A Hazard Model Approach to Dynamic TRQ Reallocation

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Abstract

Despite the prevalence of underfill in international tariff-rate quotas (TRQs), governments typically have strong incentives to administer quotas in ways that achieve full or near-full utilization. One mechanism for accomplishing this is the mid-year reallocation of quota shares when initial holders appear unlikely to fill their allocations. This paper develops an empirical framework for identifying when mid-year reallocation should occur and evaluates the market and welfare implications of more aggressive reallocation policies. Using monthly data from the U.S. raw sugar TRQ spanning 1996–2024, we estimate a Cox proportional hazards model that characterizes the evolving probability that a country-specific allocation ultimately remains underfilled. We then use the estimated hazard structure to simulate counterfactual reallocation regimes in which USDA reallocates unused quota when predicted underfill probabilities rise above a threshold. Embedding the resulting import paths in an equilibrium displacement model of the U.S. sugar market, we quantify how alternative trigger thresholds and reallocation fill efficiencies affect prices, trade flows, and welfare. Across a broad range of policy parameters, we find that more aggressive trigger-based reallocation does not necessarily increase imports. Positive welfare gains require both sufficiently stringent triggers and high fill efficiency among recipient countries.

Keywords: Tariff-Rate Quotas; Quota Reallocation; U.S. Sugar Program; Stochastic Policy Design

JEL Codes: Q18, Q17, F13

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1 Introduction

Tariff-rate quotas (TRQs) are among the most widely used instruments for managing agricultural imports, applied to products ranging from sugar and dairy to beef, grains, and horticultural goods (Beckman, 2021; Grant, Xie and Boys, 2022). A substantial body of research evaluates the restrictive effects of TRQs—how quota design, in- and out-of-quota tariffs, and license allocation mechanisms shape import volumes, quota rents, and the effective degree of market access (Beckman, Gale and Lee, 2021; Boughner, de Gorter and Sheldon, 2000; Pouliot and Larue, 2012; Schaefer and Wolf, 2025). Much of this literature emphasizes the ways in which TRQs function as trade barriers, often documenting persistent under-fill and examining how administrative frictions limit the utilization of available quota (Beckman, Gale and Lee, 2021; Schaefer and Wolf, 2025).

Yet even when TRQs are established to act as trade barriers, governments frequently have strong economic and political incentives to ensure that the permitted in-quota access is fully utilized. Full fill rates help stabilize domestic markets, prevent shortages, and support downstream processors who rely on imported inputs. They also limit the degree of protection to the level originally intended, reduce opportunities for rent-seeking or speculative quota hoarding, and mitigate the risk of international disputes over apparent under-access. Thus, the administration of quota fill and, when necessary, the reallocation of unused quota become key mechanisms through which policymakers reconcile protective objectives with the need for adequate and reliable import flows.

This distinction has recently become politically salient in the United States. Under the One Big Beautiful Bill (OBBB),[1] the U.S. government committed to more proactive mid-year reallocation of sugar TRQ allotments when initial quota holders cannot meet their

[1] §10312(d) of the One Big Beautiful Bill (H.R. 1, 119th Congress) amends Section 359k of the Agricultural Adjustment Act of 1938 to require USDA to (1) determine which countries do not intend to fulfill their quota allocation for the quota year; and reallocate any forecasted shortfall as soon as practicable, and (2) reallocate any additional forecasted TRQ shortfalls no later than March 1 of each quota year.

import commitments.[2] The stated objective was to facilitate the use of available in-quota access, particularly in years when domestic markets are constrained and downstream users face rising input costs. This commitment brings attention to a broader policy question that has received limited empirical scrutiny: when should policymakers intervene to reallocate unused quota, and what factors influence the timing of that decision?

A substantial literature investigates TRQ design and performance, including theoretical models of quota rents and administration (Abbassi, Tamini and Dakhlaoui, 2015; Barichello, 2000), empirical examinations of quota fill rates (Beckman, Gale and Lee, 2021; Cardwell and Biden, 2024; Schaefer and Wolf, 2025), and analyses of how allocation rules affect utilization (Gervais and Surprenant, 2000, 2003). Several studies explore the U.S. sugar program specifically (Beghin and Elobeid, 2015; Beghin et al., 2003; Carter, Saitone and Schaefer, 2019; Meade, Grant and Regmi, 2010), but this work focuses primarily on pricing, producer benefits, and market distortions. Despite these contributions, little is known about how governments actually administer TRQs over the course of the year and, in particular, the factors that trigger mid-year reallocation. Existing empirical work treats TRQs as static annual constraints rather than dynamic administrative instruments, leaving the "reallocation decision" largely unstudied.

This paper fills that gap by examining the determinants and timing of TRQ reallocation, conceptualizing reallocation as a discretionary, time-dependent administrative response to evolving market conditions, using the U.S. sugar program as a case study. To do so, we assemble a dataset combining monthly country-specific quota utilization, U.S. sugar price indicators, global supply conditions, and policy variables to identify the market, institutional, and country-level factors associated with underfill risk. Although our empirical application focuses on sugar, the administrative setting we study is common to many TRQs, including those for dairy, beef, grains, and horticultural products.

[2]The U.S. sugar TRQ provides a particularly informative empirical setting because it features substantial cross-country variation in fill performance and a discretionary reallocation mechanism. However, we note that the underlying administrative problem is common to many TRQs worldwide.

Using these data, we make three empirical contributions. First, we introduce a Cox proportional hazards model framework to estimate the probability that a country-specific TRQ allocation will remain underfilled at each point in the quota year. To our knowledge, this provides the first empirical characterization of how underfill risk evolves over time and the market, institutional, and country-level factors that shape it. Second, we use the estimated hazard structure to quantify the extent to which mid-year USDA reallocation decisions function as a trade-facilitation tool by increasing expected in-quota imports. Third, we combine the estimated underfill probabilities with an equilibrium displacement model of the U.S. sugar market to simulate the market and welfare implications of adopting more aggressive reallocation triggers, evaluating effects on domestic producers, refiners and food manufacturers, and foreign quota holders.

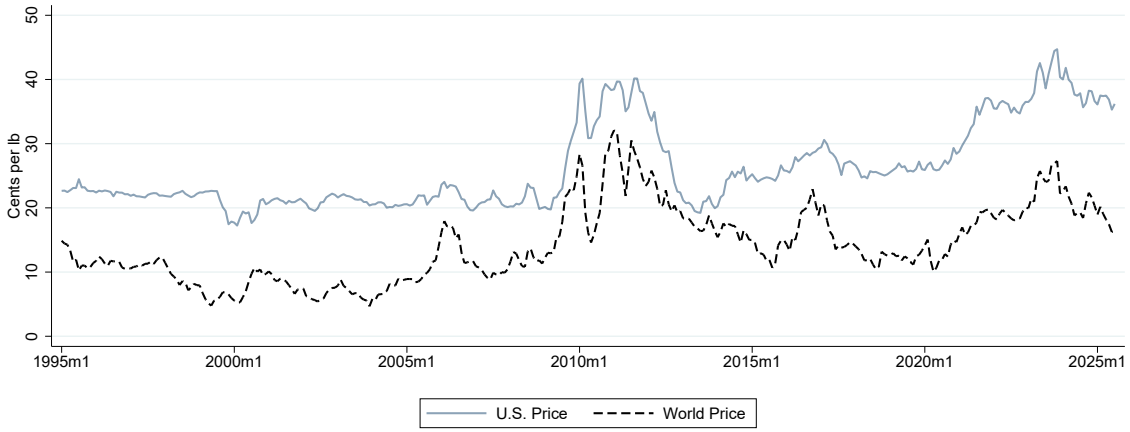
The remainder of the paper proceeds as follows. Section 2 provides institutional background on the U.S. sugar TRQ and describes the reallocation process. Section 3 presents a simple conceptual model characterizing the USDA decision on whether to reallocate unused TRQ allocations. Section 4 develops the empirical framework and describes the data and summary statistics. Section 5 presents the empirical results, and Section 6 concludes with policy implications and directions for future research.

2 U.S. Sugar Program and TRQ Allocation Process

The United States maintains a longstanding system of sugar market interventions that create a substantial gap between domestic and world sugar prices (Figure 1). The core elements of the U.S. sugar program include domestic marketing allotments, minimum price guarantees through nonrecourse loans, and tariff-rate quotas (TRQs) that restrict out-of-quota imports (Beghin and Elobeid, 2015; Carter and Schaefer, 2019; DeLong, Trejo-Pech and Johansson, 2025; Turner et al., 2025). Together, these policies keep U.S. prices well above world levels—often by more than 100 percent—generating substantial quota rents and making in-quota

access a key source of economic value for foreign exporters.

