Taxing Green Beans: Your Morning Cup of Joe

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Overview

Over the past year, the United States has imposed increased tariffs on many countries and is one of the world's largest consumers of coffee. Since coffee can only be commercially grown in Hawaii and California, the United States heavily relies on imports to meet the demand for coffee. Historically, green coffee has had little to no tariffs imposed on them when imported into the United States. Since domestic production of coffee cannot sustain demand, tariffs directly impact both importers and roasters. We want to understand how the tariffs imposed over the last year by the United States affected green coffee beans imported from countries around the world.

Green coffee is a fairly homogeneous commodity and has a stable demand in the United States. This reduces the complexity of our study as we have less complications from product differentiation. It also allows us to derive a clear interpretation of how imports respond when tariffs increase. The tariff changes over the past year targeting key exporters, such as Brazil and Colombia, provide us with a real-world policy change that we can estimate. By focusing on a single commodity, our research will provide a focused but meaningful understanding of how tariffs affect green coffee bean imports into the United States.

Data Description

The data used in our analysis comes from several sources. We obtained our trade data from the United States Census Bureau. This data includes the imported value of green coffee beans (HS 090111) from each country between January 2021 to August 2025, with a total of 2,289 observations. Our tariff data comes from multiple sources. Baseline tariff data from 2021

to 2025 comes from the Harmonized Tariff Schedule, which is maintained by The U.S. International Trade Commission (USITC). This data lists all official tariff rates by product and HS code and only changes through acts of Congress. For the increased tariff rates, we referenced Executive Orders, which imposed additional duties that customs must apply in addition to the published HTS rate. Together, the trade and tariff data completes our data set for our analysis.

Methodology

This section describes the empirical approach used to estimate the effect of tariffs on monthly U.S. import flows. We begin by discussing the dataset. Then we present the baseline gravity model and discuss the role of source-country and month fixed effects in addressing unobserved heterogeneity. Finally, we delve into the Poisson Pseudo-Maximum Likelihood (PPML) estimator and explain how identification arises from variation of tariff rates between exporters over time.

We start in January 2021 to avoid the global supply chain shock of the COVID-19 pandemic in 2020. Additionally, since our tariff data is concentrated in 2025, there is little variation or identification power to be gained going back any further. Keeping a smaller window mitigates the risk of unnecessary noise as well as ensures that structural conditions are relatively stable, which strengthens causal inference. From January 2021 to August 2025, there were 101 exporters of green coffee. The U.S. Census only includes positive monthly import flows, so bilateral months with no imports appear as missing values. To avoid spurious correlation in our estimate we expanded the dataset of 2,289 non-zero observations to a total of 5,656 observations since zero provides real information about bilateral relationships. Including zero is important in gravity models estimated with PPML, as excluding them would introduce selection bias by conditioning the sample on positive trade. We omit countries that never exported green coffee into the United States during the sample period because they provide no variation in import values nor contribute identifying information to the analysis. The Harmonized Tariff Schedule (HTS) imposed no additional duties on coffee, so all the positive tariff rates in our sample are the result of Executive Orders (EO) issued during the study period. EO 14194 established a 25% tariff on imports from Mexico, a major exporter of coffee, announced in February and executed

in March. EO 14257 announced country-specific tariff rates in April, however the actual timing of enforcement of a baseline 10% tariff was laid out by the Cargo Systems Messaging Systems (CSMS) note #64680374. EO 14323 introduced slightly revised rates in August, in which announcement and execution rates were identical. Since the announcements and execution of these tariff rates aligned very closely to the beginning of their respective month, we treat the tariff as applying to the full month it became effective.

Trade favors efficient producers, and if a country becomes more expensive, U.S. firms will substitute them for the rest of the world. We use the gravity model to study tariffs because it treats tariffs as a bilateral trade cost and allows us to control unobserved heterogeneity via fixed effects. As for understanding the model and addressing several challenges, we referenced "**An Advanced Guide to Trade Policy Analysis**" (Yotov et al, 2016). To account for multilateral resistances (or ease of market access), we use exporter fixed effects. These control time invariant unobservables for each source country. Since the United States is the sole importing country in our data, including an importer and country pair fixed effects are unnecessary. Additionally, we include year-month fixed effects to absorb shocks that affect all exporters simultaneously, such as global price movements.

