Vertical Contracts and Upstream Market Structure: Insights from the Connecticut Beer Industry*

Minhee Lee

The Ohio State University†
Click here for the latest version.

October 25, 2024

Abstract

This paper examines the motivation behind vertical contracts, focusing on their interplay with upstream market structure. Changes in upstream market structure through mergers can incentivize exclusionary vertical agreements by altering product ownership and the profit gains from excluding rivals. I analyze the Connecticut beer market, where a dominant upstream manufacturer rewarded distributors if its *share* of sales volume in the distributor's portfolio exceeds a certain threshold. I build a structural model that incorporates contract terms revealed through state regulations and federal antitrust enforcement to estimate demand, marginal costs, product entry costs, and pricing distortions under the reward program. Counterfactual analysis highlights the importance of firms' endogenous choice of vertical contracts, by evaluating a merger in which the dominant manufacturer acquires a craft manufacturer. The merger motivates the dominant manufacturer to adopt more aggressive exclusionary vertical contracts, as the portfolio expansion increases the substitutability between its products and those of rivals. I find that accounting for changes in vertical contracts results in a 42 percent greater consumer welfare loss after the merger.

JEL: K21, L11, L13, L41, L42, L66
Keywords: mergers, antitrust policy, vertical foreclosure, vertical contracts, loyalty program, partial exclusion, brewing industry

*Researcher own analyses calculated (or derived) based in part on data from Nielsen Consumer LLC and marketing databases provided through the NielsenIQ Datasets at the Kilts Center for Marketing Data Center at The University of Chicago Booth School of Business. The conclusions drawn from the NielsenIQ data are those of the researcher(s) and do not reflect the views of NielsenIQ. NielsenIQ is not responsible for, had no role in, and was not involved in analyzing and preparing the results reported herein.

†Department of Economics. Email: lee.8954@osu.edu

1 Introduction

Vertical contracts between firms at different production stages can raise antitrust concerns due to their potential to exclude rival firms from the market. These contracts have been the subject of antitrust litigation across various sectors, including microprocessors, hospital services, and credit card platforms.[1] While previous empirical studies have examined the effects of vertical contracts on market outcomes, less attention has been given to the market conditions that drive firms to adopt exclusionary vertical contracts and how these contracts are designed. Understanding these conditions is crucial because it helps develop proactive, rather than reactive, policy measures.

This paper investigates the motivations behind exclusionary vertical contracts, focusing on the upstream market structure. Shifts in upstream market structure—through mergers, acquisitions, and divestiture—can influence vertical agreements by altering product ownership and the profit gains from excluding competitors. When an upstream firm expands its product portfolio through acquisitions, exclusionary vertical contracts often become more profitable, as the firm can better capture the market share from excluded competitors. As a result, even seemingly minor mergers involving products that are not direct competitors can increase market concentration by reshaping vertical relationships. This insight that vertical contracts can change after a merger aligns with findings from the literature on the hospital industry (Gowrisankaran, Nevo, and Town, 2015; Ho and Lee, 2017; Dafny, Ho, and Lee, 2019), which focuses on the bargaining framework.

The analysis develops an empirical framework within the context of the beer industry in Connecticut. I seek to answer the following question: When a large beer company acquires small craft breweries, does it gain a stronger incentive to offer exclusionary contracts? The focus is on a reward program offered by a dominant beer manufacturer, referred to as Big Beer hereafter, to its distributors. This program, which lasted until the Department of Justice (DOJ) imposed a ban in 2018, made payments to distributors if Big Beer's *share* of sales volume in the distributor's portfolio exceeded a certain threshold.

[1] *Cascade Health Solutions v. PeachHealth*, 515 F.3d 883 (9th Cir. 2007); *AMD v. Intel*, 05-441 (D. Del. Nov. 11, 2009); *Intel* (Case COMP/AT.37990), Commission decision of May 13, 2009; *United States v. American Express Co.*, No. 1:10-cv-04496 (E.D.N.Y. filed Oct. 4, 2010). See Genchev and Mortimer (2016) for more court cases.

The program qualifies as a contract that references rivals (CRR), as distributors could increase their payments by reducing sales from rival upstream firms. CRRs raise antitrust concerns because they have potential to exclude upstream rivals by directly tying the downstream buyer's payment to the upstream seller to its purchases from rival sellers (Scott-Morton, 2012).

Historically, shifts in upstream market structure have reshaped the vertical relationships between beer manufacturers and distributors. Big Beer's reward schemes have evolved in response to changes in distributors' participation incentives under different market environments. In the mid-1990s, when American-style light lagers dominated the market, Big Beer successfully implemented a reward program that incentivized distributors to exclusively carry its products. However, as the craft beer sector grew, distributors began to move away from exclusivity in the late 2000s. Since the 2010s, Big Beer has increasingly acquired craft breweries, and as its craft portfolio expanded through these acquisitions, it restructured the reward program. An article by Beer Marketer's Insights reported on a meeting of Big Beer with its distributors, noting that it revamped its reward program, increasing funds and adding flexibility to encourage greater participation. This shift raised concerns about its impact on beer distribution and potential barriers to entry for smaller brewers (U.S. Department of the Treasury, 2022).

I develop a multi-stage model that incorporates the reward program provided by Big Beer to its distributors. The model is solved using the equilibrium concept of subgame perfection and proceeds in five stages. First, Big Beer sets the reward amount for each of its distributors. This stage allows us to examine how the profitability of the reward program changes under different market conditions, including demand environments, manufacturers' and distributors' cost structures, and product ownerships. Second, distributors select which products to offer. This product entry stage enables us to study how vertical contracts can lead to the foreclosure of rival manufacturers by influencing distributors' decisions on product offerings. Third, manufacturers set wholesale prices for distributors, and fourth, distributors set retail prices for consumers. In these pricing stages, I depart from the double marginalization framework in Villas-Boas (2007) by accounting for the distortion in pricing incentives under the reward program. Finally, in the last stage, consumers make their purchase decisions.

Before proceeding to estimate the demand system and cost structures, I present numerical results from a simplified version of the comprehensive model to illustrate the interplay between vertical contracts and upstream market structure. The findings suggest that Big Beer's reward program can increase upstream market concentration by foreclosing rival firms. Furthermore, the reward program is profitable when distributors have high fixed costs for offering products and when the dominant manufacturer's products are highly substitutable for rivals' products. This occurs because the reward program is particularly effective when distributors require minimal compensation to stop selling competitors' products, and when the dominant company benefits substantially from excluding these competitors.

In the supply estimation, I estimate distribution marginal costs and reward effects using the distributors' first order conditions in Stage 4. Simply inverting these first order conditions gives only the sum of distribution marginal costs and reward effects. To separate these two components, I apply a method similar to difference-in-differences (DiD). Unlike standard DiD settings, the treatment occurs prior to a specific time period, the DOJ's ban of the reward program, and its effects differ depending on whether the product is from Big Beer or not. For identification, a parallel trend assumption is required, but there is no need to assume specific values for the unobserved parameters related to the reward program. The results indicate that the reward effects are statistically significant before the ban, showing that Big Beer's distributor lowered retail prices for Big Beer products and raised retail prices for non-Big Beer products. Essentially, they applied a per-unit subsidy to products from Big Beer and a per-unit tax on those from other manufacturers. Brewing marginal costs are then inferred by inverting the manufacturers' first order conditions in Stage 3, after inserting the estimated distribution marginal costs and reward effects into the first order conditions. The results show that Big Beer has lower brewing marginal costs than craft manufacturers, and these costs remain stable after the DOJ's ban.

To estimate the fixed costs that distributors face when offering products, I apply the revealed preference approach by Pakes, Porter, Ho, and Ishii (2015). I construct moment inequalities based on distributors' profit maximization problems in Stage 2. For inference, I implement the generalized moment selection procedure by Andrews and Soares (2010). The findings indicate that the fixed costs align previous research (Fan and Yang, 2024), and distributors operating in larger markets tend to incur higher fixed costs.

For demand estimation, I use a nested logit model to estimate demand with four nests: craft beer, non-craft beer, imported beer, and the outside option. To address potential endogeneity of prices and within-group market share, I use three instruments: a shipping cost measure, the sum of shipping costs across all products within the same nest, and the total number of products within the same nest in each market. The results confirm that consumers' utilities are highly correlated within categories, and the price elasticities are consistent with prior studies in the U.S. beer industry (Miller and Weinberg, 2017; Fan and Yang, 2024).

A counterfactual analysis evaluates a merger in which Big Beer acquires a craft manufacturer. This merger case is evaluated using three approaches: (1) the standard merger evaluation, which considers only unilateral price effects, (2) the fixed vertical contract approach, which accounts for the vertical structure but assumes the vertical contract remains unchanged after the merger, and (3) the endogenous vertical contract approach, which allows for changes in vertical contracts post-merger. In the standard approach, I assume that upstream manufacturers set retail prices and sell products directly to consumers. The manufacturers' marginal costs are the sum of previously estimated brewing and distribution marginal costs. I calculate the Nash-Bertrand pricing equilibrium based on the pre- and post-merger ownership structures using the estimated demand system and cost structure.

The other two approaches incorporate the vertical structure and Big Beer's reward program. By setting Big Beer's profits as the objective function, I numerically identify the optimal reward level by repeatedly solving for equilibrium product offerings and prices. The key difference between the two approaches is that in the fixed vertical contract approach, I identify only the pre-merger optimal reward level and apply it to the post-merger scenario, while in the endogenous vertical contract approach, I determine both the pre- and post-merger optimal reward levels.

The counterfactual results show that the merger motivates the dominant manufacturer to adopt more aggressive exclusionary vertical contracts, as the portfolio expansion increases the substitutability between its products and those of rivals. I find that accounting for changes in vertical contracts results in a 42 percent greater consumer welfare loss after the merger.

This paper contributes to the literature in several ways. First, it contributes to the empirical literature on vertical contracts by examining motivations and market conditions behind these contracts. Previous studies have focused on pro- and anticompetitive effects of vertical contracts: Sass (2005), Chen (2014), Asker (2016), and Chen and Shieh (2016) focus on exclusive dealing arrangements. Sass and Saurman (1993) and Burgdorf (2019) investigate exclusive territories. Ho, Ho, and Mortimer (2012) examine bundling, and Conlon and Mortimer (2021) focus on all-units discounts. This paper differs by not only analyzing the effects of vertical contracts on market outcomes and welfare, but also examining how changes in upstream market structure can influence the optimality of these contracts.

Second, this paper builds on the literature related to antitrust analysis of mergers. Hausman, Leonard and Zona (1994), and Nevo (2000) quantify the unilateral effects of mergers by conducting merger simulations. Several studies advanced this static unilateral effect analysis by relaxing the assumption of a fixed mode of conduct. Miller and Weinberg (2017) and Miller, Sheu, and Weinberg (2021) investigate the increased coordination between mega beer manufacturers after a merger using a price leadership framework. Gowrisankaran, Nevo, and Town (2015), Ho and Lee (2017), and Dafny, Ho, and Lee (2019) examine changes in bargaining power after mergers in the hospital industry using a Nash-in-Nash bargaining framework. This paper differs by investigating the change in the optimality of exclusionary vertical contracts after merger, through developing a model of CRR.

Third, this paper adds to the theoretical literature on exclusionary vertical contracts. A large literature responds to the Chicago Critique (Posner, 1976; Bork, 1978)'s defense of exclusive dealing, by demonstrating that inefficient exclusion can occur. Mathewson and Winter (1987) show this by restricting analysis to linear contracts, while Bernheim and

Whinston (1998) examine incentive conflicts arising from common agency. Rasmusen, Ramseyer, and Wiley (1991) and Segal and Whinston (2000) investigate cases where entrants need to hnysupply more than one buyer to cover fixed costs. Fumagalli and Motta (2006) and Abito and Wright (2008) analyze situations in which buyers are competing downstream firms rather than final consumers. Asker and Bar-Isaac (2014) study situations where vertical contracts allow incumbents to transfer profits to downstream firms. In this paper, exclusion arises because the reward program creates inefficiencies when Big Beer and other upstream firms share the same distributor. These inefficiencies, resulting from common representation by the same downstream firm, align with Bernheim and Whinston's (1998) finding that exclusion can be a consequence of incentive conflicts under common agency. However, the difference is that, in their model, incentive provision is costly due to downstream firm risk aversion. In contrast, in my model, the cost of incentive provision arises due to the negative marginal incentive for the downstream firm's sales on behalf of the rival upstream firms under the reward program.

The paper is organized as follows: Section 2 discusses the essential definitions, institutional background, data sources, and state regulations that lay the groundwork for the model. Section 3 introduces the model, and Section 4 describes the empirical estimation strategy and the estimation results. Section 5 explains the counterfactual analysis, and Section 6 concludes.

2 Institutional Background and Data

2.1 Definitions

This section outlines the definitions of product, market, and upstream and downstream firms, providing clarity on the terminologies used in this article. These definitions are essential for understanding the subsequent discussions on data collection and analysis.

Product Definition: In this analysis, a *product* is defined as a specific combination of brand and package size. Beers with the same brand but different package sizes are treated as distinct products. This distinction is made because treating them as the same product could lead to misleading price variations attributed to sales of larger-sized packages. Typically, larger packages offer a lower unit cost, potentially skewing the average product price downward if sales are predominantly in larger sizes, regardless of price changes by the firms. Beers sold in different types of containers (e.g., aluminum bottles, regular bottles, and cans) are considered the same product if the brand and package size are the same. This approach simplifies the analysis by reducing the number of products and is justified since price differences across container types are generally minor compared to those across different package sizes.

Product Classification: Beer products are classified into three groups: *domestics*, *crafts*, and *imports*. Domestics are beers manufactured in the U.S. by mega-brewers such as Anheuser-Busch, Miller, and Pabst. Crafts are beers produced by American microbreweries and often referred to as specialty beers.[2] Imports are beers not manufactured in the U.S. and shipped from other countries, such as Corona and Heineken. Classification of beers in the sample is straightforward as manufacturers and distributors specify whether a beer product belongs to each group when posting wholesale prices, with clear subsections for each group. Unlike the Brewers Association, which defines a craft brewer based on annual production size (under 6 million barrels) and ownership (less than 25 percent by a non-craft alcoholic entity), this analysis maintains a beer's craft status even after its producer is acquired by a larger brewer, assuming the product's quality and characteristics remain unchanged. Additionally, beers created by macro brewers to resemble craft brands are classified as crafts despite their macrobrewer origins.

Upstream Firms: Upstream firms in the beer industry are variously known as manufacturers, brewers, or suppliers, and as importers if they bring beer into the U.S. from abroad.[3] To ease explanation, this article consistently uses the term "manufacturers" to refer to both domestic producers and foreign importers. Manufacturers are categorized into three groups: domestic brewers, craft brewers, and importers. Some manufacturers

[2] In the U.S., "domestic beer" typically refers to mass-produced, widely distributed brands like Budweiser and Coors. This category emerged when such beers dominated the market, distinguishing them from "imported" premium beers. Even though craft beers are also made in the U.S., they don't fall into the "domestic" category, as this term has come to imply more affordable, mainstream beers.

[3] Under Connecticut General Statutes, in-state brewers are referred to as "manufacturers," while out-of-state brewers and importers are called "out-of-state shippers."

own a combination of domestic and craft brands, often through acquisitions of smaller craft breweries, and may also function as importers by holding licenses to market foreign beers in the U.S. In such instances, manufacturers are classified based on the predominant source of their sales.

Market definition: A *market* is defined by a specific combination of month, retailer, and county. For instance, a grocery chain's stores in Fairfield in January 2021 constitute one market. This approach is justified since cross-retailer competition is minimal, as discussed in Fan and Yang (2024). The market sizes are assumed to be 50 percent larger than the maximum observed unit sales within each geographic market throughout the study period, a method also employed by Miller and Weinberg (2017).

2.2 Industry Background

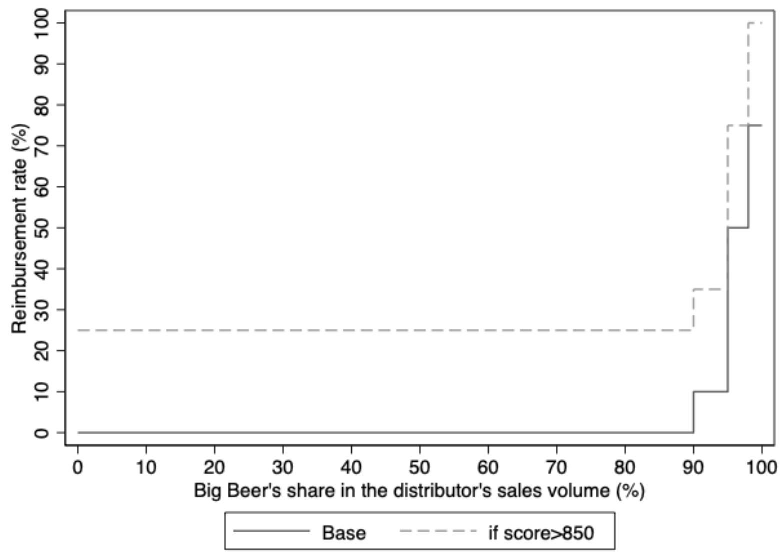
This section outlines the context of the U.S. beer industry, highlighting its relevance in analyzing the interplay between exclusionary vertical contracts and upstream market structure. In 2023, the industry generated $116.9 billion in revenue and sold over 173 million barrels (Brewers Association, 2023). A notable shift within this sector has been the rise of craft breweries and a trend towards market consolidation.