Figure 1: U.S. and World Raw Sugar Prices (Jan-1995 to Jul-2025)



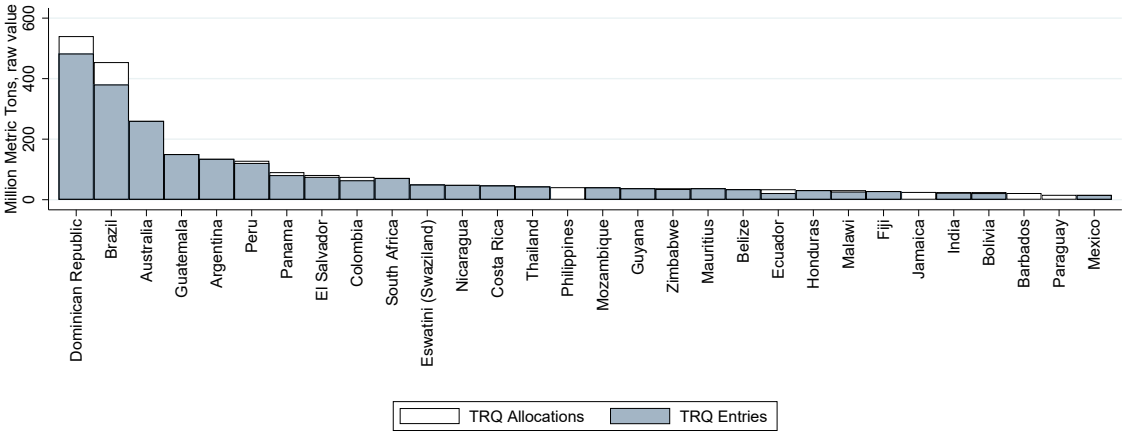
Notes: World raw sugar prices are Intercontinental Exchange Contract Number 11 nearby, free-on-board the receiver's vessel to a port within the country of origin of the sugar, obtained from the USDA Economic Research Service "Sugar and Sweeteners Yearbook Table 3b. U.S. raw sugar prices are Intercontinental Exchange Contract Number 14/16, duty fee paid by deliverer at 1 of 5 U.S. refinery ports as selected by the receiver. The price represents the average of the nearest futures month for which an entire month of prices is available, data obtained from the USDA Economic Research Service "Sugar and Sweeteners Yearbook Table 4."

Annual TRQ Allocations Across Countries: The raw sugar TRQ is allocated annually across more than 40 supplying countries according to historical shares established under U.S. commitments at the World Trade Organization. Each quota year (October 1 to September 30), the U.S. Department of Agriculture (USDA) announces the country-specific allocations and delegates to each country the right to ship up to its assigned amount.

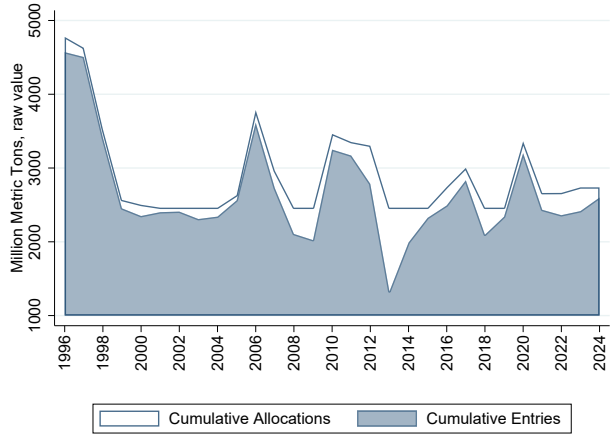
These allocations differ widely in size and in historical fill performance (Figure 2). Some major suppliers tend to consistently fill their allocations early in the quota year, while others frequently under-utilize their allotments due to production shortfalls, domestic market conditions, infrastructure constraints, or competing export opportunities. As these differences accumulate throughout the year, USDA must balance its statutory objective of maintaining adequate domestic supplies with its interest in honoring initial quota commitments.

Within-Year Monitoring and the Reallocation Mechanism: USDA actively monitors

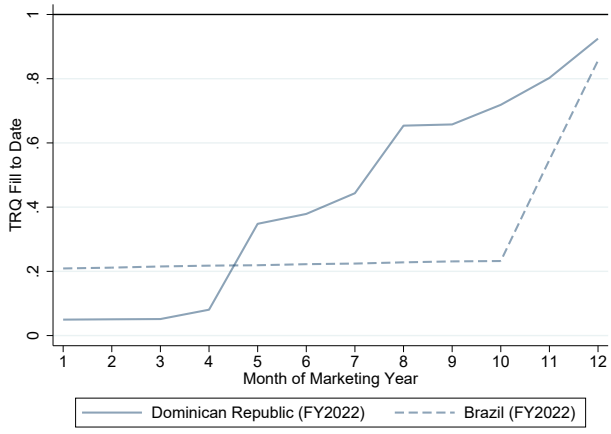
Figure 2: Historical TRQ Allocation and Fill Patterns



(a) Annual TRQ Allocations and Entries by Country, FY2022



(b) Aggregate TRQ Allotments and Entries, 1996–2024



(c) Monthly TRQ Fill for Major Suppliers, FY2022

Notes: Panel (a) compares country-specific TRQ allocations with actual in-quota imports for a representative fiscal year (2022). Panel (b) shows aggregate TRQ allotments and realized entries for fiscal years 1996–2024, showing variation in total annual fill over time. Panel (c) plots within-year cumulative fill for Brazil and the Dominican Republic—the two largest quota holders in FY2022—to illustrate differences in shipment timing and potential underfill risk. Data are obtained from the USDA Economic Research Service "Sugar and Sweeteners Yearbook" and are based on data from the USDA Foreign Agricultural Service "U.S. Sugar Monthly Import and Re-Export" report.

quota fill on a near-monthly basis throughout the marketing year. Import entries are tracked against each country's allocation, and USDA observes both (i) how much of the quota has been used to date and (ii) broader market indicators such as domestic wholesale prices, inventories, and refining demand. Import timing varies across suppliers: some countries ship early and steadily, while others ship late or irregularly.

Underfill can arise for a number of reasons, including domestic production shortfalls in the exporting country, weather-related disruptions, higher domestic prices abroad that divert exports, shipping delays or logistical constraints, or lack of commercial interest from exporters or refiners. When underfill becomes likely, USDA faces pressure from downstream industries—most notably refiners, confectioners, and food manufacturers—to ensure that the in-quota volume is fully utilized. This is because in-quota imports enter at a low tariff rate, which allows domestic refiners and food manufacturers to access sugar at prices far below U.S. domestic market levels. This makes full quota utilization particularly important during periods of tight domestic supply, and it is a central economic rationale for the TRQ reallocation mechanism.

If USDA determines that certain countries are unlikely to fill their allocations, it has the authority to reallocate the unfilled portion of their quota shares to other suppliers. Reallocation usually occurs in the second half of the marketing year, historically between late spring and mid-summer, although the timing is discretionary. When reallocation occurs, additional quota is awarded to countries that USDA expects to be able to ship promptly, often those with strong historical fill performance or reliable export infrastructure.

Reallocation affects not only total in-quota imports but also the distribution of quota rents across exporting countries. Countries that receive reallocated quota gain access to rents associated with the domestic-world price wedge, while original allocation holders lose some or all of their entitlement. For domestic stakeholders, reallocation increases available supply and tends to exert downward pressure on domestic prices.

Recent Policy Changes under the OBBB: The importance of reallocation has become

more prominent under recent policy changes. In the One Big Beautiful Bill (OBBB), the U.S. government committed to "more aggressive" within-year TRQ management, including more proactive reallocation when existing quota holders appear unlikely to fill their allotments. The policy shift reflects growing concern about domestic sugar availability, particularly during periods of high demand or low stocks.

3 Conceptual Model of the TRQ Reallocation Decision

This section develops a simple two-period model to illustrate the core economic trade-offs associated with the U.S. Department of Agriculture (USDA) decision on whether to reallocate unused tariff-rate quota (TRQ) allocations. This stylized model is not intended to capture all institutional details of TRQ administration. Rather, it provides a minimal structure that clarifies the determinants of underfill risk and motivates the hazard-model approach described in Section 4.

Suppose the marketing year can be divided into two periods, $t = 1, 2$. Further, there are two potential foreign suppliers of sugar to the United States: Country A and Country B. At the start of the year, USDA allocates a country-specific sugar TRQ of size $\bar{Q}$ to Country A. For simplicity (and without loss of generality), the quota allotment to Country B is zero.

Now assume that Country A exports $q_1 \leq \bar{Q}$ units of sugar to the U.S. in Period 1. Thus, the remaining unfilled allocation at the end of period 1 is $R = \bar{Q} - q_1$. Large R corresponds to substantial underfill risk early in the year, whereas small R indicates that Country A is already close to meeting its allocation. At the end of period 1, USDA observes (i) the realized imports q_1 and (ii) a vector of market indicators X (e.g., wholesale prices, domestic stocks, or world prices).