The gravity model has a multiplicative structure, so it is tempting to use a logarithmic transformation to make it additively separable for linear regression. However, international trade data is plagued with heteroskedasticity, and log-OLS estimates are biased and inconsistent (Santos Silva and Tenreyro, 2006). OLS cannot use the information contained in zero trade flows because these observations are dropped when the value of trade is transformed into a logarithm form, thus introducing selection bias. To resolve both of these issues, we estimate the gravity model using PPML since it does not log-transform the dependent variable and remains consistent with the presence of heteroskedasticity. PPML also preserves the multiplicative structure of the gravity model, ensuring exporter fixed effects correspond to the structural multilateral resistance terms in theory.

We use ln(1+t) to represent tariff rates because tariffs enter trade costs multiplicatively. A tariff, t, raises the price of an imported good by a factor of 1 + t. Using the price increase directly would impose a linear relationship between tariffs and trade flows and unrealistically assumes the marginal effect of tariff changes is constant across all tariff levels. Performing a log-

transformation accounts for diminishing marginal impact and gives the percentage change in trade cost levels implied by the structural gravity model. Although tariff announcements occurred simultaneously for all exporters, each country faced a different announcement and eventually executed tariff rate, and Mexico experienced an earlier increase. With exporter and year-month fixed effects absorbing time-invariant heterogeneity and common shocks, identification arises from cross-country differences in tariff intensity.

Econometric Model

Gravity Model with PPML Estimation:

$$\mathbf{X_{i,m} = exp(\alpha_i + \gamma_m + \beta_1 ln(1 + E_{i,m}) + \beta_2 ln(1 + A_{i,m-k}) + u_{i,m}}$$

$\mathbf{X_{i,m}}$: Nominal imports from source to the United States at month m;
CIF (USD) // Quantity (kg)

$\boldsymbol{\alpha_i}$: Set of time-invariant source-country fixed effects (geography, distance, production, etc.)

$\boldsymbol{\gamma_m}$: Set of year-month fixed effects (common time shocks that affect all exporters)

$\mathbf{ln(1 + E_{i,m})}$: Executed tariff rate applied by U.S. Customs in year-month m

$\mathbf{ln(1 + A_{i,m-k})}$: Represents announced tariffs at year-month m minus k-lag(s)

$\mathbf{u_{i,m}}$: Error term

Above is our general specification for the tariff analysis. Since shipping coffee from the source-country to the United States typically takes four to eight weeks, we implemented a one- and two-month announcement lag. Due to the gap between the announcement and execution of the tariffs, we lagged the announcement tariff rate since that is primarily what firms expect and respond to. We also estimate versions of the model with quantity as the dependent variable as a robustness exercise, however standard practice is to use the CIF import values (Cost, Insurance, and Freight) cost because it reflects the ad-valorem nature of tariff policy. Quantities are noisy due to inconsistent measurement units and reporting practices. For this reason, CIF values

provide a more reliable and theoretically appropriate measure of trade flows in gravity models.

Discussing Results

Table 1. PPML Estimates of Tariff Effects on U.S. Green Coffee Imports
(Standard errors clustered at the exporter level)

Panel A: Dependent Variable = CIF Import Value (USD)

Executed Tariff	2.657667*	2.735623*	3.298106*	2.725542*
	(0.4606377)	(0.7131781)	(0.9134347)	(0.4073968)
Announced Tariff	0	1	0	0
1-Month Lag	0	0	1	0
2-Month Lag	0	0	0	1

Panel B: Dependent Variable = Quantity Imported (kg)