Craft beers have gained popularity by introducing diverse beer styles distinct from mass-produced light lagers. These include India Pale Ales, stouts, porters, sours, pilsners, and Belgian ales, each noted for its unique flavors and brewing methods. By 2023, craft beers accounted for 24.7 percent of the industry's revenue and 13.5 percent of its volume, and microbreweries represented 98 percent of all U.S. breweries.[4]

In response to the craft beer boom, Big Beer has been particularly active in acquiring craft breweries and implementing vertical contracts to incentivize distributors to promote their products. Big Beer has acquired over 14 craft breweries nationwide and 10 of these were introduced to the Connecticut market post-acquisition. In contrast, other major brewers have been less aggressive and each introduced at most one acquired craft

[4]The figures cited here are from the Brewers Association report (2023). It is important to note that the definition of craft beer used by the Brewers Association differs from that used in the main analysis of this paper, as detailed in Section 2.1. Consequently, the market share figures reported here might be higher if the broader craft beer definition from this paper were applied.

Figure 1: Big Beer's Incentive Program



Notes: This graph is based on information disclosed during a hearing conducted by the Judiciary Committee in 2015.

brand to Connecticut. These craft acquisitions may face fewer legal barriers because some do not meet the reporting requirements of the Hart-Scott-Rodino (HSR) Act. The Act requires premerger notifications to the Federal Trade Commission (FTC) and the DOJ for transactions exceeding certain thresholds, which many craft brewery acquisitions do not reach.

Furthermore, Big Beer exerted influence over its distributors through an incentive program. Under the terms of their contracts, distributors were required to meet a yearly minimum marketing expenditure. They are eligible for reimbursement of 10 percent, 50 percent, or 75 percent if 90 percent, 95 percent, or 98 percent of their sales, respectively, is from Big Beer's brands. Additionally, if distributors score more than 850 in Big Beer's evaluation program, they receive enhanced reimbursements of 35 percent, 75 percent, and 100 percent at the same sales volume thresholds.[5] Figure 1 illustrates this reimbursement structure. This incentive program, which is a type of CRR, potentially motivates distributors to limit the sales of competing manufacturers' beers to meet Big Beer's sales volume share thresholds.

[5]The exact scores of distributors from the award program and the corresponding reimbursement amounts are not observed in the data. Consequently, this paper assumes that rewards are optimally chosen and the reward amounts are endogenously determined within the model.

Such programs can have exclusionary effects since distributors play a key role in beer sales by exerting marketing efforts and maintaining relationships with retailers. Strong distributor relationships often lead to preferred shelf placements. It is important to note that while there are multiple manufacturers, the number of available large-scale distributors is limited, typically fewer than three in each territory. Moreover, once a craft brewer partners with a distributor, switching to a more efficient one is challenging due to beer franchise laws (details in Section 2.3). These laws, originally intended to protect distributors from dominant mega brewers, now pose barriers for smaller brewers looking to terminate or alter their distribution agreements.

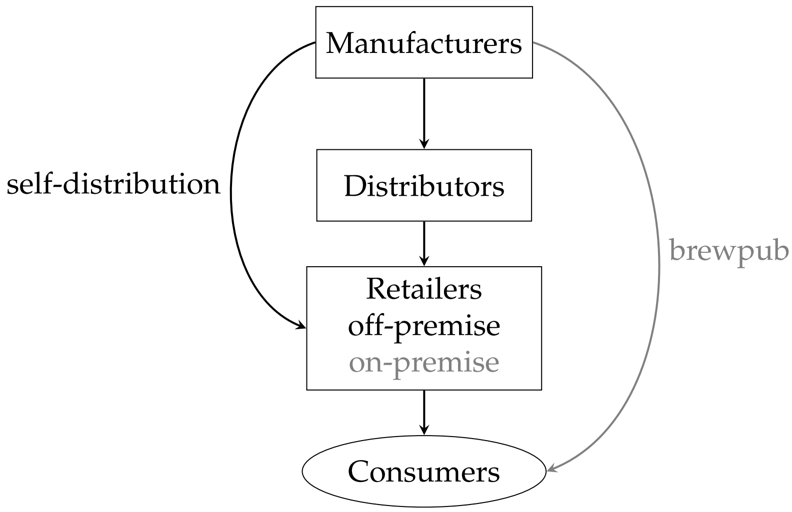
To ensure fair competition within the U.S. beer industry, the DOJ implemented a ban on Big Beer's practices that restricted independent distributors from selling competing brands. This included the incentive program discussed earlier. Additionally, Big Beer is now required to inform the government about any future acquisitions, even those that fall below the HSR thresholds. This allows the DOJ to assess any potential impacts on competition. The Proposed Final Judgment (PFJ) was issued in July 2016, followed by the Modified Final Judgment (MFJ) in October 2018.

2.3 State Regulation

This section introduces Connecticut's state regulations governing beer sales and explains their implications for the modeling choice. These regulations underpin the interpretation of the vertical structure and competition in Connecticut's beer market.

Franchise state: Among the three main alcohol regulatory schemes—open, franchise, and control—control states are characterized by a state monopoly for distribution, whereas distributors in open and franchise states are privately owned. Both open and franchise states, often referred to as license states, are regulated by the state through the issuance of permits for alcohol sales. In open states, it is relatively easy for manufacturers to switch distributors. However, franchise states, including Connecticut, require suppliers to legally justify any termination of a distributor relationship after it has lasted more than six months (Connecticut General Statutes (CGS) §30-17). In Connecticut, the necessity to

Figure 2: Three-Tier System



show "just and sufficient cause"[6] makes it rare for manufacturers to switch distributors.

Three-tier system: After the repeal of Prohibition, Connecticut adopted a three-tier alcohol distribution system, necessitating the separation of manufacturers, distributors, and retailers, and thereby prohibiting vertical integration. Under this system, manufacturers are generally required to sell their products to distributors, who then sell to retailers, ultimately reaching consumers. However, exceptions allow for direct sales under specific conditions: (i) Permittees may self-distribute, provided they make the beer accessible to all package and grocery stores in their distribution region, subject to state-determined reasonable limitations (CGS §30-16). (ii) Permittees can sell directly to consumers at the brewpub (CGS §30-22d). Notably, only two out of more than 100 brewers were observed to self-distribute their products and were excluded from my sample due to their small market shares. Figure 2 illustrates the three-tier beer distribution system, where retailers include both off-premise stores, like grocery and package stores, and on-premise establishments, such as bars and restaurants. This study utilizes NielsenIQ's scanner dataset which does not include on-premise sales, similar to previous studies.

Exclusive territories: In Connecticut, legislation permits a beer manufacturer to designate a single distributor for its product within a specific territory. Manufacturers can

[6] "Just and sufficient cause" refers to circumstances that, in the view of a reasonable person considering the interests of both sides, justify terminating or reducing the scope of a distributorship. The Department of Consumer Protection conducts hearings to determine the presence of just and sufficient cause.

appoint multiple distributors within the same territory for just and sufficient cause (CGS §30-17(a)(2)). Even though the law does not explicitly prohibit assigning multiple distributors, exclusive territories are consistently observed, possibly due to the requirement for manufacturers to justify such arrangements. Additionally, beer wholesalers are exempted from the law requiring alcohol wholesalers to sell products to retailers outside their usual territories if the desired product is not available within the retailer's territory, or if it is cheaper from a wholesaler in another territory (CGS §30-17a).

Exclusive dealing: Connecticut law does not outright prohibit exclusive dealing arrangements, except where they have substantial anti-competitive effects. As outlined in CGS §35-29, which is the Connecticut analogue of Section 3 of the Clayton Act, such arrangements are unlawful if they notably lessen competition or contribute to monopoly formation. During the sample period (2010-2021), exclusive dealing arrangements are not observed in Connecticut.

Price posting: Connecticut enforces the post-and-hold regulation for alcohol manufacturers and distributors, mandating the monthly posting of bottle and can prices with the state agency. For beer, manufacturers and distributors may post additional prices for the following month. Additionally, the law permits intrabrand price matching (CGS §30-63(c)). Conlon and Rao (2023) examine the distilled spirits market in Connecticut and find that such regulations limit competition among wholesalers selling identical products. Wholesalers have less incentive to offer lower initial prices, as they can match their intrabrand competitor's prices. However, the beer market, due to its exclusive territories, inherently lacks intrabrand competition, potentially making the post-and-hold policy less impactful in reducing competition further. Additionally, wholesalers are required to post suggested consumer resale prices for each brand and size, although retailers can sell below these suggested prices (CGS §30-64).

Pricing regulations: In Connecticut, quantity discounts are prohibited. This ensures equal pricing regardless of purchase volume, to avoid disadvantaging smaller outlets (CGS §30-63(b), CGS §30-94(a)). Furthermore, the state's minimum retail price policy requires sales to consumers at or above a defined "cost," which includes the lowest posted price plus any additional fees (CGS §30-68m(a)). Additionally, the state's minimum retail price policy requires that retailers sell beer to consumers at or above a statutorily defined "cost" (CGS §30-68m(a)). The cost is defined as the lowest posted price for the month in which the beer is being sold plus any shipping or delivery fees.

Implications: The three-tier system underpins the vertical structure of the current model, comprising manufacturers, distributors, and retailers. Due to state regulations, registered beer brands, their associated distributors in each territory, and the relevant effective and expiration dates are available. This information unveils the partnerships across different tiers and how these relationships have evolved over time. The post-and-hold policy provides access to wholesale prices set by manufacturers and distributors, which are usually hard to observe. The aforementioned pricing regulations support the current model's linear pricing structure. Crucially, the model assumes that distributors, rather than retailers, set the final retail prices for consumers. This assumption is supported by the requirement for distributors to post suggested consumer prices, as mandated by state law and the fact that resale price maintenance is not *per se* illegal in Connecticut, as evidenced by *Connecticut Fine Wine & Spirits v. Harris*.[7]

2.4 Data

Analyzing vertical contracts requires detailed data on the relationships among manufacturers, distributors, and retailers, as well as the contracts that between them. Such relationships are complex (they are not one-on-one) and typically difficult to observe directly. However, in the beer industry, this information is sometimes accessible due to state regulations.

In Connecticut, the Department of Consumer Protection (DCP) provides data that includes registered liquor brand names, distributor names, their designated territories, and the effective and expiration dates of these licenses. This dataset identifies the backer[8] of each beer brand and specifies which distributor is assigned to sell the beer within each territory during specific periods. This information facilitates the mapping of relation-

[7] In *Connecticut Fine Wine & Spirits v. Harris, 255 F. Supp. 3d 355*, 2017, the court determined that resale price maintenance does not inherently violate antitrust laws and is not per se illegal.

[8] A backer is a legal term referring to an entity that owns and operates a liquor business. This could be the manufacturer or importer of the beer brand.

ships between beer manufacturers and distributors over time. Furthermore, product-level wholesale prices are available from DCP's monthly price postings. As outlined in Section 2.3, alcohol manufacturers and distributors are required to post wholesale prices they charge to distributors and retailers each month.

The second primary data source for this study is the NielsenIQ Retail Scanner Data from the Kilts Center for Marketing at the University of Chicago Booth School of Business. This dataset offers weekly price and sales information from retail chains across the United States, including stores in Connecticut. It specifies the counties where each store is located, facilitating the alignment of price and sales data from the retail to the distributor tier. This alignment is possible because the DCP dataset provides detailed information on the designated distributor for each territory. Note that distribution territories are typically defined by county lines, with only a few exceptions.

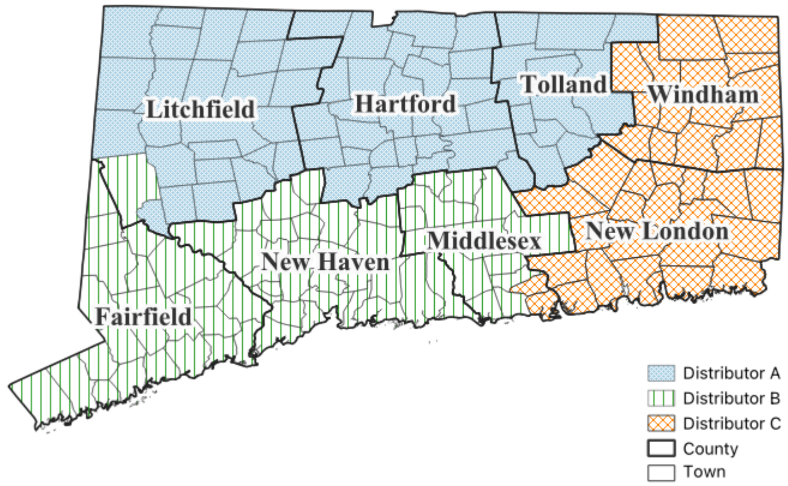
The analysis covers data from 2010 to 2021 in Connecticut, processed according to the market and product definition. The scanner data are aggregated from the weekly store level to the monthly county-retailer level. The analysis focuses on 12-ounce container beers, which represented 81.16 percent of craft beer sales in 2021, and 6 and 12-packs, accounting for 71.34 percent of craft beer sales in the same year. To standardize the data, product units are converted to 144 ounces, the total volume in a 12-pack of 12-ounce containers. Weekly sales and quantities sold are summed across each month, and quantity-weighted average prices are calculated by dividing total sales by total quantities. These prices are then adjusted for inflation using the consumer price index, normalized so that January 2010's index equals 1.

2.5 Empirical Facts

This section illustrates the distribution of beer products, detailing how they reach consumers and the partnerships between upstream and downstream firms. It also presents key facts and evidence that support the hypotheses driving the main analysis.

Figure 3 describes the distribution of Big Beer's products across Connecticut, where territories generally align with county borders. Distributors A, B, and C distribute Big

Figure 3: Big Beer’s Distribution Territories

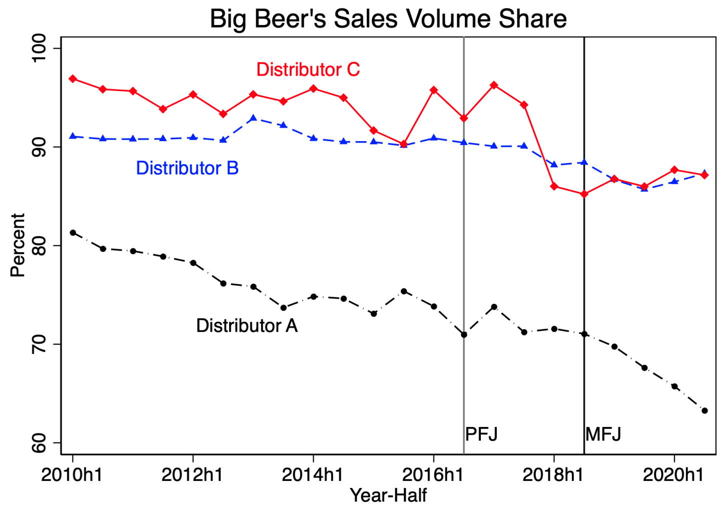


Beer’s products to retail stores within their designated areas. Notably, these distributors are local, family-owned businesses that operate solely within Connecticut. This localization allows the analysis to concentrate exclusively on Connecticut, disregarding Big Beer’s vertical contracts in other states.

The distribution process of beer from manufacturers to consumers involves several key steps. Take, for example, Big Beer’s “Light Lager X” 12oz 12-pack. Big Beer manufactures the beer and sells it to distributors at a fixed wholesale price of $13.840. Under exclusive territorial agreements, different distributors handle the distribution within designated areas. Distributor A purchases the beer at this price and sells it to retailers in Hartford, Litchfield, and Tolland counties at $22.48. Distributor B covers New Haven, Middlesex, and Fairfield counties, selling the beer for $22.49, while Distributor C operates in Windham and New London counties, where the price is at $22.47.[9] These distributors, who are local businesses exclusive to Connecticut, manage the logistics of delivering the beer to various retail outlets in their assigned territories. This includes ensuring that the beer is available and prominently displayed in retail stores. Consumers ultimately pur-

[9]While distribution territories generally align with county borders, there are exceptions. Distributor A is responsible for all of Litchfield County except for New Milford. Distributor B handles all of Middlesex County except for Old Old Saybrook and Essex, and also covers New Milford in Litchfield County. Distributor C covers Old Saybrook and Essex in Middlesex County. The NielsenIQ scanner dataset lacks town-specific information, so these exceptions are not reflected in the analysis. However, the exceptional towns constitute a minor portion of each county’s population, which is unlikely to significantly impact the overall findings.

Figure 4: Big Beer's Sales Volume Share

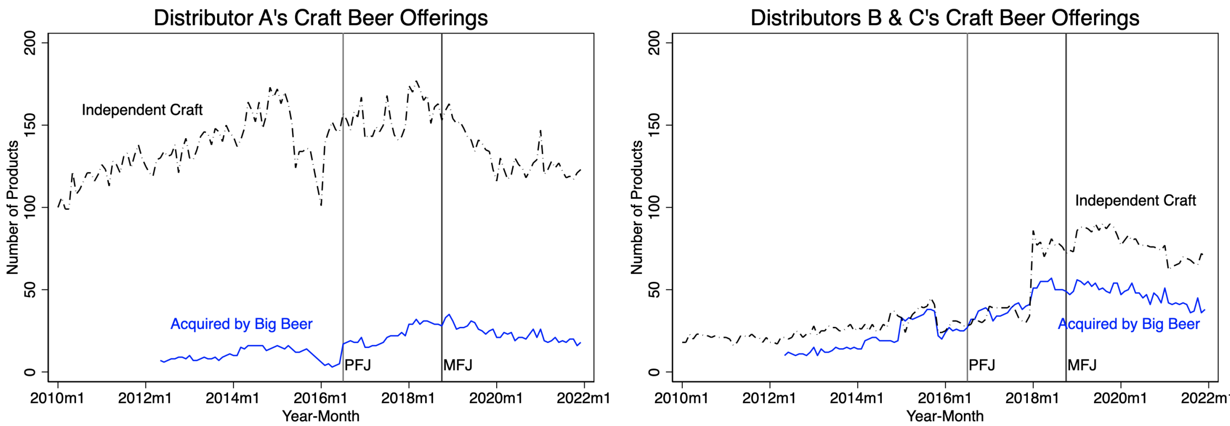


chase the beer from these retail locations, completing the journey from the manufacturer to the end consumer.