Based on (q_1, X), USDA forms a belief about the probability that Country A will fill the remaining amount R in period 2. Let $\rho = \rho(q_1, X) \in [0, 1]$ denote the perceived probability that Country A will deliver the remaining allocation R if USDA does not reallocate. If USDA

reallocates the unfilled amount R to Country B, assume that Country B will fill a fraction $\beta \in [0, 1]$, which may reflect its export capacity or reliability as a supplier.

If USDA does not reallocate, expected total imports over the marketing year are $Q^{NR} = q_1 + \rho R$. If USDA reallocates the remaining quota R to Country B,[3] expected imports become $Q^R = q_1 + \beta R$. Therefore, the expected import gain from reallocating is $Q^R - Q^{NR} = (\beta - \rho)R$. In other words, reallocation increases expected imports whenever $\beta > \rho$, i.e., when Country B is expected to be more reliable than Country A in filling the remaining quota.

Let $W(Q)$ denote expected short-run domestic welfare as a function of total in-quota imports (Q), where $W'(Q) > 0$.[4] TRQ reallocation may impose a fixed cost $K \geq 0$, which can reflect administrative burdens, diplomatic frictions, or other political-economy considerations. Thus, expected welfare without reallocation is $E[W^{NR}] = W(Q^{NR})$, while expected welfare under reallocation is $E[W^R] = W(Q^R) - K$. Accordingly, a welfare-optimizing USDA will choose to reallocate whenever $W(Q^R) - W(Q^{NR}) \geq K$.

Using a first-order approximation around Q^{NR}, this condition becomes $W'(Q^{NR}) \cdot (Q^R - Q^{NR}) \geq K$. Let $\mu \equiv W'(Q^{NR}) > 0$ denote the marginal welfare gain from an additional unit of in-quota imports. Then, substituting terms yields the trigger condition $\mu(\beta - \rho)R \geq K$.

Solving for ρ gives a threshold rule:

$$\rho \leq \tau \equiv \beta - \frac{K}{\mu R}. \tag{1}$$

USDA therefore reallocates the remaining quota whenever the perceived probability that Country A fills its allocation falls below the threshold τ. This threshold is increasing in the size of the unfilled allocation R and the reliability of alternative suppliers β, and decreasing in the reallocation cost K.

Expression (1) illustrates that reallocation behavior depends on $\rho(q_1, X)$, the perceived

[3] Of course, in reality, the USDA may reallocate only a portion of the unfilled TRQ or may re-allocate across a set of multiple recipient countries. The extension to partial reallocation or multiple recipient countries is straightforward and does not alter the intuition of the threshold rule.

[4] Here, we refer to welfare in the partial-equilibrium context, e.g., consumer and downstream user surplus net of political or administrative costs.

probability that Country A will fill its allocation conditional on information available at the end of period 1. Note that aggressive reallocation is not unambiguously welfare-improving. Its effects hinge critically on (i) the timing of the trigger, (ii) the reliability of the countries losing quota, and (iii) the fill efficiency of the countries receiving it.

In reality, ρ is unobserved. Thus, the empirical task is to characterize how underfill risk evolves over the course of the marketing year as information accumulates, and how this risk varies across countries and market conditions.

4 Empirical Strategy

Guided by the conceptual framework, the empirical analysis proceeds in two stages. In the first stage, we estimate a Cox proportional hazards model of the probability that a country-specific allocation remains unfilled at each point in the marketing year, as a function of observed fill to date and market indicators X. In the second stage, we use the estimated hazard structure to simulate counterfactual reallocation policies and evaluate their market and welfare implications using an equilibrium displacement model (EDM) of the U.S. sugar sector.

4.1 Estimating Underfill Risk Using a Cox Proportional Hazards Model

We characterize how underfill risk evolves over the marketing year using a Cox proportional hazards model in which the outcome is the month in which a country-specific TRQ allocation reaches (or fails to reach) a predefined fill threshold (Cox, 1972, 2018).[5] We define "full" utilization as reaching 90% of the allocation. The resulting hazard structure provides a forward-looking measure of the likelihood that an allocation will be filled in the near term.

[5]The hazard-model framework is well-suited to settings where the timing of the event carries information and where countries are observed at risk over multiple months.

This approach thus offers an empirical counterpart to the unobserved probability $\rho(q_1, X)$ in the conceptual framework.

In what follows, we describe the construction of the monthly country-level panel, the associated risk sets and censoring structure, and the covariates used to capture shipment dynamics and market conditions over the quota year. We then report the model specification and basic statistics.

Panel Construction and Data Sources. The monthly hazard panel is constructed by merging (i) country-level TRQ allocations and annual quota entries, (ii) monthly shipment data from the USDA Foreign Agricultural Service, and (iii) marketing-year-average U.S. and world raw sugar prices (P_y^{US} and P_y^W) from the USDA Economic Research Service (Figure 1). All data are harmonized into a panel indexed by country i, marketing year y, and marketing-year month $t = 1, \ldots, 12$.

Event Definition. For each country-year pair (i, y), we define an event as the first marketing-year month t in which cumulative shipments reach at least 90% of the annual TRQ allotment $\bar{Q}_{iy}$. Let

$$F_{iyt} = \frac{\sum_{j=1}^{t} M_{iyj}}{\bar{Q}_{iy}}$$

denote the share of the allocation filled by month t. An event occurs at month t^* if $F_{iyt^*} \geq 0.9$ and $F_{iy,t^*-1} < 0.9$. Allocations that never reach the threshold are right-censored at $t = 12$.

Risk Sets and Time Structure. For each country-year, the risk interval begins in October ($t = 1$) and ends either in the month when the threshold is reached or at censoring. Each observation therefore represents a country-month at risk of experiencing the event. The first occurrence of the event is treated as terminal, and country-years with no event are treated as right-censored at the end of the marketing year.

Covariates. We include three covariates motivated by the conceptual framework. First, the key state variable is the fill share to date, F_{iyt}, which summarizes the country's observed shipment performance up to month t. Second, we include a measure of how far a country is ahead of or behind its own typical shipping schedule. For each country i and month t, we compute its historical average fill share for that month across all years, $\overline{F}_{it}$, and define:

$$\text{FGap}_{iyt} = F_{iyt} - \overline{F}_{it}.$$

A negative FGAP_{iyt} value indicates that the country is shipping more slowly than it typically does at that stage of the year; a positive value indicates it is ahead of its historical pace. This variable captures deviations from country-specific seasonal shipping patterns and proxies the "ahead/behind schedule" signals that may inform expectations of underfill.

Third, we incorporate the marketing-year-average domestic-world price wedge,

$$w_y = \frac{P_y^{US}}{P_y^{W}},$$

which measures the relative attractiveness of selling into the U.S. market. A larger wedge increases the profitability of directing exports toward the U.S. TRQ, strengthening exporters' incentives to ship promptly and fully utilize their allocations. Conversely, a low wedge implies weaker incentives and a higher likelihood of delayed shipments or underutilization.

Country fixed effects α_i are included to capture persistent differences in logistical capacity, export timing patterns, and institutional reliability.

Model Specification. We estimate a Cox proportional hazards model of the form:

$$h_{iy}(t) = h_0(t) \exp\left(\beta_1 F_{iyt} + \beta_2 \text{FGap}_{iyt} + \beta_3 w_y + \alpha_i\right) \tag{2}$$

where $h_{iy}(t)$ is the hazard that country i reaches the fill threshold in month t, conditional on not having done so earlier. The baseline hazard $h_0(t)$ is left unspecified and estimation proceeds using partial likelihood. Predicted hazards and survival probabilities from this model form the basis for the counterfactual reallocation simulations.

Summary Statistics. Table 1 reports summary statistics for the variables used to estimate the Cox proportional hazards model. The estimation sample contains 9,198 country-month observations, representing 998 country-year allocations. Across all country-year subjects, we observe 541 events (i.e., approximately 54% of allocations reached at least 90% of their TRQ allotment within the marketing year). The remaining allocations are right-censored at the final month of the marketing year.[6]

The fill share to date exhibits substantial dispersion, reflecting both large differences in quota sizes and wide variation in shipment timing across suppliers. The mean fill share is 2.66 percent, though the distribution is highly skewed, with some suppliers occasionally shipping large volumes early in the season. Instances where the fill share exceeds 100 percent are attributable to the inclusion of out-of-quota shipments or adjustments arising from reallocation programs. The fill gap measure, which captures whether a country is ahead of or behind its own historical shipping schedule, ranges from -100.0 to 182.6 percentage points, indicating substantial month-to-month deviations from typical behavior. Finally, the domestic-world price wedge averages 2.01, reflecting the substantial and persistent premium of U.S. raw sugar prices over world prices.