Executed Tariff	2.911236*	3.201714*	3.669146*	2.962228*
	(0.7839055)	(0.64876)	(0.5887926)	(0.5207489)
Announced Tariff	0	1	0	0
1-Month Lag	0	0	1	0
2-Month Lag	0	0	0	1

note: * denotes significance at the 1% level

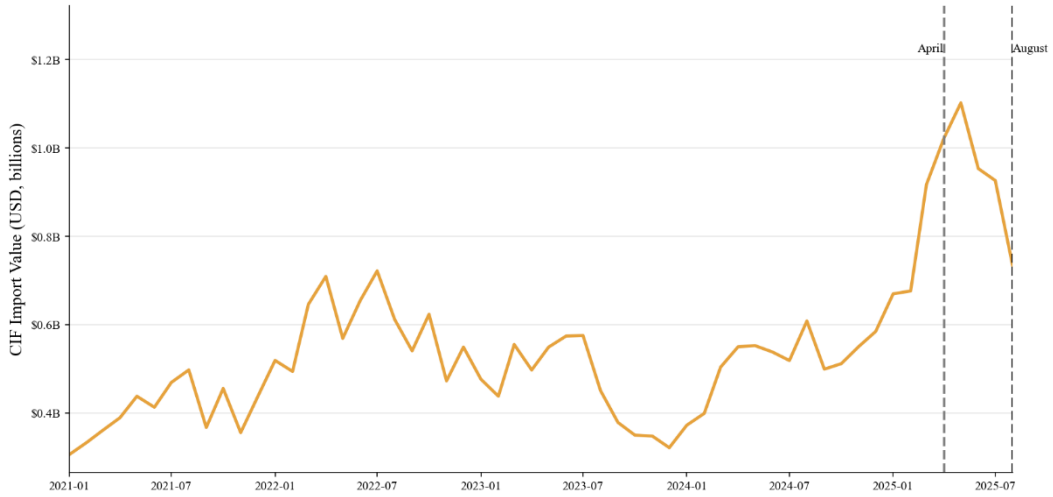
From our first PPML regression, we estimate the coefficient on the executed tariff rate is 2.66. These results are statistically significant at the 1% level. The tariff variable enters the regression as $\ln(1 + E_{i,m})$, so the estimated coefficient of 2.66 represents the elasticity of imports with respect to the tariff-inclusive price term $(1 + E_{i,m})$. Holding all else constant, a 1% increase in one plus the tariff rate is associated with a 2.66% increase in the U.S. imports of green coffee beans. Starting in August, the average tariff for major coffee exporting countries was 13.56% which corresponds to a 34% increase in imports, since $\ln(1 + E_{i,m})$ is not the same as $\ln(E_{i,m})$.

With most countries experiencing a 10% increase in the tariff rate from April to July, this would mean that the 10% tariff increase is associated with a 25% increase in green coffee bean imports into the United States.

Taking a first look at this result, the positive sign of the coefficient seems to contradict standard trade theory. We predicted that higher tariffs rates would cause a decrease in imported green coffee beans. However, the timing and environment around the tariff changes provide us with a reasonable explanation. The original tariffs set in EO 14257 were delayed in execution (and later revised) until August; in the months between April and July almost every country faced a 10% tariff. Starting in August, some major coffee countries like Indonesia, Nicaragua, and Vietnam would face rates of 19, 18, and 20% respectively. Knowing this, firms stockpiled inventory while coffee is only tariffed at 10%. This anticipation effect explains the increase in coffee imports in the short-run. Another plausible explanation for this result is policy uncertainty. Even after EO 14257 was signed, the exact timing and magnitude of any potential tariff adjustments remained unclear. To hedge against the uncertainty of higher tariffs, firms may have imported more aggressively. Additionally, headlines about a total of 50% tariffs on Brazil, the world's largest exporter of coffee, disseminated the coffee industry. However, EO 14323 primarily placed an additional 40% tariff on Brazil's manufactured goods, not coffee products.