Figures 4 and 5 support the hypothesis that the incentive program provided by Big Beer had exclusionary effects prior to its prohibition by the DOJ, by presenting the changes in beer sales volume and craft beer offerings over time. Figure 4 shows the changes in Big Beer's sales volume share over time. Distributor A did not participate in Big Beer's incentive program at all, as its sales share remained consistently below the required 90 percent threshold, never exceeding 80 percent. This non-participation contrasts with Distributors B and C, who maintained higher sales shares until the DOJ's intervention discussed in Section 2. Following the PFJ and MFJ, both Distributors B and C saw their sales shares decrease below 90 percent. Notably, Distributor A's share of Big Beer sales had been declining continuously, likely influenced by the rising popularity of craft beers, even before the DOJ's ban. In contrast, the shares for Distributors B and C only began to decline following the ban, dropping below 90 percent.

Figure 5 displays the number of craft beer brands offered by Big Beer's distributors over time. The graph reveals that Distributor A consistently offered a wider array of third-party craft beers compared to Distributors B and C. This pattern is consistent with Distributor A's non-participation in Big Beer's incentive programs, as previously discussed in Figure 4. After the DOJ's enforcement, marked by the PFJ and MFJ, Distributors B

Figure 5: The Number of Craft Beer Products Offered by Big Beer's Distributors



and C notably increased their offerings of independent craft beers more than those of Big Beer's craft brands. Conversely, Distributor A's portfolio of craft beers does not show a similar increase, which suggests its non-involvement in the incentive program.

Table 1 presents the upstream and downstream market structure within three major distribution territories in Connecticut: Fairfield, New Haven, and Hartford in 2021. The percentages in parentheses next to each entity indicate the share of units that firm sold within the respective territories. Specific firm names are not disclosed and top 10 upstream firms and all downstream firms are listed based on the volume of units they handle. Note that most upstream firms operate across all distribution territories, and some downstream firms operate in multiple territories. The first 10 rows of each table specify which upstream firms are paired with which downstream distributors, and the next 3 rows show the total number of upstream firms each downstream distributor works with.

There are three key observations: First, the number of distributors is substantially fewer than the number of manufacturers. For example, Fairfield has 212 beer manufacturers, while Hartford has 148; however, each territory is served by 11 or fewer distributors. Second, in each territory, Big Beer and another leading domestic manufacturer choose different distributors for their distribution. Third, in Fairfield and New Haven, Big Beer partners with only a few competing manufacturers through the same distributor. In contrast, other leading manufacturers share their distributors with a larger group of competing upstream firms.

Table 1: Upstream and Downstream Firm Matchings (2021)

Fairfield

Upstream \ Downstream	Dist F1 (59.31)	Dist F2 (31.23)	Dist F3 (6.98)	Dist F4 (1.50)	Dist F5 (0.46)	Dist F6 (0.17)	Dist F7 (0.15)	Dist F8 (0.1)	Dist F9 (0.06)	Dist F10 (0.05)	Dist F11 (0.004)
Big Beer (33.51)		O									
Domestic (19.63)	O										
Importer (14.01)	O										
Importer (11.10)		O									
Importer (7.14)	O										
Craft (3.79)	O										
Importer (1.55)	O										
Domestic (1.36)	O										
Domestic (1.05)			O								
Craft (0.89)			O								
Domestic total	3	1	3	1	1	0	0	0	0	0	0
Importer total	14	2	22	6	0	1	0	0	7	1	1
Craft total	29	7	27	37	24	10	3	2	2	1	0

New Haven

Upstream \ Downstream	Dist N1 (39)	Dist N2 (30.21)	Dist N3 (27.69)	Dist N4 (1.54)	Dist N5 (1.12)	Dist N6 (0.19)	Dist N7 (0.14)	Dist N8 (0.09)	Dist N9 (0.01)	Dist N10 (0.01)	Dist N11 (0.01)
Big Beer (45.66)	O										
Domestic (19.90)		O	O								
Importer (6.33)	O										
Craft (5.67)		O									
Importer (4.76)			O								
Importer (4.19)			O								
Domestic (2.37)			O								
Importer (1.6)		O									
Domestic (1.32)					O						
Craft (1.17)	O										
Domestic total	1	4	3	1	0	1	0	0	0	0	0
Importer total	1	10	12	4	5	0	0	0	1	0	2
Craft total	6	13	23	31	15	15	2	1	1	1	2

Hartford

Upstream \ Downstream	Dist H1 (60.24)	Dist H2 (29.79)	Dist H3 (4.97)	Dist H4 (2.37)	Dist H5 (2.08)	Dist H6 (0.3)	Dist H7 (0.12)	Dist H8 (0.11)	Dist H9 (0.03)	Dist H10 (0.01)
Big Beer (44.98)	O									
Domestic (20)		O								
Craft (5.97)	O									
Importer (5.82)	O									
Importer (3.66)		O								
Importer (2.72)		O								
Importer (1.99)				O						
Domestic (1.67)	O									
Craft (1.3)	O									
Craft (1.21)	O									
Domestic total	1	2	2	1	1	1	0	0	0	0
Importer total	7	3	11	4	6	0	0	0	1	1
Craft total	17	12	19	2	32	17	2	1	0	0

Notes: Numbers in parentheses represent the percentage of units sold within each territory. Only the top 10 upstream firms are reported.

Table 2: Model Overview

	Stage 1	**Stage 2**	**Stage 3**	**Stage 4**	**Stage 5**
Decision Maker	Big Beer	Distributors	Manufacturers	Distributors	Consumers
Decision Variable	Reward r_{dt}	Product Offerings $\mathcal{J}_{dmt}$	Prices p^D_{jmt} Paid By Distributors	Prices p^C_{jmt} Paid By Consumers	Demand s_{jmt}

3 Oligopoly Model for Vertical Contracts

The first three subsections present an empirical model of vertical contracts between beer manufacturers and distributors, motivated by the Connecticut beer market. In the last subsection, I provide a simplified case with a limited number of firms to demonstrate the potential profitability of the reward program for Big Beer and to show that this profitability depends on model primitives. Table 2 presents an overview of the model.

3.1 Model Primitives and Timeline

The model includes two types of firms: manufacturers and distributors. Each manufacturer partners with a single distributor for a specific brand in each territory, and these partnerships are predetermined. Among these manufacturers, one holds a dominant position and is referred to as Big Beer, or BB for short. Big Beer implements a reward program for its distributors, unlike its competitors who do not engage in such practices. Big Beer provides a reward contingent on its sales volume relative to its competitors within the same distribution channel. Specifically, in period t, if Big Beer's sales volume share within distributor d's channel, x_{dt}, exceeds the threshold $\underline{x}_{dt}$ (which ranges between 0 and 1), then d receives a positive payment r_{dt}. In other words, the reward amount is r_{dt} if $x_{dt} \geq \underline{x}_{dt}$ and zero otherwise. The model follows the timeline outlined below:

1. Big Beer sets the amount of reward r_{dt} for each of its distributors.
2. Manufacturers and distributors learn the realizations of fixed cost shocks ω^F_{jmt}. Distributors then decide on the offering of craft beer $\mathcal{J}_{dmt}$ and incur the fixed costs associated with each product.
3. Manufacturers and distributors learn the realizations of demand shocks ξ_{jmt} and

marginal cost shocks ω^B_{jmt} and ω^D_{jmt}. Manufacturers then determine the wholesale prices for distributors p^D_{jmt}.

4. Each distributor sets the price paid by consumers p^C_{jmt}.
5. Consumers make choices and profits are realized.

Unlike exclusive dealing arrangements, this reward program does not require full commitment from downstream firms to receive benefits. As a result, the incentive program impacts competition on both extensive and intensive margins, affecting not only the distributor's product selection but also their pricing incentives.

In the second stage, distributors, rather than manufacturers, are responsible for choosing the product offerings. This assumption is based on the practical considerations of regional markets, where distributors are typically more attuned to local demand nuances and marketing requirements. The fixed costs in the model, associated with these offerings, are thus reflective of the distributor's marketing efforts within these regional markets. Note that distributors' decision-making is limited to craft beer offerings and the non-craft beers are assumed to be present in the market in all cases. This simplification allows for a focus on craft beer distribution strategies while reflecting the market reality where flagship domestic non-craft beers are widely accessible.

Notation: p^D_{jmt} represents the price that distributors pay to the manufacturer for product j in region m during period t and p^C_{jmt} denotes the price consumers pay to the distributor for product j in region m during period t. The marginal costs associated with brewing c^B_{jt} and distributing c^D_{jdt} each product are incurred by the respective manufacturer and distributor. f_{jmt} is the fixed cost associated with marketing product j in region m during period t. M_{mt} denotes the size for market (m, t), and s_{jmt} is the market share of product j in region m during period t. $\mathcal{J}_{dmt}$ is the set of products that distributor d offers in region m in period t. $\mathcal{J}_{dt}$ is the set of products that distributor d distributes during period t. $\mathcal{J}_{bt}$ is the set of products that manufacturer b brews in period t. $\mathcal{J}_{mt}$ is the set of products that are offered by any distributor in region m during period t. $\mathcal{J}_t$ is the set of products offered in at least one region in period t. $D_{BB,t}$ is the set of distributors affiliated with Big Beer during period t. Lastly, N_t represents the number of observations in period t.

3.2 Demand Model

Since the model is solved through backward induction, the explanation starts with the last stage, Stage 5, in the timeline introduced in Section 3.1, which corresponds to the demand-side modeling.

Stage 5: Consumer preference for beer is modeled as a nested logit framework. In this model, each consumer has the option to purchase one beer product, defined as a brand and package size pair, or to choose the outside option. The outside option can be interpreted as beers not included in the sample and non-beer alcohol products. The utility for consumer i choosing product j in a regional market m and monthly period t is expressed as:

$$u_{ijmt} = \delta_{jmt} + \bar{\epsilon}_{ijmt} \tag{1}$$

where δ_{jmt} represents the mean utility level of product j common to all consumers, and $\bar{\epsilon}_{ijmt}$ captures idiosyncratic taste shocks.

The mean utility level δ_{jmt} is modeled as:

$$\delta_{jmt} = \alpha p^C_{jmt} + F_j + F_m + F_t + \xi_{jmt} \tag{2}$$

where F_j, F_m, and F_t represent unobserved fixed effects specific to product, region, and time, respectively. Demand shock ξ_{jmt} is unobserved by researchers but observed by firms when setting prices. The mean utility for the outside good is normalized to zero (i.e., $u_{i0mt} = \varepsilon_{i0mt}$). Note that product characteristics not varying across markets are excluded due to absorption by the product fixed effects F_j.

Products are categorized into mutually exclusive and collectively exhaustive groups g: the outside good ($g = 0$), craft beers ($g = 1$), domestic non-craft beers ($g = 2$), and imported beers ($g = 3$). Following Berry (1994), Cardell (1997), and Grigolon and Verboven (2014), $\bar{\epsilon}_{ijmt}$ is formulated as:

$$\bar{\epsilon}_{ijmt} = \zeta_{igmt} + (1 - \rho)\epsilon_{ijmt}$$

where ϵ_{ijmt} is an independent and identically distributed extreme value, g denotes the group that product j belongs to, and ζ_{igmt} follows a unique distribution ensuring $\bar{\epsilon}_{ijmt}$ is also an extreme value. The nesting parameter ρ is between 0 and 1, and measures the correlation of consumer utility for products in the same group. As ρ approaches 1, consumers perceive products within the same group as close substitutes. When ρ is zero, the model reduces to the pure logit model.

The inclusive value of group g in market m is

$$I_{gmt} = \sum_{j' \in J_{gmt}} \exp\left(\frac{\delta_{j'mt}}{1-\rho}\right) \tag{3}$$

where $\mathcal{J}_{gmt}$ is the set of products in group g available in region m during period t. The inclusive value represents the mean utility of randomly selecting a product from group g.

The market share for an inside good j is then determined as:

$$s_{jmt} = \frac{\exp\left(\frac{\delta_{jmt}}{1-\rho}\right)}{I_{gmt}^{\rho}\left[\sum_{g=0}^{3} I_{gmt}^{(1-\rho)}\right]} \tag{4}$$

Multiplying this market share by the market size M_{mt} yields the demand for product j, denoted as D_{jmt}.

3.3 Supply Model

In this section, I present the objective functions from each stage of the model and, where possible, the closed-form equilibrium conditions. These are used for three purposes: (i) solving the entire model in the numerical example and the counterfactual analysis, (ii) estimating the cost structures of both upstream and downstream firms for the counterfactual analysis, and (iii) estimating the impact of the reward program.

The original reward scheme is a step function, which introduces discontinuities that make solving the model challenging. To address this, I use an approximated reward scheme to solve the model and accomplish objective (i). Since the counterfactual analysis is based on post-ban data, objective (ii) is straightforward, as the reward is set to zero, reducing the model to a standard form without the reward program. For objective (iii), I rely on the equilibrium conditions from the model with the original reward scheme because using an approximation for actual data raises concerns about accuracy. Objective (iii) only requires equilibrium conditions from Stage 4 of the model, where distributors set prices for consumers. Therefore, I present the equilibrium conditions based on the approximated reward scheme and additionally provide the conditions from the original reward scheme specifically for Stage 4.

Reward: The reward payment $\mathcal{R}_{dt}$ by Big Beer is given when the distributor is affiliated with Big Beer, during the period before the DOJ's ban, and when Big Beer's share within distributor d's portfolio exceeds a certain threshold. Therefore $\mathcal{R}_{dt}$ is specified as follows:

$$\mathcal{R}_{dt} = \begin{cases} r_{dt} 1\{x_{dt} \geq \underline{x}_{dt}\}, & \text{if } d \in D_{BB,t}, t < \text{DOJ's ban} \\ 0, & \text{otherwise} \end{cases} \tag{5}$$

where x_{dt} is calculated as: $\dfrac{\sum_{m'} \sum_{j' \in \mathcal{J}_{dm't} \cap \mathcal{J}_{BB,t}} M_{m't} s_{j'm't}}{\sum_{m'} \sum_{j' \in \mathcal{J}_{dm't}} M_{m't} s_{j'm't}}$.

For analytical simplicity, this term is approximated as $\tilde{\mathcal{R}}_{dt}$:

$$\tilde{\mathcal{R}}_{dt} = \begin{cases} \dfrac{r_{dt}}{1 + e^{-\kappa(x_{dt} - \underline{x}_{dt})}}, & \text{if } d \in D_{BB,t}, t < \text{DOJ's ban} \\ 0, & \text{otherwise} \end{cases} \tag{6}$$

where $\kappa > 0$ is the parameter for the approximation. For details regarding the approximation, see Appendix A. The approximation of the step function $r_{dt} 1\{x_{dt} \geq \underline{x}_{dt}\}$ allows direct differentiation of the optimization problems.

Stage 4: Distributor d solves the following problem to choose prices paid by consumers:

$$\max_{p^C_{jmt}} \sum_{m'} \sum_{j' \in \mathcal{J}_{dm't}} (p^C_{j'm't} - p^D_{j'm't} - c^D_{j'm't}) M_{m't} s_{j'm't} + \tilde{\mathcal{R}}_{dt} \tag{7}$$

The nested summation shows that, for each region, the distributor sets the retail prices for the product offerings selected in the second stage. Assuming a pure strategy Bertrand-

Nash equilibrium in prices, the first order conditions are, $\forall m, \forall j \in \mathcal{J}_{dmt}$,

$$M_{mt}s_{jmt} + \sum_{j' \in \mathcal{J}_{dmt}} \left[M_{mt}(p^C_{j'mt} - p^D_{j'mt} - c^D_{j'mt}) + \frac{\partial \tilde{\mathcal{R}}_{dt}}{\partial x_{dt}} \frac{\partial x_{dt}}{\partial s_{j'mt}} \right] \frac{\partial s_{j'mt}}{\partial p^C_{jmt}} = 0 \tag{8}$$

where $\frac{\partial s_{j'mt}}{\partial p^C_{jmt}}$ comes from the price derivatives under the nested logit demand system. Except for the last term in the bracket, the first order conditions (8) resemble those in typical multi-product pricing problems (e.g., Nevo, 2000; Villas-Boas, 2007). A higher price for product j raises its markup but also induces consumers to switch to substitutes. The last term in the bracket is newly introduced due to the reward offered by Big Beer, detailed as follows:

$$\frac{\partial \tilde{\mathcal{R}}_{dt}}{\partial x_{dt}} = r_{dt}\kappa \frac{e^{-\kappa(x_{dt} - \underline{x}_{dt})}}{[1 + e^{-\kappa(x_{dt} - \underline{x}_{dt})}]^2} > 0 \tag{9a}$$

$$\frac{\partial x_{dt}}{\partial s_{jmt}} = \begin{cases} M_{mt} \frac{\sum_{m'} \sum_{j' \in \mathcal{J}_{dm't} \setminus \mathcal{J}_{BB,t}} M_{m't}s_{j'm't}}{(\sum_{m'} \sum_{j' \in \mathcal{J}_{dm't}} M_{m't}s_{j'm't})^2} \geq 0, & \text{if } d \in D_{BB,t} \text{ and } j \in \mathcal{J}_{dmt} \cap \mathcal{J}_{BB,t} \\ -M_{mt} \frac{\sum_{m'} \sum_{j' \in \mathcal{J}_{dm't} \cap \mathcal{J}_{BB,t}} M_{m't}s_{j'm't}}{(\sum_{m'} \sum_{j' \in \mathcal{J}_{dm't}} M_{m't}s_{j'm't})^2} \leq 0, & \text{if } d \in D_{BB,t} \text{ and } j \in \mathcal{J}_{dmt} \setminus \mathcal{J}_{BB,t} \\ 0, & \text{if } d \notin D_{BB,t} \end{cases} \tag{9b}$$

The expressions (9a) and (9b) show that unless $\mathcal{J}_{dmt} \cap \mathcal{J}_{BB,t}$ or $\mathcal{J}_{dmt} \setminus \mathcal{J}_{BB,t}$ is empty, $\frac{\partial \tilde{\mathcal{R}}_{dt}}{\partial x_{dt}} \frac{\partial x_{dt}}{\partial s_{jmt}}$ is positive when product j belongs to Big Beer and negative when it does not. Therefore, distributor d's pricing decisions are distorted by the reward program, effectively applying a per-unit subsidy to Big Beer's products and a per-unit tax to rival products. Another interpretation is that the effective marginal cost of distributing product j is $c^D_{jmt} - \frac{\partial \tilde{\mathcal{R}}_{dt}}{\partial x_{dt}} \frac{\partial x_{dt}}{\partial s_{jmt}}$. This effective marginal cost is lower than the original marginal cost c^D_{jmt} for Big Beer products and higher for non-Big Beer products due to the reward payment.