4.2 Counterfactual TRQ Reallocation Simulations

Estimating the hazard model described by equation(2) provides month-specific predictions of the probability that each country-year TRQ allocation ultimately remains underfilled. Using these predictions, we construct counterfactual reallocation scenarios designed to mimic more

[6] All country-year spells begin at the first month of the marketing year, and the earliest and latest exit times correspond to months $t = 0$ and $t = 12$, respectively.

Table 1: Summary Statistics for Cox Proportional Hazards Model

Variable	Mean	Std. Dev.	Min	Max
Fill share to date (F_{iyt})	2.66	17.19	0.00	312.41
Fill gap (FGAP_{iyt})	0.20	8.97	-102.62	182.63
Price wedge (w_y)	2.01	0.57	1.17	3.38

Notes: Statistics are based on the 9,198 country-year-month observations included in the hazard-model risk set after removing post-event months and right-censored structure. Fill share to date is measured as cumulative imports to month t divided by the annual TRQ allocation. FGAP_{iyt} measures deviations from country-specific historical average fill rates. The price wedge equals the ratio of the U.S. raw sugar price to the world price (NEARBY No. 14/16 relative to No. s11).

aggressive quota administration by USDA. This analysis proceeds as follows.

Predicting Underfill Probabilities. The estimated Cox model provides the components needed to compute predicted underfill probabilities for each country-year at each month of the marketing year. Let $S_0(t)$ denote the estimated Breslow baseline survival function—i.e., the probability of not having reached the fill threshold by month t for a country with covariates equal to zero. For each country i in year y, let η_{iyt} denote the fitted linear predictor from the Cox model in month t:

$$\eta_{iyt} = \beta_1 F_{iyt} + \beta_2 \text{FGap}_{iyt} + \beta_3 w_y + \alpha_i. \tag{3}$$

The predicted survival probability for country i at month t is then $S_{iy}(t) = S_0(t)^{\exp(\eta_{iyt})}$, which follows from the proportional hazards structure. By construction, $S_{iy}(t)$ is the predicted probability that country i has not yet reached 90% of its allocation by month t. Because covariates are time-varying, these projections hold the month-t covariates fixed when forecasting forward. The probability of ultimate underfill is obtained by evaluating the survival probability at the end of the marketing year: $S_{iy}(12) = \Pr(\text{F}_{iy,t=12} < 0.90 \,|\, X_{iyt})$. This quantity is referred to as the unconditional underfill probability.

For each month t, we also compute forward-looking conditional underfill probabilities—that is, the probability of underfill given that the country has not yet reached the threshold

by month t. Let $\mathcal{A}_{iyt}$ be an indicator that country i is "alive" at month t (i.e., has not yet reached 90% of its allocation in any prior month). The conditional probability of ultimate underfill at month t is then

$$\Pr(\text{underfill} \mid \mathcal{A}_{iyt} = 1) = \frac{S_{iy}(12)}{S_{iy}(t)}.$$

This conditional probability summarizes the model-implied likelihood, at each point in the marketing year, that a country ultimately fails to utilize its allocation fully, given the shipment performance and market conditions observed through month t.

Trigger-Based Counterfactual Reallocation. We use the predicted underfill probabilities to simulate alternative quota administration rules in which USDA reallocates unused quota shares earlier and more frequently. In each counterfactual scenario, USDA is assumed to monitor the predicted probability of underfill $S_{iy}(t)$ for each country-month. If—for any month t after the mid-point of the marketing year (i.e., for all $t > 6$)[7]—the probability rises above a specified trigger threshold τ (e.g., 0.50, 0.25, or 0.10), the remaining unfilled portion of the country's allocation is assumed to be reallocated immediately to a set of potential recipient countries. This policy rule operationalizes the conceptual trigger condition in Section 3, with the model-implied underfill probabilities replacing the unobserved $\rho(q_1, X)$.

Because the hazard model does not predict which countries would receive reallocated quota or the volume they would ship, we treat the shipment response of recipient countries as exogenous and vary it parametrically. In each scenario, we assume that recipient countries fill a share $\beta \in (0, 1]$ of the reallocated quota. We conduct sensitivity analysis across a range of β values to reflect uncertainty about exporters' ability to expand shipments on short notice. Together with the trigger rule τ, this defines a two-dimensional policy space (τ, β) spanning a continuum of potential reallocation regimes.

[7]The condition that reallocation occurs after the sixth month is to reflect the reality that historical USDA reallocations usually occur in the second half of the marketing year, historically between late spring and mid-summer.

In each scenario, the monthly shipment profile for country i is replaced with the reallocation-adjusted trajectory whenever the trigger is activated, generating a full counterfactual path of in-quota imports under the policy regime (τ, β).

4.3 Welfare Analysis Using an Equilibrium Displacement Model

To evaluate the market and welfare implications of the alternative reallocation scenarios described above, we embed the counterfactual import flows into a partial-equilibrium displacement model (EDM) of the U.S. raw sugar market. The objective is to quantify how more aggressive reallocation affects domestic sugar prices; the welfare of domestic growers, refiners, and downstream users; and the quota rents earned by foreign exporters.

EDM Model Structure. The EDM is based on a standard linearized representation of supply and demand responses to changes in the domestic price of raw sugar. Let P denote the domestic price of raw sugar, Q_d total domestic use, Q_b beet sugar production, Q_c cane sugar production, and M in-quota imports. Under both the observed and counterfactual scenarios, market equilibrium satisfies:

$$Q_d(P) = Q_b(P) + Q_c(P) + M.$$

A change in the availability of in-quota imports (ΔM), generated by the trigger-based reallocation simulations, induces an endogenous price change ΔP that clears the market. Totally differentiating the equilibrium condition yields the linearized equilibrium displacement expression:

$$\frac{\Delta P}{P} = -\frac{\Delta M}{\eta Q_d + \varepsilon_b Q_b + \varepsilon_c Q_c},$$

where $\eta > 0$ is the (absolute value of the) demand elasticity, and ε_b and ε_c denote the supply elasticities for beet and cane sugar, respectively. This expression determines the counterfactual domestic price $P_1 = P_0(1 + \Delta P/P)$ under each reallocation scenario. Calibrated

elasticity values used in the simulations are presented in Table 2.

Table 2: Elasticities Used in the Equilibrium Displacement Model (EDM)

Parameter	Symbol	Value
Demand elasticity (absolute value)	η	0.10
Beet sugar supply elasticity	ε_b	0.20
Cane sugar supply elasticity	ε_c	0.15

Notes: Elasticities reflect short-run supply and demand responses in the U.S. raw sugar market and are consistent with prior EDM applications in U.S. sugar policy analysis. The domestic supply elasticity $\varepsilon_{\text{dom}} = 0.18$ is used when beet and cane production data are not separately available.

Quantity Adjustments. The implied price change propagates through the model via standard proportional supply and demand responses:

$$Q_d^1 = Q_d^0(1 - \eta\,\Delta P/P), \qquad Q_b^1 = Q_b^0(1 + \varepsilon_b\,\Delta P/P), \qquad Q_c^1 = Q_c^0(1 + \varepsilon_c\,\Delta P/P).$$

These adjustments, together with the counterfactual level of in-quota imports M^1, ensure consistency with the market-clearing condition.[8]

Welfare Measures. Annual changes in welfare for all stakeholder groups follow directly from linear supply and demand schedules.

Downstream users and consumers. Lower domestic prices increase consumer and downstream-user surplus by:

$$\Delta CS = \frac{(P_0 - P_1)(Q_d^0 + Q_d^1)}{2}.$$

Domestic sugar growers. Beet and cane producers experience a loss in producer surplus when domestic prices fall. Producer surplus changes are:

$$\Delta PS_b = \frac{(P_1 - P_0)(Q_b^0 + Q_b^1)}{2}, \qquad \Delta PS_c = \frac{(P_1 - P_0)(Q_c^0 + Q_c^1)}{2}.$$

[8] As a diagnostic, we also compute the residual market imbalance to verify that the EDM-generated quantity responses close the market appropriately.

We aggregate these to obtain total producer surplus change, ΔPS_{dom}.

Aggregate welfare. Evaluated across all domestic stakeholder groups, total national welfare equals:

$$\Delta W_{\text{dom}} = \Delta CS + \Delta PS_{\text{dom}},$$

Foreign quota rents. Foreign suppliers earn quota rents equal to the domestic-world price difference on in-quota shipments. Let P_w denote the world raw sugar price. The change in aggregate foreign quota rents is:

$$\Delta Rent_{\text{foreign}} = (P_1 - P_w)M^1 - (P_0 - P_w)M^0.$$

This measure captures total foreign rents across all exporters; the EDM is not designed to allocate rent changes to individual quota holders or recipients.

Cross-Year Variation in Impact Estimates. Because the reallocation simulations generate a distinct counterfactual import path for each marketing year, we implement the EDM separately for each year in the sample. This yields a cross-year distribution of predicted price, quantity, and welfare impacts, allowing us to characterize not only the average effect of a more aggressive reallocation rule, but also its variability across market conditions.