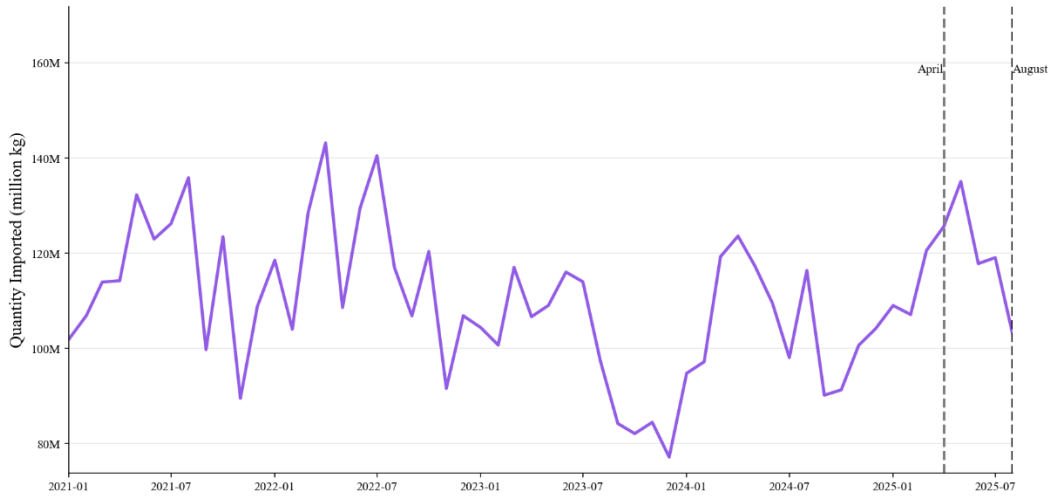
The anticipation effects are visible in Figures 1 and 2. Although the ad valorem tariffs were announced in April, the spike in imports occurs in May, which aligns with the typical four-to-eight-week shipping lag for ocean freight. Firms appear to have responded immediately to the announcement by placing larger orders, but the resulting shipments did not clear U.S. customs until May. The sharp decline beginning in June and especially August further supports the interpretation that the positive coefficient is mainly capturing U.S. firms stockpiling behavior rather than a persistent increase in demand.

Figure 1. U.S. Green Coffee CIF Value (2021–2025)



note: CIF values include commodity prices, shipping costs, and insurance, making them more volatile than quantity. Vertical lines denote tariff announcement and execution dates.

Figure 2. U.S. Green Coffee Quantity Imported (2021–2025)



note: Quantity is measured in kilograms. Vertical lines denote tariff announcement and execution dates.

The estimated positive elasticity from our model reflects an indirect stockpiling and hedging behavior, rather than a direct tariff response. Importers began to stockpile as much inventory as they could in the period between April and July. In this study, the estimate is capturing the short-run effect driven by future expectations; it does not capture a long-run causal relationship between tariffs and green coffee imports. Overall, our findings suggest that green coffee imports

increased in the short-run after tariffs were increased, but likely due to future expectations and uncertainty.

Potential Limitations

Initially, we considered conducting our analysis using a traditional OLS difference-in-differences (DiD) design, which would have given us a cleaner causal relationship between the change in tariffs and the change in imports. However, DiD requires a control group that didn't experience a tariff change. Since all exporters (except Mexico's earlier change) were exposed to tariff changes in the same months, there is no control group to compare to. As a result, our analysis relied on a continuous treatment specification utilizing the PPML. This allows treatment to take on many possible values, estimates how changes in tariff intensity affects imports, and does not require an untreated control group.

Although our results gave us a meaningful short-run response to tariff increases, our analysis is limited by the absence of industry shipment-level data that would allow us to separate the anticipatory and direct effect of the tariffs. We only observe imports upon arrival, not the procurement decisions when ordered. These factors may influence the timing of import flows, but they do not necessarily bias our elasticity estimates unless they vary systematically across exporters in a way that correlates with tariff changes.

Because our sample covers only the months immediately surrounding the tariff adjustments, we cannot draw any conclusions about long-run substitution towards alternative source-countries. Long-run effects such as permanent reductions in imports may occur, but it is not observable within the current data sample. The short time frame means trade flow might not yet reflect full adjustment to the new tariff regime. An expanded dataset, including several more months or years in the future would be needed to determine the medium and long-run effects of tariff policy on U.S. green coffee imports.

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