Stage 4, original reward scheme: Distributor d solves the following problem to choose prices for consumers:

$$\max_{p^C_{jmt}} \sum_{m'} \sum_{j' \in \mathcal{J}_{dm't}} (p^C_{j'm't} - p^D_{j'm't} - c^D_{j'm't}) M_{m't}s_{j'm't} + \mathcal{R}_{dt} \tag{10}$$

It solves the problem (10) with and without the constraint $x_{dt} \geq \underline{x}_{dt}$. If the additional payoff from removing the constraint is smaller than the reward r_{dt}, d will choose to receive the reward by fulfilling the requirement $x_{dt} \geq \underline{x}_{dt}$. Since the unconstrained optimization reduces to the standard problem, I focus on the problem with the constraint. The Lagrangian of the constrained optimization problem is:

$$\mathcal{L} = \sum_{m'} \sum_{j' \in \mathcal{J}_{dm't}} (p^C_{j'm't} - p^D_{j'm't} - c^D_{j'm't}) M_{m't} s_{j'm't} + \lambda_{dt}(x_{dt} - \underline{x}_{dt}) \tag{11}$$

The Kuhn-Tucker conditions are, $\forall m, \forall j \in \mathcal{J}_{dmt}$,

$$M_{mt} s_{jmt} + \sum_{j' \in \mathcal{J}_{dmt}} \left[M_{mt}(p^C_{j'mt} - p^D_{j'mt} - c^D_{j'mt}) + \lambda_{dt} \frac{\partial x_{dt}}{\partial s_{j'mt}} \right] \frac{\partial s_{j'mt}}{\partial p^C_{jmt}} = 0 \tag{12a}$$

$$x_{dt} - \underline{x}_{dt} \geq 0 \tag{12b}$$

$$\lambda_{dt} \geq 0 \tag{12c}$$

$$\lambda_{dt}(x_{dt} - \underline{x}_{dt}) = 0 \tag{12d}$$

Notably, the condition (12) resembles the condition (8), except that $\dfrac{\partial \tilde{\mathcal{R}}_{dt}}{\partial x_{dt}}$ is replaced by the Lagrange multiplier λ_{dt}. The Lagrange multiplier λ_{dt} is the shadow price on the constraint $x_{dt} \geq \underline{x}_{dt}$. It can be interpreted as the increase in distributor d's variable profits when the constraint is relaxed by one unit.

Stage 3: Big Beer solves the following problem to choose prices paid by distributors:

$$\max_{p^D_{jmt}} \sum_{j' \in \mathcal{J}_{BB,t}} \sum_{\substack{m' \text{ s.t.} \\ j' \in \cup_{d' \in D_{BB,t}} \mathcal{J}_{d'm't}}} (p^D_{j'm't} - c^B_{j'm't}) M_{m't} s_{j'm't} - \sum_{d' \in D_{BB,t}} \mathcal{R}_{d't} \tag{13}$$

The nested summation reflects that Big Beer earns variable profits from product j' in regions where it has been made available by one of its distributors. The final component represents the total rewards paid out to the affiliated distributors. For manufacturers other than Big Beer, the optimization problem resembles (13) but with $\mathcal{R}_{dt} = 0$ for all d.

Model conditions in Stage 3 are used to estimate brewing marginal costs in 2021, and to solve the numerical example in Section 3.4 and the counterfactual analysis in Section 5. Since I do not estimate pre-ban brewing marginal costs, the model conditions for solving the original optimization problem are not presented.

The first order condition for expression (13) is, $\forall m$, $\forall j \in \mathcal{J}_{BB,t}$, $j \in \mathcal{J}_{dmt}$,

$$M_{mt}s_{jm't} + \sum_{j' \in \mathcal{J}_{BB,t}} (p^D_{j'mt} - c^B_{j'mt})M_{mt}\frac{\partial s_{j'mt}}{\partial p^D_{jmt}} - \sum_{j' \in \mathcal{J}_{dmt}} \frac{\partial \tilde{\mathcal{R}}_{dt}}{\partial x_{dt}}\frac{\partial x_{dt}}{\partial s_{j'mt}}\frac{\partial s_{j'mt}}{\partial p^D_{jmt}} = 0 \tag{14}$$

where d is the distributor that carries product j in market m, $\frac{\partial \tilde{\mathcal{R}}_{d't}}{\partial x_{d't}}$ and $\frac{\partial x_{d't}}{\partial s_{j'm't}}$ are derived as in (9a) and (9b), and $\frac{\partial s_{j'mt}}{\partial p^D_{jmt}}$ is derived as follows:

$$\frac{\partial s_{j'mt}}{\partial p^D_{jmt}} = \sum_k \frac{\partial s_{j'mt}}{\partial p^C_{kmt}}\frac{\partial p^C_{kmt}}{\partial p^D_{jmt}} \tag{15}$$

where $\frac{\partial s_{j'mt}}{\partial p^C_{kmt}}$ is derived from the standard first derivatives of the nested logit demand model, and the passthrough term $\frac{\partial p^C_{kmt}}{\partial p^D_{jmt}}$ is derived by totally differentiating the distributor's first order condition (12) (see Appendix B for details). There are two sources of distortion in Big Beer's wholesale pricing decisions. First, the final term in (14) indicates that Big Beer can reduce the reward expenses by raising wholesale prices and lowering its share in its distributors' portfolio. Second, the retail passthrough terms are distorted because distributors tend to lower the retail prices for Big Beer's products while raising the retail price for rival products. For manufacturers that are not Big Beer, the first order conditions can be obtained by ignoring the last term in (14).

Stage 2: Distributors' product choices are influenced by the expected variable profit, the reward term, and the fixed costs. Distributor d solves the following maximization problem to choose product offerings:

$$\max_{\mathcal{J}_{dmt}} E_{\xi_{mt},\omega_{mt}}\left[\sum_{m'}\sum_{j' \in \mathcal{J}_{dm't}} (p^C_{j'm't} - p^D_{j'm't} - c^D_{j'm't})M_{m't}s_{j'm't} + \mathcal{R}_{dt}\right] - \sum_{m'}\sum_{j' \in \mathcal{J}_{dm't}} f_{j'm't} \tag{16}$$

Here, the expectation is taken over the distributions of demand shocks and marginal cost shocks. The last term represents the total fixed costs incurred by distributor d for offering products. This specification assumes there are neither economies nor diseconomies of scope in these fixed costs.

Let VP_{dt} be the expected variable profit of distributor d during period t and let F_{dt} be d's total fixed cost from offering products during period t. Then

$$VP_{dt} = E_{\xi_{mt},\omega_{mt}}\left[\sum_{m'}\sum_{j'\in\mathcal{J}_{dm't}}(p^C_{j'mt} - p^D_{j'mt} - c^D_{j'm't})M_{m't}s_{j'm't} + \mathcal{R}_{dt}\right] \tag{17}$$

$$F_{dt} = \sum_{m'}\sum_{j'\in\mathcal{J}_{dm't}} f_{j'm't} = \sum_{m'}\sum_{j'\in\mathcal{J}_{dm't}} (x^F_{dmt}{}'\gamma^F + \omega^F_{j'm't}) \tag{18}$$

Per-product fixed costs f_{jmt} are modeled as linear functions of distributor-specific cost shifters x^F_{dt} and mean-zero cost shocks ω^F_{jmt}:

$$f_{jmt} = x^F_{dt}{}'\gamma^F + \omega^F_{jmt} \tag{19}$$

where x^F_{dmt} is a vector of distributor-specific indicators. Specifically, the i-th element of this vector is $1(d \text{ is distributor } i)$, and the dimension of the vector corresponds to the total number of distributors operating in market m during time t.

The necessary conditions for Nash equilibrium are used to estimate the fixed cost parameters in Section 4.4. Consider two types of single-product deviations when product j is in distributor d's portfolio: (i) If product j is offered in the market (i.e., $j \in \mathcal{J}_{mt}$), it implies that the savings in fixed costs by dropping product j is smaller than the loss in variable profits. (ii) If product j is not offered in the market (i.e., $j \notin \mathcal{J}_{mt}$), it implies that the increase in fixed costs by adding product j is larger than the gain in variable profit. The following inequalities can be constructed:

$$-\Delta VP^{-jmt}_{dt} + x^F_{dmt}{}'\gamma^F + \omega^F_{jmt} \leq 0 \text{ if } j \in \mathcal{J}_{mt} \tag{20}$$

$$\Delta VP^{+jmt}_{dt} - x^F_{dmt}{}'\gamma^F - \omega^F_{jmt} \leq 0 \text{ if } j \notin \mathcal{J}_{mt} \tag{21}$$

where ΔVP_{dt}^{-jmt} represents the change in expected variable profits when product j in region m during t is dropped, and ΔVP_{dt}^{+jmt} represents the change in expected variable profits when product j in region m during t is added.

Stage 1: Big Beer solves the following problem to determine the amount of reward:

$$\max_{r_{dt}} \sum_{j' \in \mathcal{J}_{BB,t}} \sum_{\substack{m' \text{ s.t.} \\ j' \in \cup_{d' \in D_{BB,t}} \mathcal{J}_{d'm't}}} (p^{D}_{j'm't} - c^{B}_{j'm't}) M_{m't} s_{j'm't} - \sum_{d' \in D_{BB,t}} \mathcal{R}_{d't} \tag{22}$$

Here, Big Beer takes into account that the reward influences firms' optimizing behavior in subsequent stages. The choice of r_{dt} affects not only the reward expenses, but also product offerings, wholesale prices, retail prices, and market shares. Since closed-form optimality conditions for the reward are not available, this stage does not provide model conditions for estimation or solving the model. In Sections 3.4 and 5, the optimal reward level is numerically identified by repeatedly solving the subgame.

3.4 Two Brewers and One Distributor Example

This subsection presents numerical results from a simplified version of the comprehensive model to help build intuition. This example is simplified by focusing on a single market with a limited number of firms and products. The primary goal is to explain the effects of the reward program on the downstream distributor's behavior and its profitability for the dominant brewer, providing insights into the motivations behind adopting the reward program. The model predicts that profitability depends on two key factors: the distributor's fixed costs and the dominant manufacturer's product portfolio. The results reveal the potential for vertical contract's potential to lead to the foreclosure of rival craft brewers and demonstrate how changes in upstream competition can alter vertical agreements.

Setup: The model features two upstream manufacturers, Big Beer (BB) and Small Beer (SB), and one downstream distributor (D). To concentrate on the contractual relationships between manufacturers and the distributor, the retail sector is omitted. The analysis is confined to a single market; hence, market-specific subscripts are omitted to simplify the exposition. Since this section does not aim to identify demand and cost parameters, the mean utility term, marginal costs, and fixed costs are assumed to be fully observable. Consequently, demand shocks ξ_{jmt} and cost shocks ω^B_{jt}, ω^D_{jmt}, and ω^F_{jmt} are assumed to be zero.

There are three differentiated products: a non-craft beer from Big Beer and two craft beers, one from Big Beer and one from Small Beer.[10] Big Beer's non-craft beer, referred to as product 1, is highly valued by consumers and has lower production costs compared to the other beers. Although Big Beer and Small Beer's craft beers have identical production costs, consumers perceive Small Beer's product as superior. Consumer preferences for these products are captured through a nested logit demand framework, a simplified variant of the model used in the main analysis detailed in Section 3.2. Two simplifications are made. First, the mean utility term is specified as

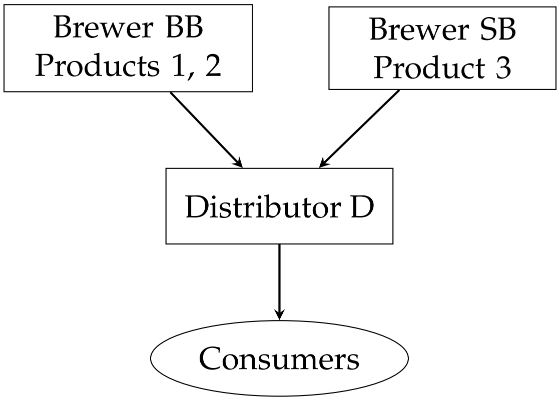
$$\delta_j = \alpha p_j + \text{quality}_j$$

where p_j is price and quality_j is quality of product j. Second, instead of four groups, there are three: the outside option, non-craft beer, and craft beer. The nesting parameter ρ, which proxies for the degree of preference correlation between beers in the same group, is set to 0.8. The price coefficient α is set to -0.1. Figure 6 details the product ownership, distribution channel, product characteristics, brewers' marginal costs, and distributors' marginal costs for each product.

Potential for Foreclosure: Figure 17 demonstrates how Big Beer's reward program can lead to foreclosure of Small Beer by comparing equilibrium product offerings under the scenario without the reward program (Figure 20a) to those with the optimal level of reward (Figure 20b). The figures show equilibrium product offerings under different levels of fixed costs for offering products 2 and 3. The labels within each region indicate which products are available in the market. In Figure 20a, which depicts the scenario without rewards, it is clear that higher fixed costs reduce the likelihood of distributor

[10] The dominant firm, Big Beer, which is not inherently a craft brewer, may own craft beer brands through the acquisition of craft breweries. The assumption is that a beer retains its "craft" designation if it was originally produced by a small brewer, even after acquisition by a larger entity, provided consumer perception remains unchanged.

Figure 6: Vertical Relationship and Product Details



Prod.	Nest	Quality	c^B	c^D
1	non-craft	0.7	7.00	1.00
2	craft	0.5	9.00	1.00
3	craft	0.6	9.00	1.00

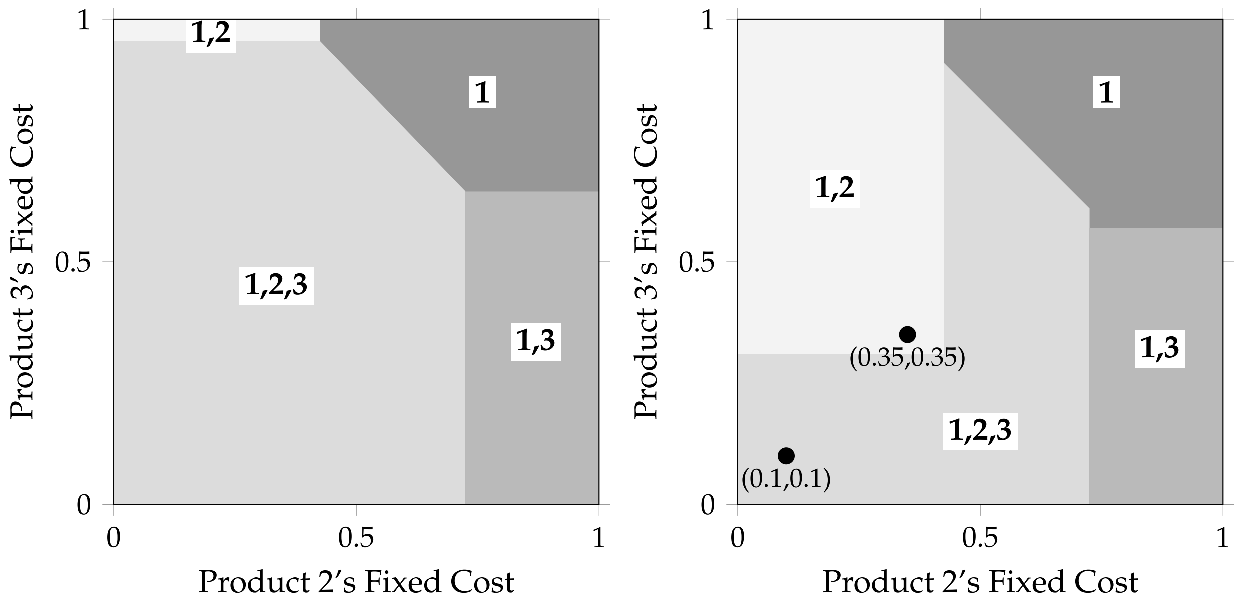
D offering the product. The asymmetry between the "1,2" and "1,3" regions reflects the consumer preference for product 3 over product 2. The distributor is more inclined to offer product 3, as it generates higher revenue. In Figure 20b, where Big Beer introduces an optimal reward r, there is an expansion in the "1,2" and "1" regions compared to Figure 20a. This suggests that the reward incentivizes the distributor to exclude product 3 from the market, potentially leading to foreclosure.

Distributor Fixed Costs and Foreclosure: In Figure 20b Distributor D continues to offer product 3 when the associated fixed costs are low, despite the presence of the reward program. However, when the fixed costs for product 3 become sufficiently high, D stops offering it. This result implies that Big Beer's reward program is more effective when the fixed costs for offering Small Beer's product are relatively high.

To explain why the effectiveness of Big Beer's reward program depends on the level of fixed costs, the payoffs for D and Big Beer in stages 2 and 1, respectively, are examined. This analysis is visualized in Figures 19 and 9, which correspond to the scenarios marked in Figure 20b. The first scenario considers a situation where the fixed costs for offering products 2 and 3 are high (with both f_2 and f_3 at 0.35), while the second scenario examines a situation with lower fixed costs (where f_2 and f_3 are both 0.1). These cases demonstrate the profitability of Big Beer's reward program under different fixed cost conditions.