5 Results

5.1 Hazard Model Estimates

Table 3 reports estimated hazard ratios from the Cox proportional hazards model.[9] Consistent with the predictions of the conceptual framework, the fill share to date is a strong predictor of whether a country-specific allocation reaches the 90% utilization threshold. The

[9] Tests of proportional hazards (global and covariate-specific Schoenfeld residuals (Grambsch and Therneau, 1994)) do not reject the PH assumption at conventional levels, indicating that the Cox specification is appropriate for this setting.

estimated hazard ratio is 0.952 (statistically significant at the 5% level), implying that a 1-unit increase in the month t fill share reduces the instantaneous probability of reaching the threshold by approximately 4.8%. Economically, this reflects a convexity in reallocation risk: low fill levels early in the year translate into disproportionately low prospects of eventual fill. This supports the conceptual model's implication that policymakers should view slow early shipments as an early warning signal of underfill.

Table 3: Cox Proportional Hazards Estimates of the Probability of Reaching 90% TRQ Fill

	Hazard Ratio	Std. Err.	95% CI
Fill share to date (F_{iyt})	0.952**	0.024	[0.906, 1.001]
Fill gap (FGAP_{iyt})	1.069*	0.040	[0.995, 1.150]
Price wedge (w_y)	1.910***	0.135	[1.663, 2.194]
Country fixed effects		Yes	
Observations		9,198	
Countries		998	
Failures (events)		541	
Log likelihood		−3398.35	
LR $\chi^2(40)$		331.56	

Notes: Table reports hazard ratios from a Cox proportional hazards model. The outcome is the month in which a country-year TRQ allocation first reaches 90% utilization. Country fixed effects are included but suppressed for brevity. Standard errors are clustered at the country level. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$.

The Table also shows that the fill-gap variable, which measures whether a country is ahead of or behind its own historical pace, also predicts threshold attainment. The hazard ratio of 1.069 is statistically significant at the 10% level. A one-unit increase in FGap increases the hazard by roughly 6.9%, indicating that countries that are "ahead of schedule" relative to their historical shipping pattern are more likely to complete their allocations (and vice versa).

Third, the domestic-world price wedge emerges as a powerful predictor of quota utilization. The hazard ratio of 1.91 is statistically significant at the 1% level and economically large. A wider wedge nearly doubles the instantaneous probability that a country reaches fill. This result matches the underlying economic intuition: when the U.S. market is unusually

profitable relative to world alternatives, exporters have stronger incentives to ship promptly and fully utilize their in-quota access. When the wedge is low, underfill risk rises because opportunity costs outside the TRQ market increase.

Taken together, these estimates reveal a coherent pattern: (i) slow cumulative progress, (ii) being behind one's typical shipping schedule, and (iii) a narrow domestic-world price wedge are the three principal drivers of underfill risk. All three are observable to USDA in real time, which reinforces the plausibility of model-based trigger rules for mid-year reallocation.

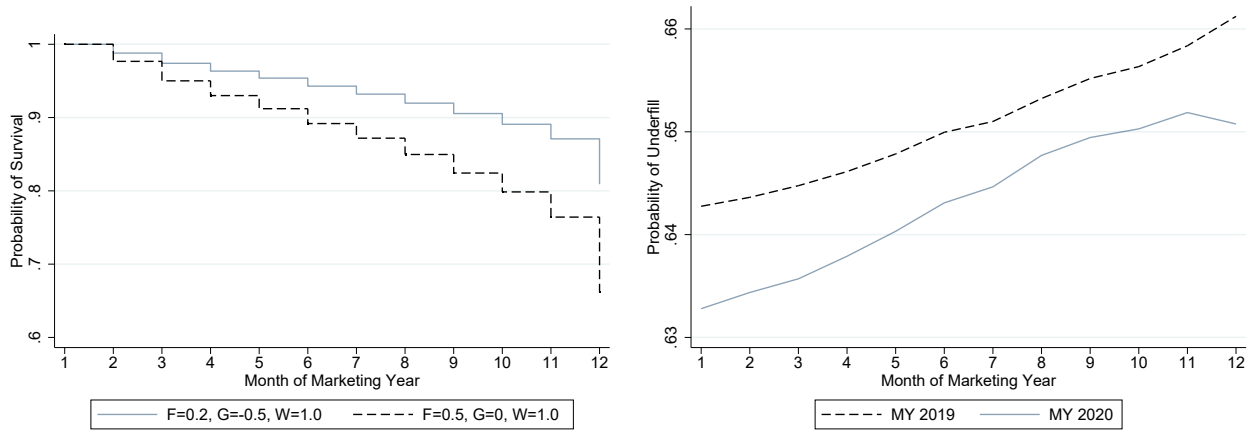
Finally, although the country fixed effects are not presented in the main table, they show substantial cross-country heterogeneity in fill behavior even after conditioning on observed covariates. Several countries (including those with historically reliable shipping performance) exhibit hazard ratios markedly above one, indicating an intrinsic propensity to reach the threshold early. Others show hazard ratios well below one, consistent with chronic underfill regardless of market conditions. These patterns may reflect persistent structural factors such as export capacity, milling reliability, logistical sophistication, and domestic-market diversion pressures.

5.2 Predicted Underfill Probabilities Over the Marketing Year

To illustrate how underfill risk evolves over the quota year at the country level, we focus on India, one of the largest quota holders in the U.S. raw sugar TRQ. Figure Figure 3 presents two complementary visualizations illustrating how shipment dynamics and market conditions shape the timing and likelihood of reaching the 90% utilization threshold. Panel (a) shows model-implied survival curves for India under two illustrative covariate profiles that differ in fill-to-date, relative shipment pacing, and the price wedge. Survival is defined as the probability that India has not yet reached the 90% fill threshold by month t. The lower curve corresponds to a scenario with stronger shipment progress (fill-to-date = 0.50, FGAP = 0, price wedge = 2.0), producing a sharply declining survival probability and therefore a low risk of underfill. The higher curve reflects a weaker shipment position (fill-to-date =

0.20, FGAP = -0.5, price wedge = 1.0), resulting in a much flatter survival path. Panel (b) plots the unconditional probability of ultimate underfill for India in marketing years 2019 and 2020, computed as the predicted probability $S_{iy}(12)$ at each month of the year.

Figure 3: Estimated Underfill Risk for India Under the U.S. Sugar TRQ



(a) Survival Probabilities Under Alternative Shipment and Market Conditions

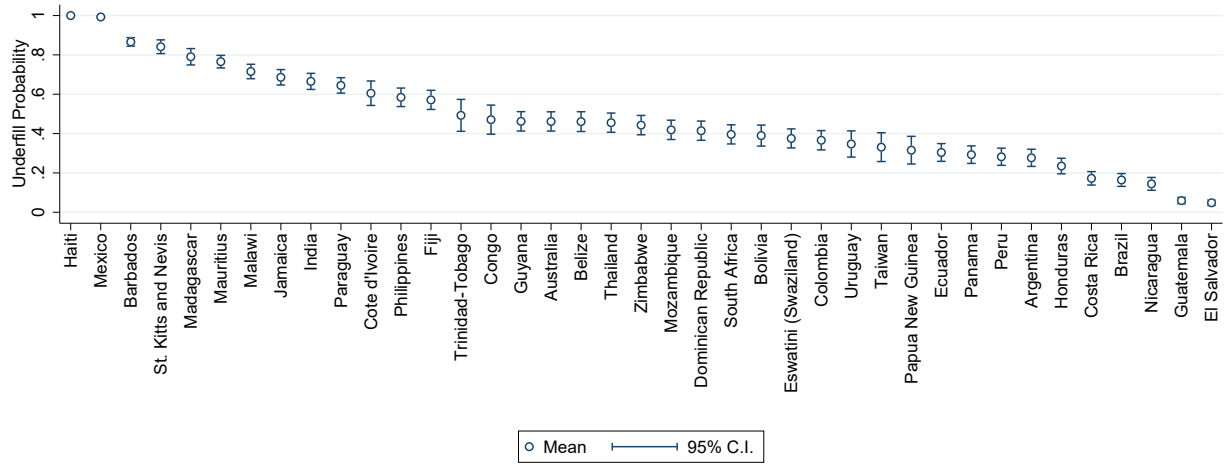
(b) Unconditional Probability of Underfill, MY 2019 vs. MY 2020

Notes: Panel (a) plots Cox model survival curves for India under two illustrative covariate profiles, showing the probability of not yet having reached 90% of the TRQ allocation by month t. Panel (b) displays the model-implied unconditional probability of underfill for India in marketing years 2019 and 2020, computed as $S_{iy}(12)$ using the estimated Breslow baseline survival function and month-specific covariates. Survival curves are based on the Cox specification described in Section 4. Underfill probabilities reflect the forward-looking assessment of whether India ultimately meets the 90% fill threshold, conditional on information available at each month of the marketing year.

