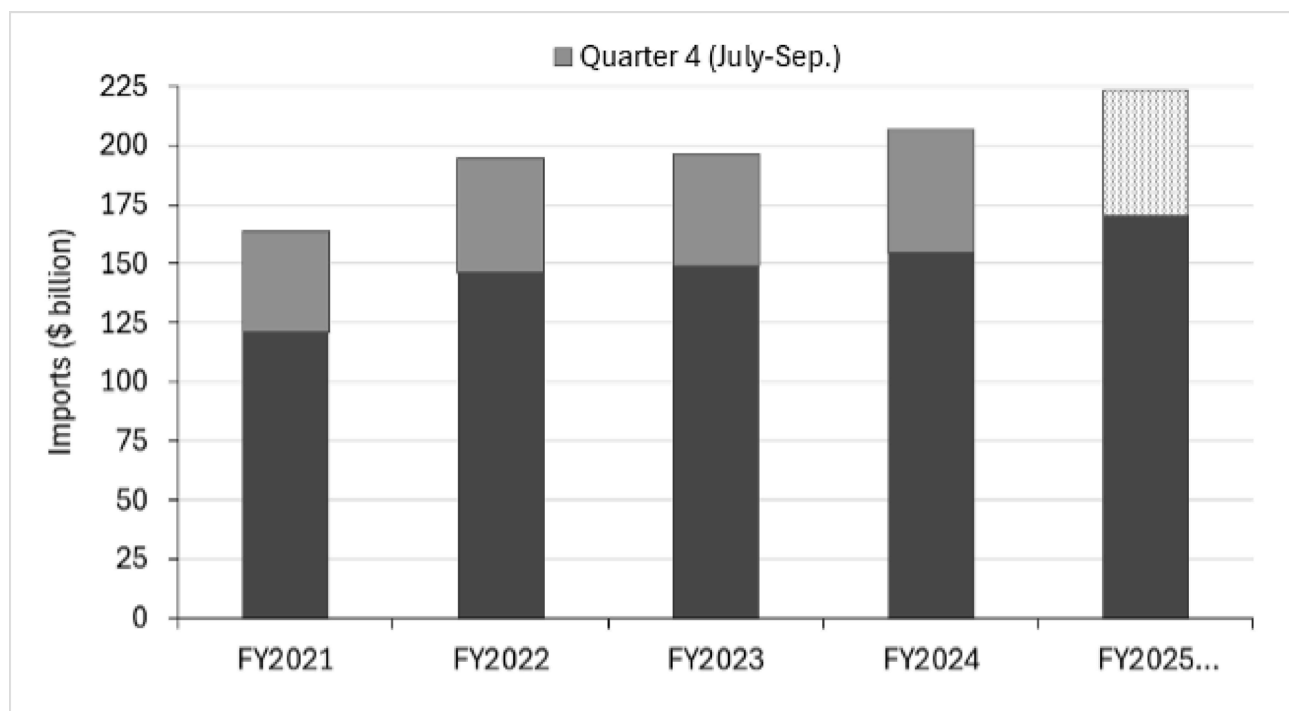
These revisions raise important questions. Are they justified based on the available data? Most notably, is there clear evidence of increased export activity to support the upward revision? And given current trends, should the import forecast have been adjusted as well—either upward or downward? A closer look at recent trade is needed to assess whether these changes reflect actual market conditions or optimism.

Year-to-date (October to June) export values are reported in Table 1. The data suggest that the value of agricultural exports will remain relatively flat. During the first three quarters of the fiscal year, export values increased slightly from \$135.0 billion in 2024 to \$135.7 billion in 2025, which is a modest 0.6% rise. However, the volume of exports grew significantly, increasing from 162.4 million metric tons (MMT) to 175.9 MMT, an 8.3% increase. This growth in quantity was offset by a 7.2% decline in average prices (unit value), which fell from \$831/MT to \$772/MT, suggesting lower prices per unit across many commodities. Depending on prices, the upward revision in the export forecast could be justified despite current trade tensions (USDA, 2025b).

Assuming fourth-quarter imports in FY2025 will follow patterns seen in recent years, available data suggest that total imports could reach \$223 billion. This

supports the decision to hold the official import forecast steady at \$220 billion given the small \$3 billion difference (USDA, 2025b). If ongoing trade tensions continue, it would not be surprising if actual imports were lower than \$220 billion.

Figure I. U.S. Agricultural Imports: FY2021-FY2025



Note: FY is the fiscal year (October - September)

Source: U.S. Department of Agriculture, Foreign Agricultural Service, Global Agricultural Trade System (GATS) (2025b)

Table I. U.S. Agricultural Exports: FY2024 and FY2025 (year-to-date: October - June)

Exports	Oct. -June 2024	Oct. - June 2025	%Change
Value (\$ billion)	\$135.0	\$135.7	0.6%
Quantity (MMT)	162.4	175.9	8.3%

Unit Value (\$/MT) \$831.1 \$777.5 -7.2%

Note: FY is the fiscal year (October - September)

Source: U.S. Department of Agriculture, Foreign Agricultural Service, Global Agricultural Trade System (GATS) (2025b)

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U.S. Department of Agriculture (USDA). 2025a. *Outlook for U.S. Agricultural Trade: August 2025*. <https://www.fas.usda.gov/sites/default/files/2025-08/AES-133.pdf>

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