In Figure 19a, when D chooses to offer "1,2" or "1", its payoff increases linearly as Big Beer raises the amount of reward r. This linear increase occurs because Big Beer fully occupies D's portfolio, effectively making the reward a fixed addition, which leaves D's

Figure 7: Equilibrium Product Offerings at Different Fixed Cost Levels



(a) No reward (r=0)

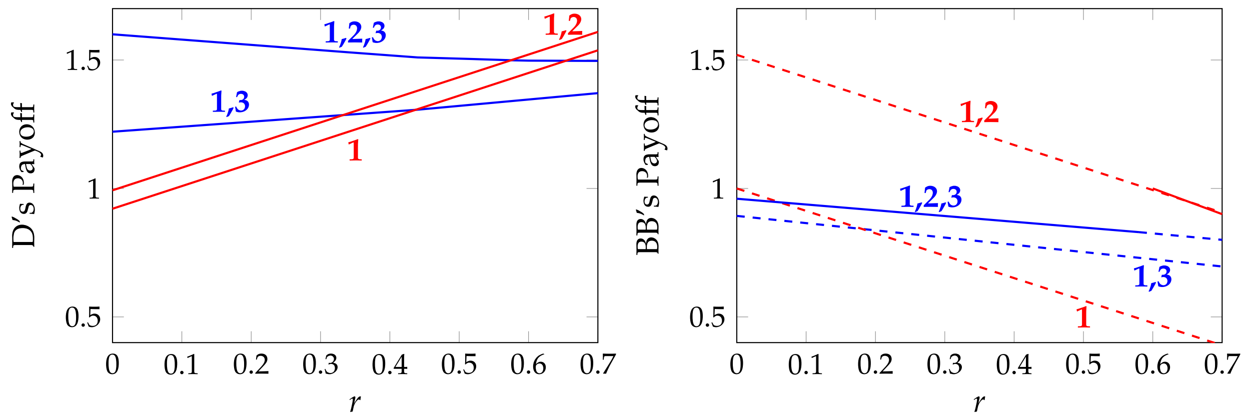
(b) Optimal r

Notes: The labels on each region indicate equilibrium product choices.

retail pricing decision unaffected by the size of the reward. In contrast, when D chooses to offer "1,2,3" or "1,3", the payoff's growth rate due to the reward is considerably slower, even turning negative in the "1,2,3" case. This happens because the reward program distorts both D's retail pricing and the upstream manufacturers' wholesale pricing, ultimately reducing D's profits. These outcomes align with the findings in the literature on common agency; when an agent serves multiple principals, conflicting incentives can generate inefficiencies (as discussed in Section V of Bernheim and Whinston, 1998, and the Appendix of Dixit, 1998).

Without Big Beer's reward, offering "1,2,3" leads to the highest payoff for distributor D. However, as the reward r increases, the differences in the payoffs across different product offerings narrow, as indicated by the converging curves. "1,2,3" remains D's preferred option until the reward r reaches 0.58. Beyond this point, offering "1,2" becomes the more profitable choice. This shift is highlighted in Figure 19b, where the segments of the curves for "1,2,3" at $r < 0.58$ and "1,2" at $r > 0.58$ are accentuated to reflect D's optimal choices at different reward levels in the second stage. The figure shows that Big Beer's optimal reward level is 0.58, as it maximizes Big Beer's profits by excluding Small

Figure 8: Stages 1 and 2 Payoffs with $f_2 = f_3 = 0.35$

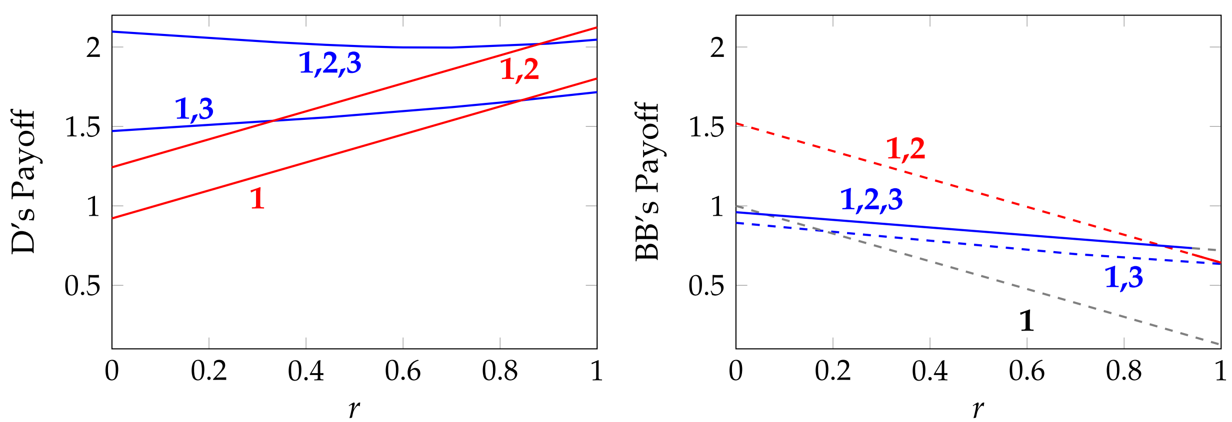


(a) Stage 2: D's Payoff

(b) Stage 1: Big Beer's Payoff

Notes: The labels on each line indicate D's product choices.

Figure 9: Stages 1 and 2 Payoffs with $f_2 = f_3 = 0.1$



(a) Stage 2: D's Payoff

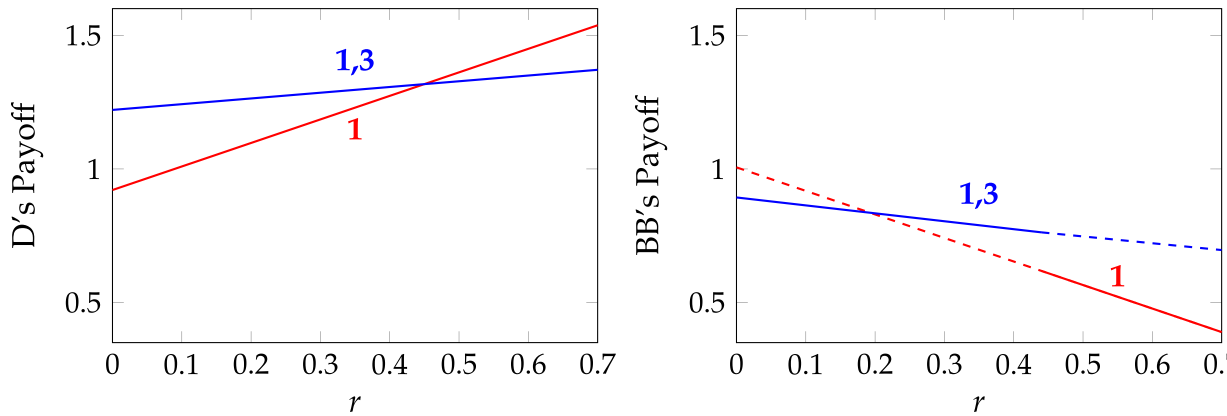
(b) Stage 1: Big Beer's Payoff

Notes: The labels on each line indicate D's product choices.

Beer. This result demonstrates that when the distributor's fixed costs are high, a positive reward is optimal for Big Beer, and the reward program leads to the foreclosure of Small Beer.

The payoff curves in Figure 9a are similar in shape to those in Figure 19a, but they are shifted upwards due to distributor D's lower fixed costs. The magnitude of this shift varies; curves representing a larger number of product offerings show a more pronounced elevation. Notably, the "1,2,3" curve shifts the most, indicating that a substantial reward (greater than 0.94) is required to induce D to eliminate Small Beer's product 3. Accordingly, as shown in Figure 9b, the cost of motivating D to foreclose Small Beer becomes

Figure 10: Stage 1 and 2 Payoffs with Absence of Product 2 and $f_2 = f_3 = 0.35$



(a) Stage 2: D's Payoff

(b) Stage 1: Big Beer's Payoff

excessively high, making it more advantageous for Big Beer not to offer any reward.

The comparison between Figures 19 and 9 shows that Big Beer's reward program is profitable when distributor D's fixed costs are high. In this scenario, Big Beer can use the reward effectively to exclude Small Beer's product 3, with an optimal reward of 0.58 maximizing profits. However, when fixed costs are low, the reward needed for foreclosure becomes prohibitively expensive (above 0.94).

Big Beer's Product Portfolio and Foreclosure: To discuss the second factor affecting the profitability of the reward program, consider a scenario where Big Beer lacks a close substitute for Small Beer's product. Specifically, Big Beer does not own product 2, which belongs to the same group (craft beer category) as Small Beer's product. Other than this change in Big Beer's product portfolio, everything else is the same as in the earlier case in Figure 19. Figure 10 is similar to Figure 19, but without the "1,2,3" and "1,2" curves. As shown in Figure 10a, distributor D would need a reward of at least 0.44 to drop Small Beer's product 3. Accordingly, the segments of the curve "1,3" for $r < 0.44$ and the curve "1" for $r > 0.44$ are highlighted to reflect D's product choices in the second stage. The figure suggests that Big Beer would be better off not offering any reward. Without a close substitute for Small Beer's product, Big Beer cannot effectively capture Small Beer's consumers, reducing the benefit of excluding Small Beer from the market. A similar implication is discussed in Appendix D, where Big Beer owns product 2 but the nesting parameter is 0.25, making it no longer a close substitute for Small Beer's product. This result indicates that a success of the reward program depends on the dominant firm's product portfolio and implies that horizontal mergers can reshape vertical relationships.

4 Estimation

In this section, I outline the estimation procedure used to identify the key parameters for the demand system, distribution and brewing marginal costs, and fixed costs of offering products. Table 3 summarizes the estimation procedure, including the estimation goals and estimation methods at each stage. The details of each step will be further explained in the subsequent subsections. The explanation begins with the last stage, as the model is solved through backward induction.

Table 3: Estimation Overview

		Stage 1	**Stage 2**	**Stage 3**	**Stage 4**	**Stage 5**
Model	*Decision Maker*	Big Beer	Distributors	Manufacturers	Distributors	Consumers
	Decision Variable	Reward r_{dt}	Product Offerings $\mathcal{J}_{dmt}$	Prices p^D_{jmt} Paid By Distributors	Prices p^C_{jmt} Paid By Consumers	Demand s_{jmt}
	Model Conditions		Necessary Nash Equilibrium Conditions	Manufacturer FOC	Distributor FOC	Nested Logit Mean Utility Equation
Estimation	*Estimation Goal*		Fixed Cost F_{dt} Parameters	Marginal Cost c^B_{jmt} Parameters	Marginal Cost c^D_{jmt} Parameters, Reward Effects λ_t	Demand Parameters α, ρ
	Estimation Method		Moment Inequalities Method	OLS	DiD	IV

4.1 Demand Estimation

Under the nested logit demand model specified in Section 3.2, the Berry (1994) inversion yields the following equation:

$$\ln(s_{jmt}) - \ln(s_{0mt}) = \alpha p_{jmt} + F_j + F_m + F_t + \rho \ln(s_{j|gmt}) + \bar{\xi}_{jmt} \tag{23}$$

where $s_{j|gmt}$ is the conditional market share of product j within group g. The linearity of this equation allows me to use a two-step least square estimator.

Instruments: due to the potential endogeneity issue stemming from the likely positive correlation between prices and within-group market share with unobserved product characteristics, instruments for both price and within-group market share are needed. To address the endogeneity of prices, a shipping cost measure is used as an instrument, following the approach of Miller and Weinberg (2017). This measure is defined as the distance from the regional market where the product is sold to the nearest brewery where the product is produced, interacted with the monthly diesel price. The brewery-market distance varies over time due to changes in diesel prices and is not absorbed by the product fixed effects, making it a valid instrument. This variable affects marginal costs, thus correlating with prices but is unlikely to correlate with unobserved product features.

To address the endogeneity of within-group market share, two instruments are utilized: the sum of shipping costs across all products within the same nest and the total number of products within the same nest in each market. The sum of shipping costs reflects variations in the marginal costs of rival products within the same nest and is likely positively correlated with within-group market share. The total number of products captures the degree of competition within the same nest and is expected to be negatively correlated with within-group market share. It is important to note that the structural error ξ_{jmt} is assumed to be realized before the pricing decision but after the product choice. Consequently, while it may be potentially correlated with price and market share, it is not correlated with the total number of products.

Results: For comparison, Table 4 reports results from logit models without nests (the first two models) alongside those from the nested logit model specified in equation (23)

Table 4: Demand Estimation Results

$\ln(s_j/s_0)$	OLS Logit Coeff.	OLS Logit SE	IV Logit Coeff.	IV Logit SE	Nested Logit Coeff.	Nested Logit SE
Price	-0.169***	0.0289	-2.286**	0.573	-0.113**	0.0266
Within-group share					0.759***	0.0662
Mean Own Price Elasticity	-2.70		-36.51		-7.36	
Domestic Non-craft	-1.75		-23.72		-4.68	
Imported	-2.59		-35.00		-6.92	
Craft	-2.79		-37.80		-7.65	
Mean Outside Diversion (%)	67.78		67.78		22.50	
Domestic Non-craft	69.77		69.77		23.30	
Imported	68.78		68.78		23.39	
Craft	67.47		67.47		22.30	
Products	218		218		218	
Regions	42		42		42	
Periods	192		192		192	
Observations	193,310		193,310		193,310	
First stage F-stat	-		38.449		172.605	

Standard errors are robust to heteroskedasticity and are clustered by regions. $*p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. Product, region, and year-month fixed effects are included in all three models.

(the last model). The primary distinction between the first two models is the use of price instruments. Product, region, and month fixed effects are included in all models but are not reported in the table. Standard errors provided are robust to heteroskedasticity and are clustered by region.

All price coefficient estimates are negative, indicating a downward-sloping demand curve. The price coefficients and mean own-price elasticities from the first two models highlight the importance of using price instruments. Since demand unobservables with positive coefficients are likely to have a positive correlation with price, the price coefficient is expected to have a positive bias if the endogeneity is not corrected. The nesting parameter estimate in the final model shows the importance of the nesting structure, which categorizes beers into craft, domestic non-craft, imported non-craft, and the outside option. The estimate is significant at 0.759, suggesting that consumers' utility is highly correlated for beers in the same group. The mean diversion to the outside option is substantially lower in the third model. The inflexibility of the first two models results in unrealistic substitution patterns where consumers predominantly substitute to the outside good, which has a large market share. Conversely, the nested logit model predicts more realistic substitutions where consumers substitute to alternative inside goods that are in the same nest.

Table 5 and Table 6 present mean price elasticities and mean diversion ratios of popular 12-pack beers. The own-price elasticities align with those reported in previous studies of the U.S. beer industry. They tend to be greater in magnitude for craft or imported beers, which typically have relatively higher prices and lower market shares. Cross-price elasticities are higher when two beers belong to the same nest, demonstrating the nested logit model's enhanced flexibility compared to standard logit models. For instance, Table 4 illustrates that a 10% price increase for the eighth product (craft beer) results in a 0.15% increase in the market share for the first product (non-craft beer) and a 4.34% increase for the seventh product (craft beer), despite the former having much larger market shares.

Diversion ratios further reveal that consumers are more likely to switch to beers within the same group when the price of a beer rises. For instance, Table 6 shows that when price of the eighth product (craft beer) is increased, the fraction of switchers choosing the first product (non-craft beer) is 0.101% while the fraction of switchers choosing the seventh product is 4.997%.

Table 5: Mean Price Elasticities of Top Sellers

		Domestic Non-Craft			Imported			Craft			
		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Domestic Non-Craft	(1)	-4.637	0.231	0.298	0.017	0.009	0.025	0.007	0.006	0.004	0.001
	(2)	0.369	-4.673	0.306	0.017	0.009	0.025	0.007	0.006	0.004	0.001
	(3)	0.370	0.235	-4.498	0.017	0.009	0.025	0.007	0.006	0.004	0.001
Imported	(4)	0.016	0.010	0.012	-5.618	0.333	1.120	0.007	0.006	0.004	0.001
	(5)	0.016	0.009	0.011	0.735	-6.279	1.041	0.007	0.007	0.004	0.001
	(6)	0.016	0.010	0.012	0.847	0.349	-5.395	0.007	0.006	0.004	0.001
Craft	(7)	0.016	0.010	0.011	0.017	0.007	0.023	-6.118	0.303	0.223	0.028
	(8)	0.015	0.009	0.011	0.016	0.007	0.022	0.434	-6.345	0.218	0.028
	(9)	0.016	0.010	0.011	0.017	0.007	0.023	0.457	0.292	-6.692	0.028
	(10)	0.019	0.012	0.009	0.013	0.000	0.014	0.530	0.236	0.246	-6.951

The cell entries i (row) and j (column) provide the percent change in the quantity of 12-pack of brand i with a 1 percent change in price of j and are calculated based on the nested logit model. Following Miller and Weinberg (2017), the last two rows compute aggregate cross-elasticities $(\sum_{i \in B, i \neq j} \frac{\partial s_i}{\partial p_j}) \frac{p_j}{\sum_{i \in B, i \neq j} s_i}$, where B is the set of craft (non-craft) beers.