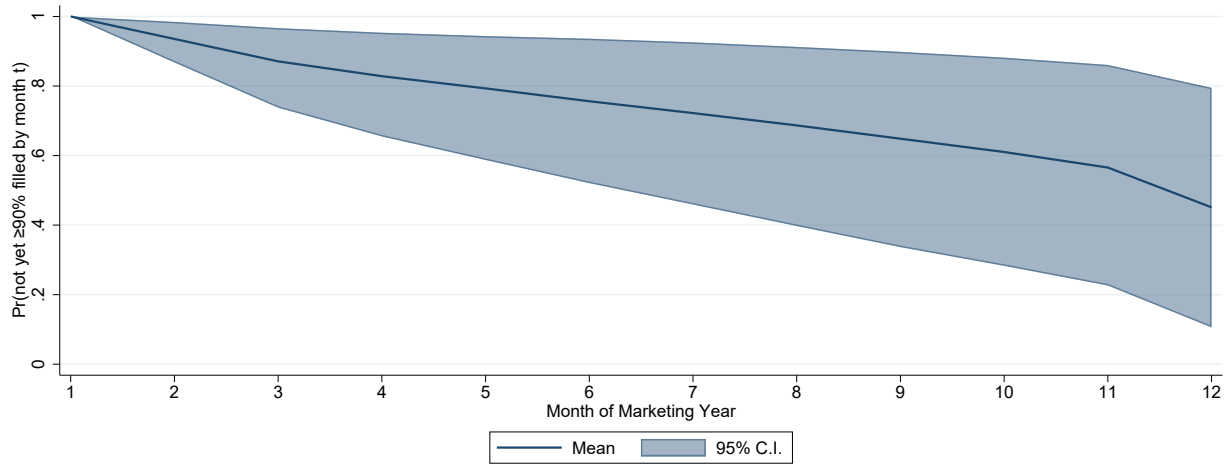
Figure 4 summarizes estimated underfill risk across countries and over the course of the marketing year. Panel (a) shows the average estimated probability that each quota-holding country ultimately underfills its TRQ allocation, evaluated at the end of the marketing year ($t = 12$). For each country, we compute the mean unconditional probability of underfill across all years in the sample and report 95% confidence intervals constructed using the standard error of the mean.

The figure reveals substantial heterogeneity in underfill risk across exporters. Several countries—including Haiti, Mexico, Barbados, St. Kitts and Nevis, and Madagascar—exhibit persistently high underfill probabilities, in some cases exceeding 75 percent. These

Figure 4: Estimated Underfill Risk Across Countries and Over the Marketing Year



(a) Mean Predicted Probability of Ultimate Underfill Across Countries



(b) Mean Estimated Survival Probability $S(t)$ Over the Marketing Year

Notes: Panel (a) plots the mean predicted probability that a country fails to reach 90% of its TRQ allocation by the end of the marketing year, with 95% confidence intervals computed using the standard error of the country-year distribution. Countries are ordered from highest to lowest predicted underfill risk. Panel (b) shows the estimated survival curve $S(t)$, defined as the probability that an allocation has not year reached 90% by month t, averaged across all country-year observations. Shaded regions denote the 10th-90th percentile range. Figures are constructed from predictions generated by the Cox proportional hazards model described in Section 4.

countries tend to have small allocations and irregular shipping patterns, which translate into elevated model-implied underfill risk. At the other end of the spectrum, major suppliers with long-standing participation in the U.S. sugar TRQ like Guatemala, El Salvador, Brazil, Costa Rica, and Honduras display very low mean underfill probabilities, often close to zero, consistent with their reputation for consistently filling their allocations.

Intermediate cases include countries like India, Paraguay, Cote d'Ivoire, and the Philippines, where underfill probabilities cluster around 40–60 percent and confidence intervals are wider. For these exporters, shipment reliability varies meaningfully from year to year, which the model captures through both time-varying fill behavior and the influence of market conditions.

Panel (b) of Figure 4 shifts attention to how underfill risk evolves within the marketing year. The plotted survival curve $S(t)$ represents the probability that an allocation has not yet reached 90% by month t, averaged across the full sample of country-year pairs. As expected, survival declines steadily over the course of the year as shipments accumulate. The interdecile range (shaded region) narrows slightly after mid-year, suggesting convergence in shipment progress as the season advances. Importantly, while the average survival curve does not fall sharply in any single month, the pattern reflects the cumulative nature of shipment timing and highlights the months in which the majority of countries cross the 90% threshold.

5.3 Market and Welfare Effects Under Alternative Reallocation Policy Scenarios

To evaluate how alternative quota administration rules would have altered trade flows under the U.S. raw sugar TRQ, we begin by examining a benchmark counterfactual (CF) scenario in which USDA reallocates unused quota whenever a country's predicted probability of underfill rises above 50 percent (i.e., $\tau = 0.5$) and recipient countries fill 80 percent of the reallocated volume (i.e., $\beta = 0.8$). This baseline case illustrates the mechanics of the trigger-based reallocation rule and provides an intuitive reference point for interpreting changes in import

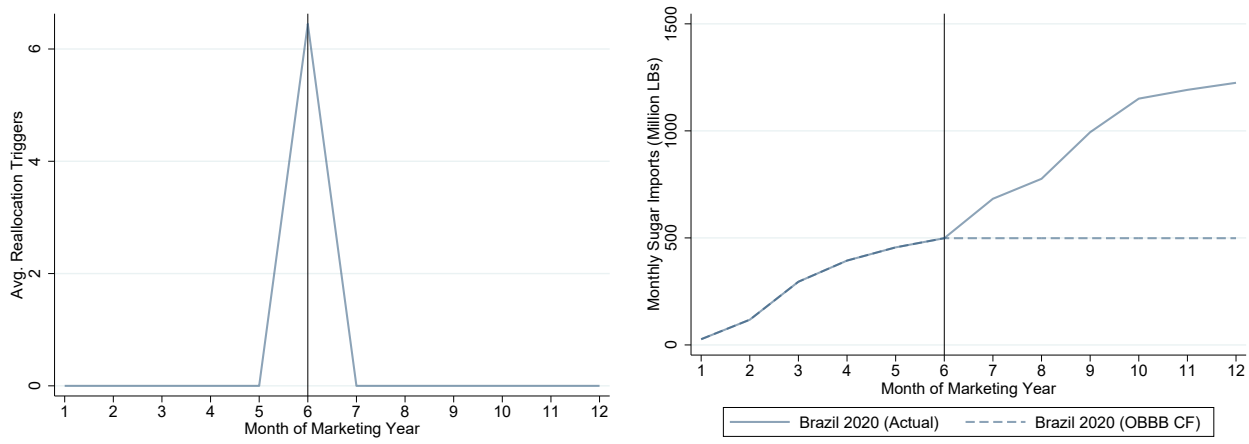
timing, total in-quota entries, and the distribution of quota utilization across exporters. We then expand the analysis by estimating counterfactual trade outcomes for the full grid of trigger thresholds—from 50 to 95 percent in 5-percentage-point increments—and reallocation fill efficiencies ranging from 50 to 100 percent in 5-percentage-point increments.

Benchmark Counterfactual Scenario ($\tau = 0.5$,$\beta = 0.8$). Figure 5(a) shows the average number of reallocation triggers in each month of the marketing year is 6.4 under the benchmark CF scenario ($\tau = 0.50, \beta = 0.80$). Under a trigger threshold of 50%, virtually all reallocations occur at month 6, the first month in which reallocation is permitted under our policy rule. This pattern indicates that the early-season shipment information used in the hazard model is already highly predictive of final underfill risk by mid-year. Thus, for a moderate trigger such as $\tau = 0.50$, a more proactive USDA reallocation policy would typically make its determinations as soon as mid-year monitoring begins. Panel (b) of Figure 5 illustrates the resulting adjustment to trade patterns using Brazil in FY2020 as an example, comparing observed in-quota imports to the counterfactual import profile implied by the simulated reallocation.

Table 4 reports the market and welfare impacts of the benchmark counterfactual reallocation scenario, in which USDA reallocates a country's remaining TRQ whenever the predicted probability of underfill rises above 50% after month 6, and recipient countries are assumed to fill 80% of the reallocated quantity. This calibration results in lower in-quota imports and higher domestic prices, leading to a net reduction in U.S. national welfare.

On average across marketing years, total in-quota imports fall by approximately 2.2% relative to the observed baseline (mean $\Delta M/M = -2.17\%$), while domestic raw sugar prices rise by about 2.17% (mean $\Delta P/P = 2.17\%$). These price increases translate into significant reductions in consumer and downstream-user surplus (mean Δ CS = -\$118.7 million), partially offset by gains to domestic beet and cane producers (mean Δ PS_{dom} = +\$88.2 million). The combined effect is a net decline in national welfare of roughly \$30 million per

Figure 5: Counterfactual Reallocations and Import Adjustments ($\tau = 0.50, \beta = 0.80$)



(a) Reallocation Triggers by Month (b) Actual and CF Imports from Brazil, FY2020

Notes: Panel (a) plots the average number of reallocation triggers in each month of the marketing year under a counterfactual policy in which USDA reallocates unused TRQ shares whenever the predicted probability of underfill rises above 50% and recipient countries fill 80% of the reallocated quota. All triggers occur in month 6, indicating that mid-year shipment information is already strongly predictive of final underfill. Panel (b) illustrates the resulting adjustment to trade patterns using Brazil in FY2020 as an example, comparing observed in-quota imports to the counterfactual import profile implied by the simulated reallocation.

year. Foreign quota rents also rise modestly (mean +$16 million), reflecting higher U.S. prices on shipments that still occur.

Although counterintuitive at first glance, these results are fully consistent with the economic logic of the reallocation mechanism and with the conceptual model in Section 3. In many years, the trigger rule identifies a country as "high underfill risk" as early as month 6 despite the fact that several major suppliers routinely ship later in the marketing year. Because the trigger rule is based on a mid-season snapshot rather than actual final fill behavior, reallocations are often initiated for countries that would have ultimately filled their allocations under the status quo.

At the same time, the assumed fill efficiency of recipient countries ($\beta = 0.80$) is lower than the effective fill rate of the original quota holders in many years. The combination of too-early triggers and less reliable substitute shippers implies that reallocation reduces expected total imports in the counterfactual rather than increasing them. In the notation

Table 4: Market and Welfare Effects Under Benchmark Reallocation Scenario

	Mean	Std. Dev.	Min	Max
Market Outcomes				
$\Delta P/P$	0.022	0.019	-0.011	0.074
$\Delta M/M$	-0.021	0.021	-0.073	0.008
Welfare Outcomes ($US Million)				
ΔCS (consumers/users)	-118.66	102.73	-344.25	77.57
ΔPS_{total}	88.23	75.51	-54.84	264.81
ΔPS_{beet}	49.00	41.76	-31.20	145.10
ΔPS_{cane}	39.23	33.90	-23.64	119.71
$\Delta Rent_{\text{foreign}}$	15.95	20.29	-16.05	66.48
ΔW_{dom}	-30.44	29.36	-92.24	22.73
Scenario Parameters				
Trigger probability τ	0.50			
Fill efficiency β	0.80			
Avg. # reallocation triggers	6.45			

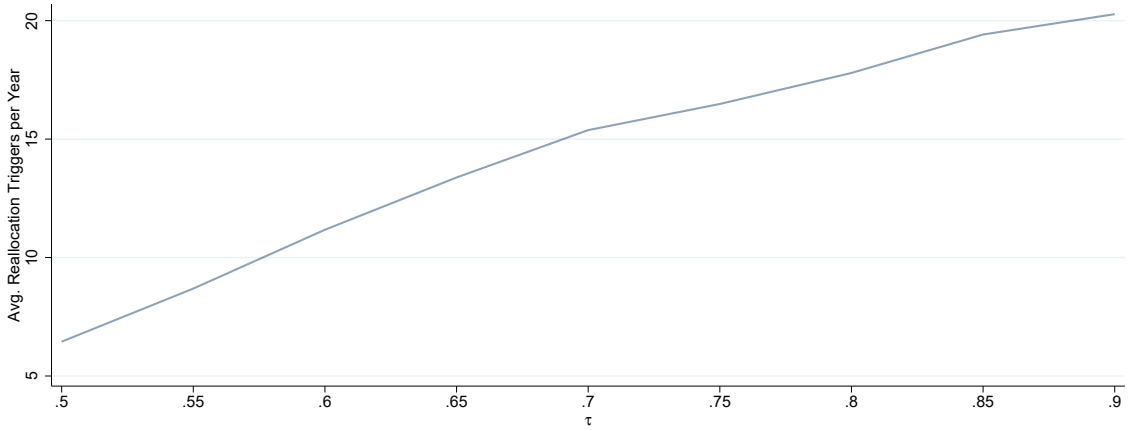
Notes: Table reports market and welfare effects from the benchmark counterfactual scenario with trigger probability $\tau = 0.50$ and reallocation fill efficiency $\beta = 0.80$. Welfare effects are expressed in millions of dollars. $\Delta P/P$ and $\Delta M/M$ represent percent changes in domestic raw sugar prices and in-quota import volumes, respectively. Domestic welfare is defined as consumer/user surplus plus total producer surplus.

of the conceptual model, this corresponds to cases in which $\beta < \rho$: recipient countries are expected to fill a smaller fraction of the remaining quota than the original allocation holders would have. In such cases, reallocation reduces total in-quota supply, raises domestic prices, and lowers national welfare.

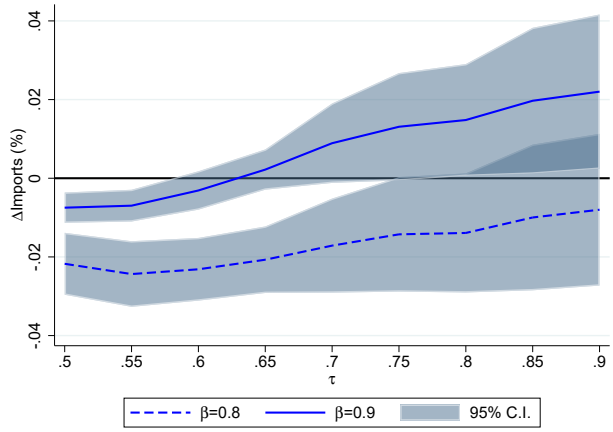
Market and Welfare Outcomes Across the Range of (τ, β). Figure 6 summarizes how different combinations of trigger thresholds (τ) and fill efficiency parameters (β) affect market-level outcomes. Panel (a) of the Figure shows the average number of reallocation events per marketing year under each trigger threshold. As expected, more aggressive trigger values lead to more frequent reallocations.

Panels (b) and (c) report how the percent change in total in-quota imports ($\Delta M/M$) responds to variation in τ and β. The results reveal two patterns. First, for a given fill efficiency, tighter trigger thresholds tend to increase imports (Panel b), though the magnitude is modest and confidence intervals widen at the extremes of the trigger range. Second, holding

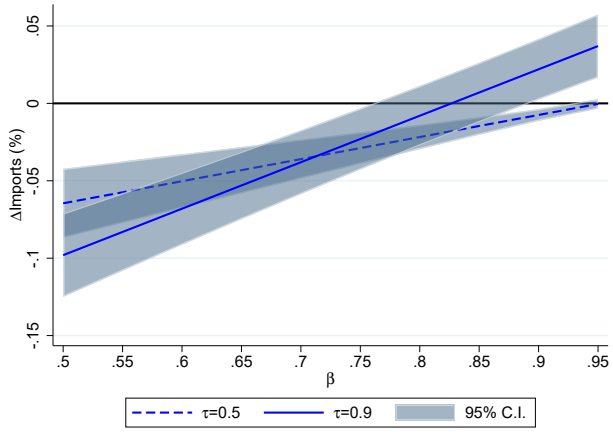
Figure 6: Market Impacts of Alternative Trigger and Fill-Efficiency Parameters



(a) Average Number of Reallocation Events per Marketing Year



(b) ΔM as a Function of τ



(c) ΔM as a Function of β

Notes: Panel (a) reports the average number of within-year reallocation events implied by each trigger threshold under the counterfactual reallocation policies generated from the hazard-based trigger rule. Panels (b) and (c) plot the percent change in in-quota imports ($\Delta M/M$). Shaded bands denote 95% confidence intervals calculated across country-year simulations. Panel (b) varies the trigger threshould τ holding fill efficiency β at 0.8 and 0.9. Panel (c) varies β holding τ constant at 0.5 and 0.9. All simulations use the estimated underfill probabilities described in Section 4.