Table 6: Mean Diversion Ratios of Top Sellers

	Domestic Non-Craft			Imported			Craft				
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	Mean Share
(1)		7.880	8.114	0.363	0.338	0.388	0.338	0.325	0.322	0.374	1.324
(2)	5.196		5.231	0.231	0.193	0.242	0.214	0.198	0.202	0.248	0.820
(3)	6.924	6.760		0.285	0.259	0.305	0.247	0.233	0.236	0.181	1.031
(4)	0.290	0.285	0.292		12.317	16.030	0.278	0.261	0.270	0.193	1.117
(5)	0.157	0.153	0.162	5.880		6.603	0.116	0.116	0.118	0.007	0.611
(6)	0.417	0.408	0.422	20.102	17.534		0.382	0.367	0.372	0.211	1.615
(7)	0.122	0.118	0.118	0.129	0.111	0.137		6.881	7.193	7.977	0.465
(8)	0.101	0.099	0.101	0.108	0.110	0.116	4.997		4.608	3.654	0.394
(9)	0.062	0.061	0.062	0.064	0.064	0.070	3.583	3.327		3.666	0.244
(10)	0.010	0.009	0.009	0.010	0.009	0.010	0.434	0.414	0.414		0.038
Domestic	77.681	78.347	77.868	4.355	3.953	4.551	4.240	4.110	4.137	5.359	
Imported	1.812	1.794	1.838	73.793	76.281	72.251	1.700	1.632	1.679	1.105	
Craft	1.784	1.831	1.826	1.858	2.035	2.096	75.760	76.415	76.828	77.564	
Outside	18.372	17.818	18.195	19.677	17.567	20.606	18.178	17.742	17.294	15.963	

The cell entries *i* (row) and *j* (column) provide the fraction of consumers that switch to brand *i* after an increase in price of *j*. All numbers are percentage values. The last two rows compute $\sum_{i \in B, i \neq j} D_{ij}$, where B is the set of craft (non-craft) beers and D_{ij} is the diversion ratio from product j to product i.

4.2 Estimation of Distribution Marginal Costs and Reward Effects

Distribution marginal costs and reward effects are recovered from the equilibrium conditions of the subgame where distributors make pricing decisions based on a given reward level, product offerings, and wholesale prices. In vector notation, these conditions are, $\forall m, t$,

$$\mathbf{s}_{mt} + \left(\boldsymbol{\Omega}_{mt}^{D} \odot \frac{\partial \mathbf{s}_{mt}}{\partial \mathbf{p}_{mt}^{C}}\right)\left[\mathbf{p}_{mt}^{C} - \mathbf{p}_{mt}^{D} - \mathbf{c}_{mt}^{D} + \frac{1}{M_{mt}}\boldsymbol{\lambda}_{t} \odot \frac{\partial \mathbf{x}_{t}}{\partial \mathbf{s}_{mt}}\right] = 0 \tag{24a}$$

$$\boldsymbol{\lambda}_{t} \geq 0 \tag{24b}$$

$$\boldsymbol{\lambda}_{t} \odot (\mathbf{x}_{t} - \underline{\mathbf{x}}_{t}) = 0 \tag{24c}$$

Here, bold terms represent vectors. For instance, $\mathbf{s}_{mt}$ is a vector of dimension $|\mathcal{J}_{mt}|$, where each element corresponds to the market share of a specific product. $\boldsymbol{\Omega}_{mt}^{D}$ is a $|\mathcal{J}_{mt}|$ by $|\mathcal{J}_{mt}|$ matrix where the general element $\boldsymbol{\Omega}_{mt}^{D}(i, j)$ equals to 1 when ith product and jth product are distributed by the same distributor in (m, t) and zero otherwise. $\frac{\partial \mathbf{s}_{mt}}{\partial \mathbf{p}_{mt}^{C}}$ is a $|\mathcal{J}_{mt}|$ by $|\mathcal{J}_{mt}|$ matrix where the general element $\frac{\partial \mathbf{s}_{mt}}{\partial \mathbf{p}_{mt}^{C}}(i, j)$ equals to $\frac{\partial s_{jmt}}{\partial p_{imt}^{C}}$. $\boldsymbol{\lambda}_{t}$ and $\frac{\partial \mathbf{x}_{t}}{\partial \mathbf{s}_{mt}}$ are $|\mathcal{J}_{mt}|$-dimensional vectors where ith element is λ_{dt} and (9b), respectively.

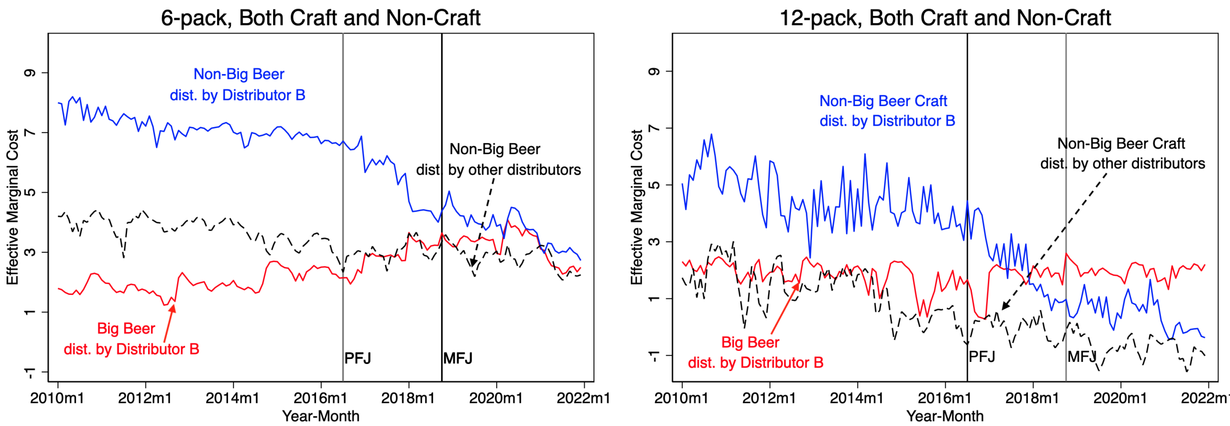
These conditions account for cases where the distributor does not participate in Big Beer's reward program, either because it does not carry Big Beer products at all or chooses not to receive the reward payment by foregoing other options. The element in $\boldsymbol{\lambda}_{t}$ is zero if $x_{dt} > \underline{x}_{dt}$ or $x_{dt} < \underline{x}_{dt}$, and positive if $x_{dt} = \underline{x}_{dt}$.

Since $\boldsymbol{\Omega}_{mt}^{D}$, M_{mt}, $\mathbf{p}_{mt}^{C}$, $\mathbf{p}_{mt}^{D}$, and s_{mt} are observable from the data, and $\frac{\partial \mathbf{s}_{mt}}{\partial \mathbf{p}_{mt}^{C}}$ can be derived from price derivatives under the specified demand system, the entire term $\mathbf{c}_{mt}^{D} - \frac{1}{M_{mt}}\boldsymbol{\lambda}_{t} \odot \frac{\partial \mathbf{x}_{t}}{\partial \mathbf{s}_{mt}}$ can be obtained by inverting the system of equations in (24a).

To separate the marginal costs of distribution $\mathbf{c}_{mt}^{D}$ from the reward effects $-\frac{1}{M_{mt}}\boldsymbol{\lambda}_{t} \odot \frac{\partial \mathbf{x}_{t}}{\partial \mathbf{s}_{mt}}$, a method similar to DiD is applied. However, unlike typical DiD applications, where treatment begins at a certain time, the "treatment" here refers to the period before the DOJ's ban. Additionally, the sign of the treatment effects varies depending on whether the product belongs to Big Beer or not.

Consider a beer product j sold in region m. The product-region pair is classified into

Figure 11: Average Effective Marginal Cost of Distributing Products



Notes: The effective distribution marginal costs are the costs after accounting for reward effects. The effective marginal costs are from products distributed in Fairfield, New Haven, and Middlesex counties. These costs are averaged using weights based on sales quantities.

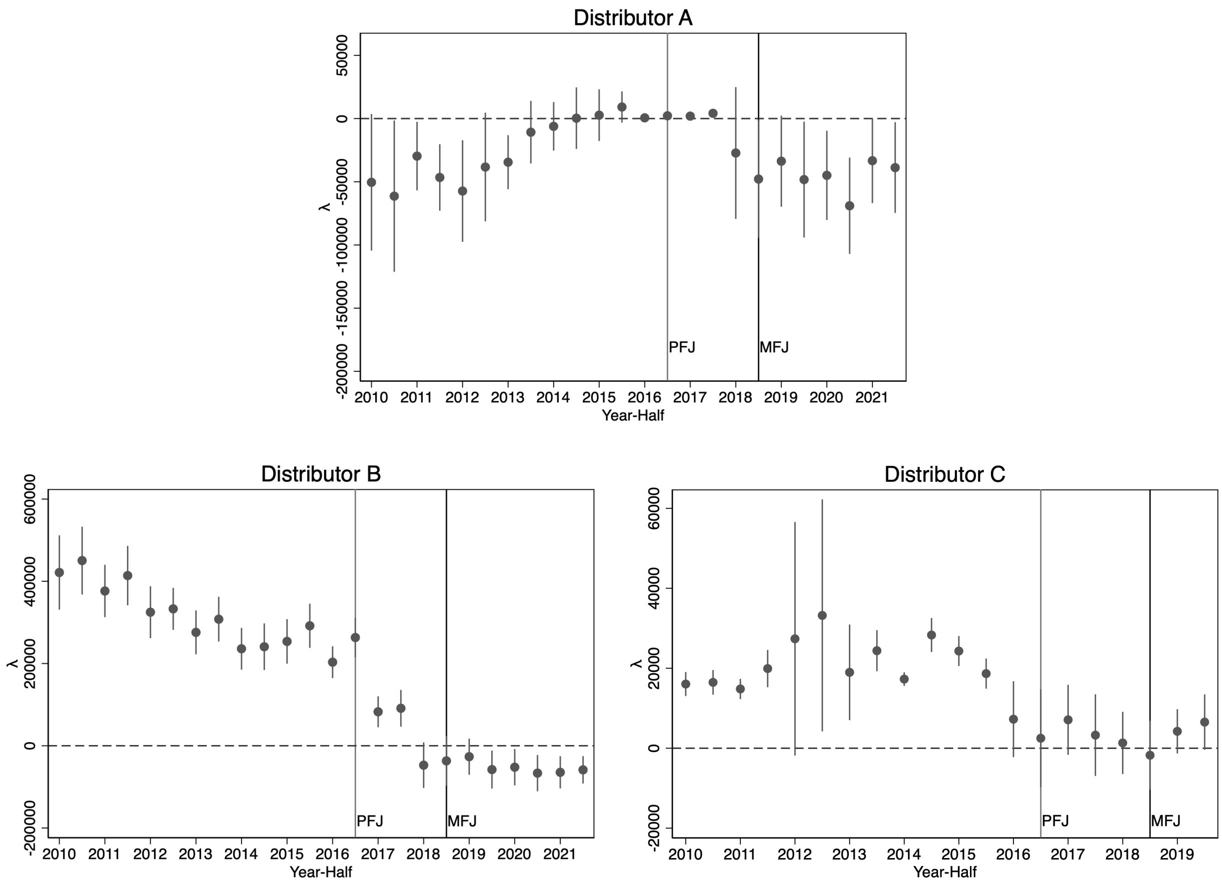
either the treatment or control group based on the following criteria: if product j is distributed by a distributor that also distributes Big Beer products in region m, or if it is brewed by Big Beer, the product-region pair (j-m) belongs to the treatment group. If the product does not share a same distributor with Big Beer in region m, the product-region pair placed in the control group. The treatment group is further divided based on the reward's impact. For products brewed by Big Beer, the reward effect $-\frac{1}{M_{mt}}\boldsymbol{\lambda}_t \odot \frac{\partial \mathbf{x}_t}{\partial \mathbf{s}_{mt}}$ is negative, as the effective marginal cost of distributing the product is reduced due to the reward payment. Conversely, for products from Big Beer's rivals, the reward effect is positive, as the reward payment increases the effective marginal cost of distributing the product.

Assuming the marginal costs for both the treatment and the control group follow a similar time trend (parallel trend assumption), the reward effects can be isolated by running the following regression:

$$p^C_{jmt} - p^D_{jmt} - \mu^D_{jmt} = \sigma^D_j + \sigma^D_m + \sigma^D_t - \lambda_{dt}\frac{1}{M_{mt}}\frac{\partial x_{dt}}{\partial s_{jmt}} + \epsilon^D_{jmt} \tag{25}$$

where μ^D_{jmt} represents the term inside the square bracket of (24a), σ^D_j is the product fixed effects, σ^D_m is the regional market fixed effects, and σ^D_t is monthly time fixed effects. Note

Figure 12: Estimated λ_{dt} for Big Beer's Distributors



that $\frac{1}{M_{mt}}\frac{\partial x_{dt}}{\partial s_{jmt}}$ is observed from the data, while λ_{dt} is not and needs to be estimated. The λ_{dt} is estimated for each half of the year because Big Beer's actual reward program evaluated distributors' performance and made payments biannually.

Figure 11 presents the effective marginal costs of distributing products, which is the sum of distribution marginal costs and reward effects calculated using conditions (24a). When Big Beer's distributor does not participate in the reward program ($x_{dt} < \underline{x}_{dt}$) or when the reward condition is not binding ($x_{dt} > \underline{x}_{dt}$), λ_{dt} is zero, meaning there is no reward effect. However, when the reward program is active and the condition is binding ($x_{dt} = \underline{x}_{dt}$), λ_{dt} becomes positive. In this case, the reward reduces the effective marginal costs of distributing Big Beer products but increases the effective marginal costs of distributing non-Big Beer products. As expected, the gap between these two narrows when the reward program is banned.

Figure 12 presents the estimation results for the Lagrange multiplier λ_{dt} for Big Beer's distributors. These values are estimated for each half of the year for three distributors, as Big Beer's actual reward program evaluated each distributor's performance and made payments biannually. For Distributors B and C, which appeared to have participated in the reward program, the estimated λ_{dt} values are positive and significant prior to the ban, as expected. This indicates that the conditions for receiving the reward were binding, and relaxing the conditions (i.e., lowering the sales volume share thresholds) by one unit would increase their profits. In contrast, Distributor A's λ_{dt} is mostly insignificant, suggesting that Distributor A did not participate in the program, as discussed in Section 2.

4.3 Estimation of Brewing Marginal Costs

Brewing marginal costs are recovered from the equilibrium conditions in Stage 3, where manufacturers set prices for distributors. These marginal costs are estimated for the counterfactual analysis. Since the counterfactual analysis focuses on markets after the DOJ's ban, the reward amount is set to zero, reducing the model to a standard double marginalization framework. In vector notation, the manufacturers' post-ban first order conditions are:

$$\Omega_{jt} \odot \mathbf{s}_t + (\Omega_{bt} \odot \frac{\partial \mathbf{s}_t}{\partial \mathbf{p}_t^D}) \left[\mathbf{p}_t^D - \mathbf{c}_t^B \right] = 0 \tag{26}$$

The bold terms represent vectorized versions of the original terms. For instance, $\mathbf{s}_t$ is a vector of dimension N_t, with each element corresponds to the market share of a specific product in a specific region. Ω_{jt} is a $|\mathcal{J}_t|$ by N_t matrix where the general element $\Omega_{jt}(i,j)$ equals one when ith product and jth product are the same. Ω_{bt} is a $|\mathcal{J}_t|$ by N_t matrix where the general element $\Omega_{bt}(i,j)$ equals one when ith product and jth product are produced by the same brewer. $\Omega_{BB,dt}$ is a $|\mathcal{J}_t|$ by N_t matrix where the general element $\Omega_{BB,dt}(i,j)$ equals one when ith product is produced by Big Beer and jth product is distributed by distributor d.

Inserting the estimated distribution marginal costs into the manufacturers' first order conditions allows for the calculation of brewing marginal costs c_t^B. I regress c_t^B on product, regional market, and monthly time fixed effects:

$$p^D_{jmt} - \mu^B_{jmt} = \sigma^B_j + \sigma^B_m + \sigma^B_t + \epsilon^B_{jmt} \tag{27}$$

where μ^B_{jmt} represents the term inside the square bracket of (26), σ^B_j is the product fixed effects, σ^B_m is the regional market fixed effects, and σ^B_t is monthly time fixed effects.

4.4 Estimation of Distributors' Fixed Costs

I estimate the distributors' fixed costs of offering products using the estimates of demand, and the marginal costs of each manufacturer and distributor in each market. The fixed costs are estimated for 2021, following the DOJ's ban, and these estimates are used in the counterfactual analysis.

Following Pakes, Porter, Ho, and Ishii (2015), the necessary conditions for Nash equilibrium (29) and (28) are used to construct inequalities that identify bounds on the fixed cost parameters:

$$-\Delta VP^{-jmt}_{dt} + x^F_{dmt}{}'\gamma^F + \omega^F_{jmt} \leq 0 \text{ if } j \in \mathcal{J}_{mt} \tag{28}$$

$$\Delta VP^{+jmt}_{dt} - x^F_{dmt}{}'\gamma^F - \omega^F_{jmt} \leq 0 \text{ if } j \notin \mathcal{J}_{mt} \tag{29}$$

The first set of inequalities (28) establishes upper bounds on fixed costs, while the second set of inequalities (29) establishes lower bounds. It is important to note that the conditional expectations of the fixed cost shocks $E(\omega^F_{jmt}|j \in \mathcal{J}_{mt})$ and $E(\omega^F_{jmt}|j \notin \mathcal{J}_{mt})$ may not be zero. Consequently, taking the conditional expectation of equations (28) and (29) could introduce selection bias. Therefore, following Eizenberg (2014), it is assumed that fixed costs have bounded supports. This approach allows for the derivation of two-sided bounds in cases where previously only one-sided bounds were available. The resulting inequalities are:

$$L_{jmt} \leq x^F_{dmt}{}'\gamma^F + \omega^F_{jmt} \leq U_{jmt} \tag{30}$$

Table 7: Fixed Cost Estimation Results (2021)

	95% Confidence Interval	
	Lower Bound	Upper Bound
Distributor A	45.243	97.018
Distributor B	51.602	143.314
Distributor C	42.269	124.645
Distributor D-1	139.306	253.843
Distributor D-2	30.932	92.935
Distributor E	71.979	108.555
Distributor F	43.419	134.434
Distributor G	89.820	192.332
Distributor H	38.602	82.683

where

$$L_{jmt} = \begin{cases} \Delta VP_{dt}^{+jmt} & j \notin \mathcal{J}_{mt} \\ \underline{F}_{dmt} & j \in \mathcal{J}_{mt} \end{cases} \qquad U_{jmt} = \begin{cases} \bar{F}_{dmt} & j \notin \mathcal{J}_{mt} \\ \Delta VP_{dt}^{-jmt} & j \in \mathcal{J}_{mt} \end{cases}$$

and $[\underline{F}_{dmt}, \bar{F}_{dmt}]$ is the support determined by the extreme values of ΔVP_{dt}^{+jmt} and ΔVP_{dt}^{-jmt}. Taking the unconditional expectations of (30) yields:

$$E(L_{jmt}) \leq x_{dmt}^{F}{}'\gamma^{F} \leq E(U_{jmt}) \tag{31}$$

Since the support of f_{fM} consists finite points, the generalized moment selection method of Andrews and Soares (2010) is implemented for the inference procedure. Table 7 presents the 95 percent confidence interval for the fixed costs of offering a 12-ounce, 12-pack equivalent size of craft beer to a regional market (retailer-county pair) during a month in 2021. The results show variability in fixed costs across distributors, which may stem from differences in the market environments they serve or variations in distributor efficiency. Distributors D-1 and D-2 belong to the same company, with D-2 being a branch operating exclusively in Litchfield, the county with the lowest population density in Connecticut. Assuming that D-1 and D-2 share the same resources and technology, D-2's lower fixed cost bound suggests that distributors in regions with larger market sizes generally face higher fixed costs. This observation aligns with Fan and Yang (2024), who also find higher fixed costs in larger markets.

5 Counterfactual Analysis

The counterfactual analysis aims to show that standard merger analysis, which considers only unilateral price effects, may understate the anticompetitive impact of a dominant manufacturer acquiring craft beer manufacturers. The analysis focuses on a medium-sized retailer in Fairfield during one month in 2021 and considers a merger in which Big Beer acquires an independent craft manufacturer. This independent craft manufacturer is not a real firm but an imagined entity that owns brands from five craft breweries actually acquired by Big Beer. To compute equilibria in counterfactual scenarios, I use demand system and cost structure estimated in Section 4, based on the actual ownership structure and vertical contracts. This merger case is evaluated using three approaches: (1) the Standard approach, which considers only the price effects from market concentration, (2) the Fixed Vertical Contract approach, which accounts for the vertical structure but fixes the vertical contract, and (3) the Endogenous Vertical Contract approach, which accounts for changes in vertical contracts after the merger.

(1) Standard: This method follows the traditional merger analysis methodology (e.g., Nevo, 2000), which does not consider vertical structures and captures only unilateral price effects. In this approach, I assume that upstream manufacturers set retail prices and sell products directly to consumers. The manufacturers' marginal costs are the sum of previously estimated brewing and distribution marginal costs. Using the estimated demand system and cost structure, the Nash-Bertrand pricing equilibrium is calculated for both the pre- and post-merger ownership structures.

(2) Fixed Vertical Contract: This approach takes into account the vertical structure and Big Beer's reward program described in Section 3, but assumes that Big Beer cannot modify the vertical contract after merger. In other words, once the reward level is determined in the pre-merger setting, it remains fixed after the merger. This approach corresponds to a scenario where the regulator permits the merger on the condition that the vertical contract remains unchanged.

(3) Endogenous Vertical Contract: This approach also accounts for the vertical structure but assumes that Big beer optimizes its reward program to maximize profits. By

Table 8: Post-Merger Welfare Change

Approach	Total	Consumer	All Firms	Upstream	Downstream	Big Beer	BB's Dist.
Standard	-119.15	-307.37	188.22	.	.	12,957.51	.
Fixed VC	-1,801.21	-1,561.13	-240.08	-674.55	434.47	6,293.99	6,072.10
Endog. VC	-2,958.07	-2,209.46	-748.61	985.38	-1,733.99	7,228.02	4,004.67

Notes: The table shows the welfare changes in total, for consumers, for all firms (including both upstream and downstream firms), and separately for upstream and downstream firms, after the merger. The units are in U.S. dollars. The increase in Big Beer's payoff by 12,957.51 in the first row is substantial because it reflects the shift of ownership from the acquired firms to Big Beer.

setting Big Beer's profits as the objective function, I numerically identify the pre- and post-merger optimal reward level by repeatedly solving for the equilibrium product offerings and prices.

The results underscore the importance of considering vertical relationships in merger evaluations to accurately assess anticompetitive effects on consumer welfare. Table 8 presents the changes in consumer welfare and profits after the merger, based on three approaches. If the standard merger evaluation approach is used, consumer welfare would decrease by only 307 dollars in this market over a month, while the consumer welfare loss is much larger when the fixed vertical contract approach is applied. This difference is due to increased market concentration in the downstream market, as Big Beer's distributor (which is a dominant firm) owns the acquired products after the merger. The comparison between the fixed vertical contract approach and the endogenous vertical contract approach demonstrates the importance of Big Beer's endogenous choice of vertical contracts. Accounting for changes in vertical contracts results in a 42 percent greater consumer welfare loss after the merger.

The additional anticompetitive effects of the merger identified from the endogenous vertical contract approach (3) stem from the intensified foreclosure effects of vertical contracts. To explain this, I compare the unilateral price effects (captured by both standard and endogenous vertical contract approaches) with the vertical foreclosure effects (captured only by the endogenous vertical contract approach). The comparison relies on diversion ratios, a key statistic in merger analysis. The first column in Table 9 explains why the unilateral price effects in this merger are limited. The fraction of consumers switching from the target's product to Big Beer's product is small. As we can see from the Up-

Table 9: Average Diversion Ratios

	Unilateral Price Effect	Vertical Foreclosure Effect	
From / To	Target	Pre-Merger: Third-Party Craft	Post-Merger: Third-Party Craft
Big Beer	10.37%	9.92%	58.00%
Non-Big Beer	67.93%	69.42%	20.98%
Outside Good	21.59%	20.65%	20.99%

Notes: Each cell shows the average fraction of consumers who switch to one of brands in row i after an increase in the price of a brand in column j. For example, the first cell indicates that, on average, 10.37 percent of consumers switch to Big Beer's products when the price of one of Target's products rises.

ward Pricing Pressure measure, unilateral price effects arise because the merging firms internalize substitution between their commonly owned products. Therefore, the low diversion ratio between the target's products and the acquirer's (Big Beer's) products indicates weak unilateral price effects in this merger. The last two columns in Table 9 shows a different mechanism of anticompetitive merger effects: foreclosure due to vertical contracts. The diversion ratios from third-party competitors to Big Beer imply the expected gains Big Beer can achieve by raising their prices or forcing them out. The increase in this ratio from 9.92 percent to 58 percent indicates that Big Beer's exclusionary reward program becomes more profitable post-merger.

Next, I explain the effect of reward program on firms' pricing and product offering decisions, and the change in profitability of the reward program for Big Beer after the merger. Figures 13 illustrate how distributors and manufacturers adjust their markups under different reward levels. As the reward level increases, Big Beer's distributor lowers the distribution markups for Big Beer's products (circles in the first graph) and raises the distribution markups for non-Big Beer products (diamonds in the first graph) to receive rewards. In contrast, Big Beer increases the brewing markups (circles in the second graph) to mitigate the costs associated with the reward program. The price distortions resulting from changes in markups affect product offerings by altering the profitability of each product. Figures 14 show that Big Beer's distributor drops non-Big Beer products (diamonds in the first and second graphs) when the reward amount reaches a sufficient level.

Figure 13: Change in Markups Due to Reward Program

(a) Distributors (b) Manufacturers

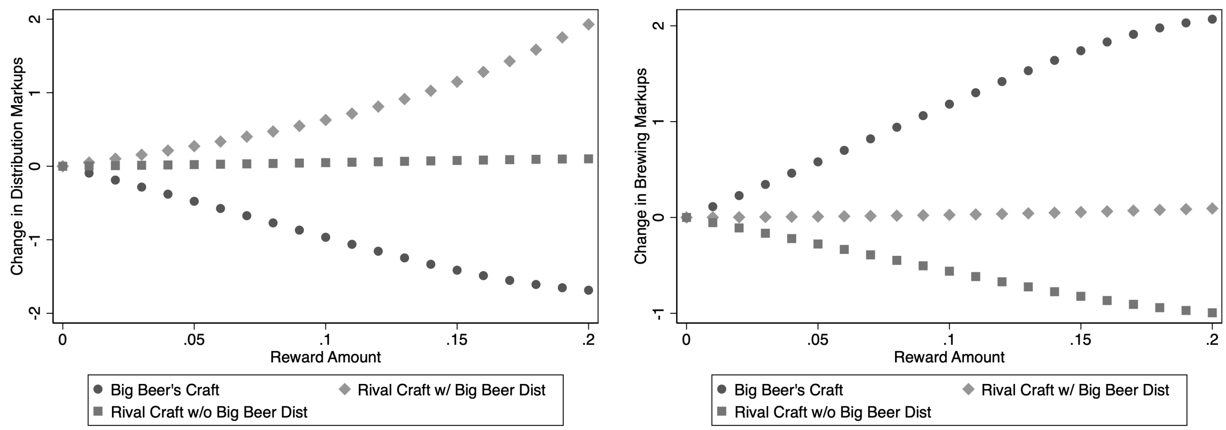
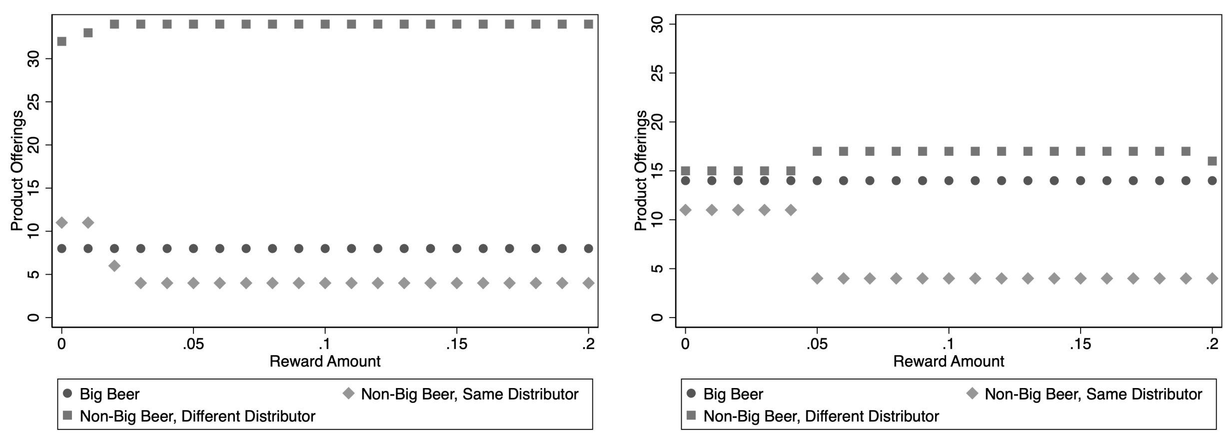


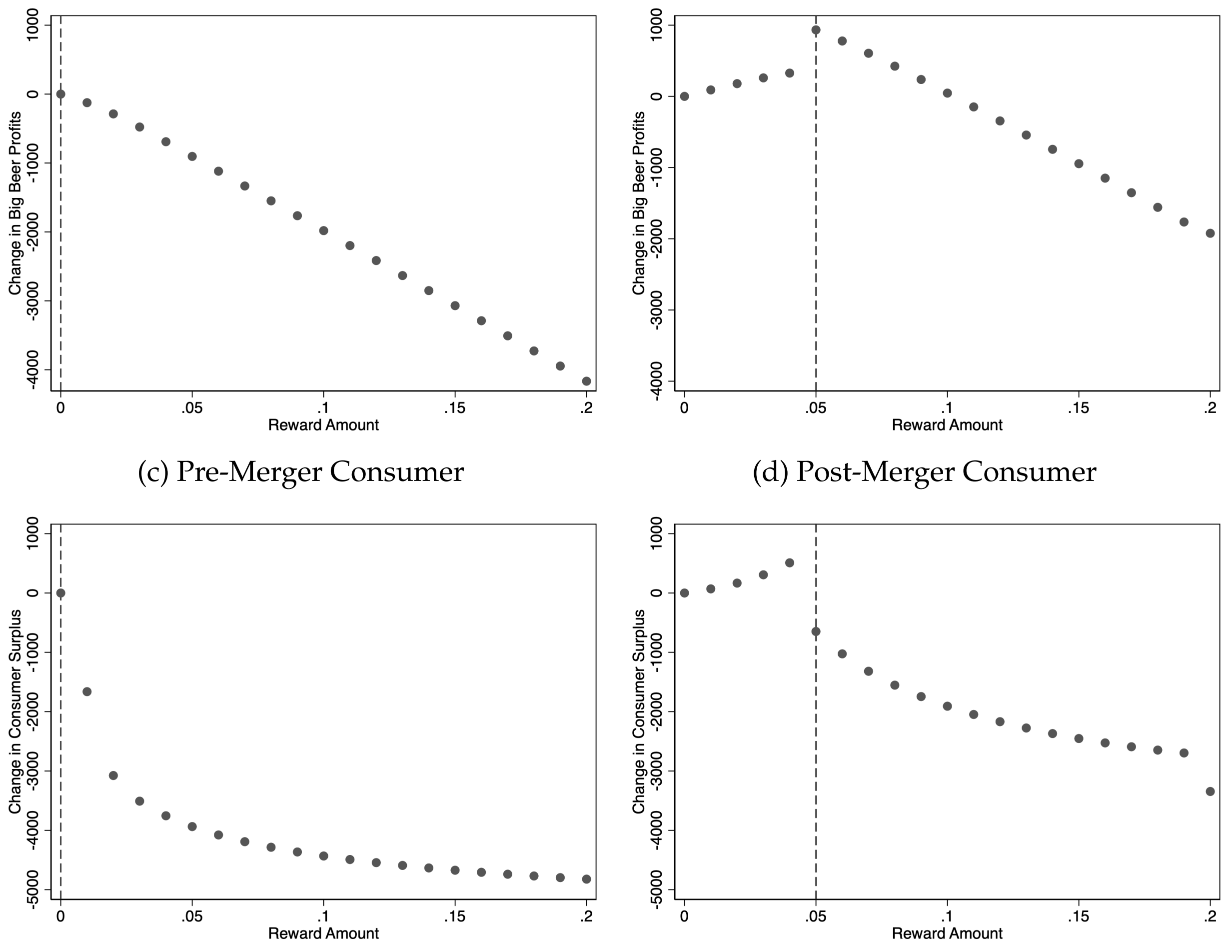
Figure 14: Craft Beer Offerings at Different Reward Levels, Pre- and Post-Merger

(a) Pre-merger (b) Post-merger



Figures 15 illustrate how Big Beer's gains from the reward program change after the merger, and the reward program's anticompetitive effects on consumer welfare. The first two figures (a) and (b) show that before the merger, it is optimal for Big Beer to offer no reward. However, after the merger, it becomes optimal to offer a reward of 0.05. This shift occurs because Big Beer has more close substitutes to its rivals' products after acquiring craft products and expanding its portfolio. As a result, Big Beer's gain from the reward program increase, as it becomes more effective at capturing consumers from excluded rivals. Thus, the merger can turn a previously unprofitable exclusionary reward program into a profitable one for Big Beer. The next two figures (c) and (d) show the reward program's anticompetitive effects. Before the merger, since no reward is offered, there is no additional anticompetitive effect. However, after the merger, the reward offered by Big Beer reduces product variety and generates anticompetitive effects that negatively impact consumer welfare.

Figure 15: Changes in Payoffs at Different Reward Levels, Pre- and Post-Merger



(a) Pre-Merger Big Beer

(b) Post-Merger Big Beer

(c) Pre-Merger Consumer

(d) Post-Merger Consumer

6 Conclusion

This study has explored the motivations behind exclusionary vertical contracts by examining their interplay with upstream market structure in the Connecticut's beer market. The findings suggest that a dominant upstream firm's reward program can exclude rival firms, with its success largely depending on the firm's product portfolio. The counterfactual analysis highlights the importance of considering vertical relationships when evaluating horizontal mergers, as mergers can strengthen a dominant firm's incentives to foreclose competitors by expanding its product portfolio.

These insights are vital for policymakers and antitrust regulators working to preserve competitive market structures. When there is a risk of increased motivation to implement exclusionary practices, regulators may want to closely monitor firms or implement additional policies governing vertical contracts. Otherwise, they would want firms to provide further evidence of efficiencies to gain approval for mergers.

References

Abito, J. M., & Wright, J. (2008). Exclusive dealing with imperfect downstream competition. *International Journal of Industrial Organization*, *26*(1), 227–246.

Andrews, D. W., & Soares, G. (2010). Inference for parameters defined by moment inequalities using generalized moment selection. *Econometrica*, *78*(1), 119–157.

Asker, J. (2016). Diagnosing foreclosure due to exclusive dealing. *The Journal of Industrial Economics*, *64*(3), 375–410.

Asker, J., & Bar-Isaac, H. (2014). Raising retailers' profits: On vertical practices and the exclusion of rivals. *American Economic Review*, *104*(2), 672–686.

Bernheim, B. D., & Whinston, M. D. (1998). Exclusive dealing. *Journal of political Economy*, *106*(1), 64–103.

Berry, S. T. (1994). Estimating discrete-choice models of product differentiation. *The RAND Journal of Economics*, 242–262.

Bork, R. H. (1978). *The antitrust paradox: A policy at war with itself*. Basic Books.

Brewers Association. (2023). National beer sales & production data. *The New Brewer*, *May/June 2023*. https://www.brewersassociation.org/the-new-brewer/

Burgdorf, J. (2019). Impact of mandated exclusive territories in the us brewing industry: Evidence from scanner level data. *International Journal of Industrial Organization*, *63*, 376–416.

Cardell, N. S. (1997). Variance components structures for the extreme-value and logistic distributions with application to models of heterogeneity. *Econometric Theory*, *13*(2), 185–213.

Chen, C.-W. (2014). Estimating the foreclosure effect of exclusive dealing: Evidence from the entry of specialty beer producers. *International journal of industrial organization*, *37*, 47–64.