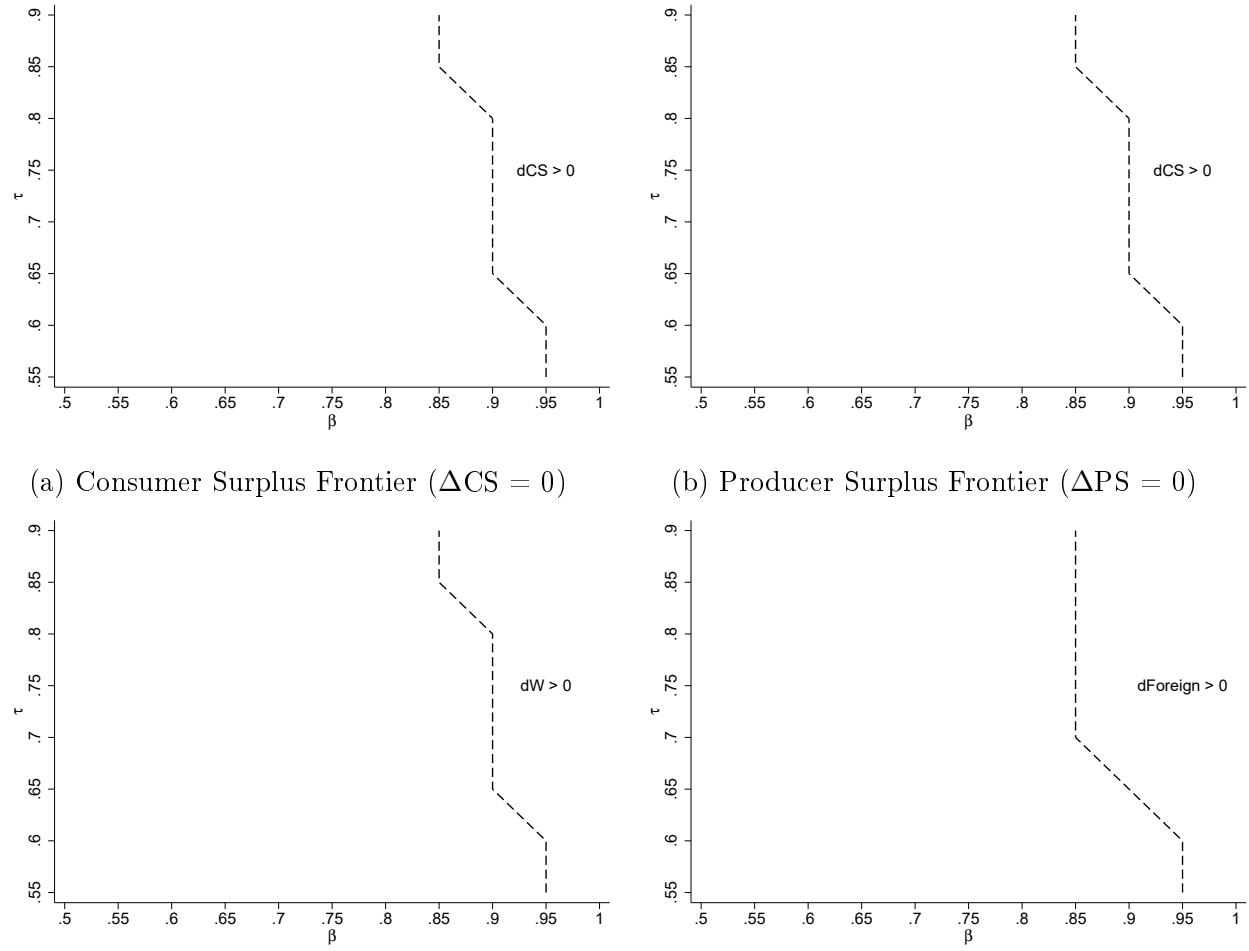
the trigger fixed, higher assumed fill efficiency leads to more pronounced import responses (Panel c), reflecting the direct role of β in determining how much of the unused quota pool is ultimately filled. Across both panels, the confidence bands show that import responses are statistically meaningful only under combinations of relatively aggressive trigger thresholds and relatively high fill efficiency.

To characterize how welfare outcomes depend jointly on the trigger threshould τ and the fill-efficiency parameter β across the range of simulated values, Figure 7 plots the welfare frontiers for each stakeholder group. Each panel shows the locus of (τ,β) pairs for which the corresponding welfare outcome equals zero. As indicated in the Figure, points to the right or left of the dashed line therefore represent combinations of trigger aggressiveness and fill responsiveness that produce positive or negative welfare changes.

Panel (a) of the Figure reports the frontier for downstream-user and consumer surplus. Because earlier reallocations tighten the domestic market in our baseline calibration, a large share of the (τ, β) space lies to the left of the zero-change line. This indicates that a reduction in consumer surplus unless fill efficiency is extremely high. Panel (b) shows the corresponding frontiers for producer surplus, which slopes in the opposite direction (i.e., more constrained import supply raises prices and increases domestic grower returns). This symmetry demonstrates the distributional tension inherent in mid-year reallocation—what benefits producers may harm downstream users and vice versa.

Panel (c) aggregates these effects to the change in domestic national welfare (ΔW_{dom}). Under low or moderate fill efficiencies, more aggressige reallocations reduce national surplus because the contraction in domestic supply raises prices without generating encough counter-vailing volume from recipient countries. Finally, panel (d) presents the foreign rent frontier. Foreign exporters benefit whenever earleir reallocation increases the volume of quota rents they receive, which requires both (i) a sufficiently aggressive trigger, and (ii) reasonably strong fill efficiency.

Figure 7: Welfare Frontiers Under Alternative TRQ Reallocation Rules



(a) Consumer Surplus Frontier (ΔCS = 0)

(b) Producer Surplus Frontier (ΔPS = 0)

(c) National Welfare Frontier (ΔW_{dom}=0)

(d) Foreign Rent Frontier ($\Delta \text{Rent}_{foreign} = 0$)

Notes: Each panel plots the combinations of the reallocation trigger threshold (τ, vertical axis) and the fill-efficiency parameter (β, horizontal axis) for which the corresponding welfare outcome equals zero. Points above or below the dashed line indicate policy combinations that produce positive or negative changes, respectively. Results are computed using the counterfactual TRQ reallocation simulations described in Section 4, with frontier values obtained from a fine grid over $\tau \in [0.5, 0.95]$ and $\beta \in [0.5, 1.00]$. ΔPS denotes the sum of beet and cane producer surplus changes. Foreign rents reflect changes in the quota-rent value accruing to exporting countries.

6 Conclusion

Tariff-rate quotas remain a central instrument in agricultural trade policy, yet their effectiveness depends critically on whether annual country-specific allocations are actually utilized. Underfill is common in many TRQs, including the U.S. raw sugar program, and recent legislation under the One Big Beautiful Bill (OBBB) has placed renewed emphasis on the role of mid-year reallocation as a tool for ensuring adequate in-quota supply. This paper has examined when such reallocations should occur and what market and welfare consequences follow from adopting more aggressive, rule-based reallocation regimes.

Using nearly three decades of monthly TRQ utilization data, we estimate a Cox proportional hazards model that characterizes the evolving probability that each country-year allocation ultimately remains underfilled. These hazard-based predictions are then embedded in a counterfactual simulation framework in which USDA reallocates unused quota whenever the predicted probability of underfill rises above a policy threshold. Finally, we evaluate the resulting trade patterns using an equilibrium displacement model of the U.S. raw sugar market to quantify price effects and welfare consequences for domestic stakeholders and foreign quota holders.

Three findings stand out. First, underfill risk is highly predictable by mid-year: cumulative fill to date, deviations from a country's historical shipping pace, and the domestic-world price wedge all strongly shape the likelihood that an allocation will be filled. Second, more aggressive trigger-based reallocation does not necessarily increase imports. When reallocations are triggered early but recipient countries fill only a modest share of the reassigned volume, total in-quota imports fall relative to the observed baseline. Third, the market and welfare implications of reallocation depend jointly on the trigger threshold and the fill efficiency of alternative suppliers. Positive national welfare gains emerge only when triggers are sufficiently stringent and the countries receiving reallocated quota reliably convert those allocations into actual shipments.

These results carry several policy implications. They suggest that early-season monitor-

ing of shipment progress can provide meaningful forward-looking information about underfill risk,. However, they also show that reallocation is not a uniformly beneficial tool: unless the countries that receive additional quota are able to ship promptly and at high efficiency, premature reallocation can reduce total imports, raise domestic prices, and lower national welfare. Designing an effective reallocation policy therefore requires balancing the informational content of mid-year signals with realistic expectations about exporters' ability to respond.

The analysis has limitations that point toward fruitful extensions. Our counterfactual simulations abstract from within-year variation in recipient-country responsiveness, potential changes in exporter behavior in anticipation of reallocation, and the administrative or diplomatic costs of reallocating quota (Feinberg et al., 2025). In addition, the EDM represents a partial-equilibrium framework; a richer structural model could capture adjustments in refining margins, storage behavior, or interactions with out-of-quota imports.

Future research could relax these constraints by examining the implications of more flexible reallocation timing beyond the current sixth-month trigger, estimating exporter-specific responsiveness to reallocated quota, incorporating stochastic shocks to production and shipping capacity, or embedding the reallocation mechanism within a multi-market or dynamic trade model. Cross-commodity applications—in dairy, grains, beef, or horticulture TRQs—would shed further light on the generality of the hazard-based trigger approach.

Overall, the results illustrate both the promise and the limits of mid-year reallocation as a tool for TRQ administration. Well-designed triggers can reduce underfill risk, but their effectiveness depends crucially on the reliability of the countries absorbing reallocated quota.

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