Chen, C.-W., & Shieh, S. (2016). Does exclusive dealing matter? evidence from distribution contract changes in the us beer industry. *The Journal of Industrial Economics*, *64*(3), 411–435.

Conlon, C., & Mortimer, J. H. (2021). Efficiency and foreclosure effects of vertical rebates: Empirical evidence. *Journal of Political Economy*, *129*(12), 3357–3404.

Conlon, C., & Rao, N. L. (2023). *The cost of curbing externalities with market power: Alcohol regulations and tax alternatives* (tech. rep.). National Bureau of Economic Research.

Connecticut fine wine & spirits v. harris, 255 f. supp. 3d 355. (2017).

Dafny, L., Ho, K., & Lee, R. S. (2019). The price effects of cross-market mergers: Theory and evidence from the hospital industry. *The RAND Journal of Economics*, *50*(2), 286–325.

Dixit, A. K. (1998). *The making of economic policy: A transaction-cost politics perspective*. MIT press.

Eizenberg, A. (2014). Upstream innovation and product variety in the us home pc market. *Review of Economic Studies*, *81*(3), 1003–1045.

Fan, Y., & Yang, C. (2024). *Estimating discrete games with many firms and many decisions: An application to merger and product variety* (tech. rep.). National Bureau of Economic Research.

Fumagalli, C., & Motta, M. (2006). Exclusive dealing and entry, when buyers compete. *American Economic Review*, *96*(3), 785–795.

Genchev, B., & Mortimer, J. H. (2016). Empirical evidence on conditional pricing practices.

Gowrisankaran, G., Nevo, A., & Town, R. (2015). Mergers when prices are negotiated: Evidence from the hospital industry. *American Economic Review*, *105*(1), 172–203.

Grigolon, L., & Verboven, F. (2014). Nested logit or random coefficients logit? a comparison of alternative discrete choice models of product differentiation. *Review of Economics and Statistics*, *96*(5), 916–935.

Hausman, J., Leonard, G., & Zona, J. D. (1994). Competitive analysis with differenciated products. *Annales d'Economie et de Statistique*, 159–180.

Ho, K., & Lee, R. S. (2017). Insurer competition in health care markets. *Econometrica*, *85*(2), 379–417.

Ho, K., Ho, J., & Mortimer, J. H. (2012). The use of full-line forcing contracts in the video rental industry. *American Economic Review*, *102*(2), 686–719.

Mathewson, G. F., & Winter, R. A. (1987). The competitive effects of vertical agreements: Comment. *The American Economic Review*, *77*(5), 1057–1062.

Miller, N. H., Sheu, G., & Weinberg, M. C. (2021). Oligopolistic price leadership and mergers: The united states beer industry. *American Economic Review*, *111*(10), 3123–3159.

Miller, N. H., & Weinberg, M. C. (2017). Understanding the price effects of the millercoors joint venture. *Econometrica*, *85*(6), 1763–1791.

Nevo, A. (2000). Mergers with differentiated products: The case of the ready-to-eat cereal industry. *The RAND Journal of Economics*, 395–421.

Pakes, A., Porter, J., Ho, K., & Ishii, J. (2015). Moment inequalities and their application. *Econometrica*, *83*(1), 315–334.

Posner, R. A. (1976). Antitrust law: An economic perspective. *University of Chicago Press*.

Rasmusen, E. B., Ramseyer, J. M., & Wiley Jr, J. S. (1991). Naked exclusion. *The American Economic Review*, 1137–1145.

Sass, T. R. (2005). The competitive effects of exclusive dealing: Evidence from the us beer industry. *international Journal of industrial Organization*, *23*(3-4), 203–225.

Sass, T. R., & Saurman, D. S. (1993). Mandated exclusive territories and economic efficiency: An empirical analysis of the malt-beverage industry. *The Journal of Law and Economics*, *36*(1, Part 1), 153–177.

Scott-Morton, F. (2012). Contracts that reference rivals. *Antitrust*, *27*, 72.

Segal, I. R., & Whinston, M. D. (2000). Naked exclusion: Comment. *American Economic Review*, *91*(1), 296–309.

U.S. Department of the Treasury. (2022). *Competition in the markets for beer, wine, and spirits* (tech. rep.). U.S. Department of the Treasury. https://home.treasury.gov/system/files/136/Competition-Report.pdf

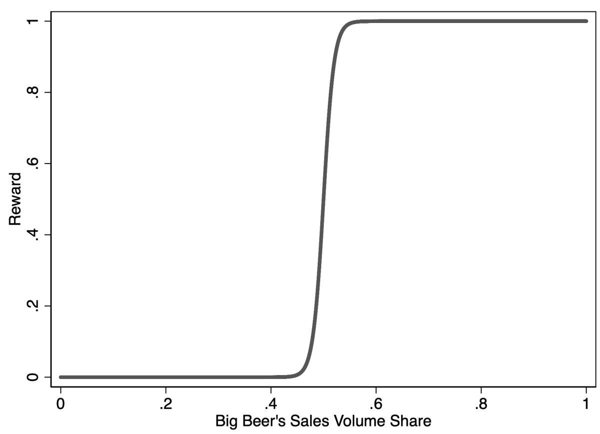
Villas-Boas, S. B. (2007). Vertical relationships between manufacturers and retailers: Inference with limited data. *The Review of Economic Studies*, *74*(2), 625–652.

Appendices

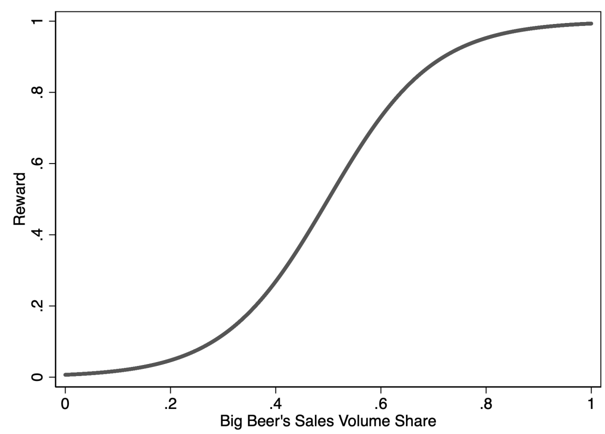
A Approximating Step Functions

Suppose that x is Big Beer's sales volume fraction within its distributor's portfolio, $\underline{x}$ is a threshold (which is between 0 and 1), and r is the amount of reward. The actual reward scheme is a step function, such as $s(x) = r \cdot 1\{x \geq \underline{x}\}$. Its discontinuity makes the analysis complicated (e.g., deriving first-order conditions for pricing stages and ensuring the existence of a pure strategy equilibrium). Therefore, a logistic function $l(x) = \dfrac{r}{1+e^{-\kappa(x-\underline{x})}}$ is used for a smooth approximation to the step function $s(x)$. The following figures show how the approximation parameter κ affects the shape of the logistic function.

Figure 16: Logistic Approximations



(a) r=1, $\underline{x} = 0.5, \kappa = 100$



(b) r=1, $\underline{x} = 0.5, \kappa = 10$

B Passthrough Terms

For a particular product f, suppose that we need to obtain the passthrough term $\dfrac{\partial p^C_{kmt}}{\partial p^D_{ft}}$ for $k \in \cup_{d'} \mathcal{J}_{d'mt}$. This term is derived from distributors' first-order conditions in stage 4:

$$s_{jmt} + \sum_{j' \in \mathcal{J}_{dmt}} \left[p^C_{j'mt} - p^D_{j't} - c^D_{j'mt} + \frac{1}{M_{mt}} \frac{\partial \tilde{\mathcal{R}}_{dt}}{\partial x_{dt}} \frac{\partial x_{dt}}{\partial s_{j'mt}} \right] \frac{\partial s_{j'mt}}{\partial p^C_{jmt}} = 0$$

Let Ω_{dmt} be a matrix of ownership for the distributors. The element (i, j) of Ω_{dmt}

is equal to 1 if the distributor d distributes both i and j in region m in period t, and is otherwise equal to zero. With variation dp^D_{ft}, the total differential of distributors' first-order conditions is

$$\sum_{k\in\mathcal{J}_{mt}}\left[\frac{\partial s_{jmt}}{\partial p^C_{kmt}}+\sum_{j'\in\mathcal{J}_{dmt}}\Omega_{dmt}(j',j)\frac{\partial^2 s_{j'mt}}{\partial p^C_{jmt}\partial p^C_{kmt}}\left(p^C_{j'mt}-p^D_{j'mt}-c^D_{j'mt}+\frac{1}{M_{mt}}\frac{\partial\tilde{\mathcal{R}}_{dt}}{\partial s_{j'mt}}\right)\right.$$
$$\left.+\Omega_{dmt}(k,j)\frac{\partial s_{kmt}}{\partial p^C_{jmt}}+\sum_{j''\in\mathcal{J}_{mt}}\sum_{j'\in\mathcal{J}_{dmt}}\Omega_{dmt}(j',j)\frac{1}{M_{mt}}\frac{\partial^2\tilde{\mathcal{R}}_{dt}}{\partial s_{j'mt}\partial s_{j''mt}}\frac{\partial s_{j''mt}}{\partial p^C_{kmt}}\frac{\partial s_{j'mt}}{\partial p^C_{jmt}}\right]dp^C_{kmt}$$
$$-\Omega_{dmt}(f,j)\frac{\partial s_{fmt}}{\partial p^C_{jmt}}dp^D_{ft}=0 \tag{32}$$

B.1 Pre-ban

If period t falls before the DOJ's ban on the incentive program, then $\frac{\partial\tilde{\mathcal{R}}_{dt}}{\partial s_{jmt}}$ and $\frac{\partial^2\tilde{\mathcal{R}}_{dt}}{\partial s_{amt}\partial s_{bmt}}$ can be calculated as follows:

$$\frac{\partial\tilde{\mathcal{R}}_{dt}}{\partial s_{jmt}}=\frac{\partial\tilde{\mathcal{R}}_{dt}}{\partial x_{dt}}\frac{\partial x_{dt}}{\partial s_{jmt}}\text{ where} \tag{33}$$
$$\frac{\partial\tilde{\mathcal{R}}_{dt}}{\partial x_{dt}}=r_{dt}\kappa\frac{e^{-\kappa(x_{dt}-\underline{x}_{dt})}}{[1+e^{-\kappa(x_{dt}-\underline{x}_{dt})}]^2}\text{ and}$$
$$\frac{\partial x_{dt}}{\partial s_{jmt}}=\begin{cases}M_{mt}\dfrac{\sum_{m'}\sum_{j'\in\mathcal{J}_{dm't}\setminus\mathcal{J}_{BB,t}}M_{m't}s_{j'm't}}{(\sum_{m'}\sum_{j'\in\mathcal{J}_{dm't}}M_{m't}s_{j'm't})^2}\geq 0, & \text{if } d\in D_{BB,t}, j\in\mathcal{J}_{dmt}\cap\mathcal{J}_{BB,t}\\ -M_{mt}\dfrac{\sum_{m'}\sum_{j'\in\mathcal{J}_{dm't}\cap\mathcal{J}_{BB,t}}M_{m't}s_{j'm't}}{(\sum_{m'}\sum_{j'\in\mathcal{J}_{dm't}}M_{m't}s_{j'm't})^2}\leq 0, & \text{if } d\in D_{BB,t}, j\in\mathcal{J}_{dmt}\setminus\mathcal{J}_{BB,t}\\ 0, & \text{if } d\notin D_{BB,t}\end{cases}$$

$$\frac{\partial^2 \tilde{\mathcal{R}}_{dt}}{\partial s_{amt}\partial s_{bmt}} = \frac{\partial \tilde{\mathcal{R}}_{dt}}{\partial x_{dt}}\frac{\partial^2 x_{dt}}{\partial s_{amt}\partial s_{bmt}} + \frac{\partial^2 \tilde{\mathcal{R}}_{dt}}{\partial x_{dt}\partial s_{bmt}}\frac{\partial x_{dt}}{\partial s_{amt}} \text{ where} \tag{34}$$

$$\frac{\partial^2 x_{dt}}{\partial s_{amt}\partial s_{bmt}} = \begin{cases} -2M_{m't}^2 \frac{\sum_{m'}\sum_{j'\in\mathcal{J}_{dm't}\setminus\mathcal{J}_{BB,t}} M_{m't}s_{j'm't}}{(\sum_{m'}\sum_{j'\in\mathcal{J}_{dm't}} M_{m't}s_{j'm't})^3}, & \text{if } d \in D_{BB,t} \text{ and} \\ & a,b \in \mathcal{J}_{dm't}\cap\mathcal{J}_{BB,t} \\ M_{m't}^2 \frac{\sum_{j'\in\mathcal{J}_{dm't}\cap\mathcal{J}_{BB,t}} M_{m't}s_{j'm't} - \sum_{j'\in\mathcal{J}_{dm't}\setminus\mathcal{J}_{BB,t}} M_{m't}s_{j'm't}}{(\sum_{j'\in\mathcal{J}_{dm't}} M_{m't}s_{j'm't})^3}, & \text{if } d \in D_{BB,t} \text{ and} \\ & a \in \mathcal{J}_{dm't}\cap\mathcal{J}_{BB,t}, b \in \mathcal{J}_{dm't}\setminus\mathcal{J}_{BB,t} \\ 2M_{m't}^2 \frac{\sum_{j'\in\mathcal{J}_{dm't}\cap\mathcal{J}_{BB,t}} M_{m't}s_{j'm't}}{(\sum_{j'\in\mathcal{J}_{dm't}} M_{m't}s_{j'm't})^3}, & \text{if } d \in D_{BB,t} \text{ and} \\ & a,b \in \mathcal{J}_{dm't}\setminus\mathcal{J}_{BB,t} \\ 0, & \text{if } d \notin D_{BB,t} \end{cases}$$

$$\frac{\partial^2 \tilde{\mathcal{R}}_{dt}}{\partial x_{dt}\partial s_{bmt}} = \left[2r_{dt}\kappa^2 \frac{e^{-2\kappa(x_{dt}-\underline{x}_{dt})}}{[1+e^{-\kappa(x_{dt}-\underline{x}_{dt})}]^3} - r_{dt}\kappa^2 \frac{e^{-\kappa(x_{dt}-\underline{x}_{dt})}}{[1+e^{-\kappa(x_{dt}-\underline{x}_{dt})}]^2}\right]\frac{\partial x_{dt}}{\partial s_{bmt}} \tag{35}$$

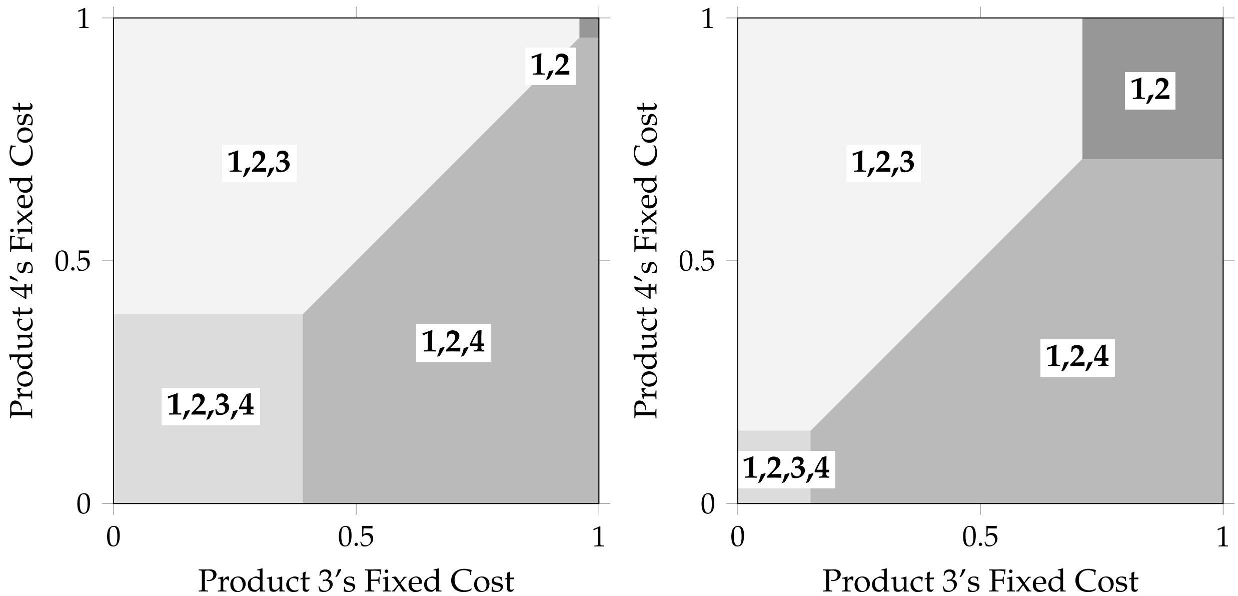
B.2 Post-ban

If period t falls after the DOJ's ban on the incentive program, then the expression (32) simplifies to the one that resembles the standard framework with vertical relationships (e.g., Villas-Boas, 2007):

$$\sum_{k\in\mathcal{J}_{mt}}\left[\frac{\partial s_{jmt}}{\partial p^C_{kmt}} + \sum_{j'\in\mathcal{J}_{dmt}}\Omega_{dmt}(j',j)\frac{\partial^2 s_{j'mt}}{\partial p^C_{jmt}\partial p^C_{kmt}}\left(p^C_{j'dt} - p^D_{j't} - c^D_{j'mt}\right) + \Omega_{dmt}(k,j)\frac{\partial s_{kmt}}{\partial p^C_{jmt}}\right]dp^C_{kmt}$$
$$-\Omega_{dmt}(f,j)\frac{\partial s_{fmt}}{\partial p^C_{jmt}}dp^D_{ft} = 0 \tag{36}$$

C Partial Exclusive Dealing Case

Figure 17: Equilibrium Product Offerings at Different Fixed Cost Levels, Partial Exclusive Dealing Case

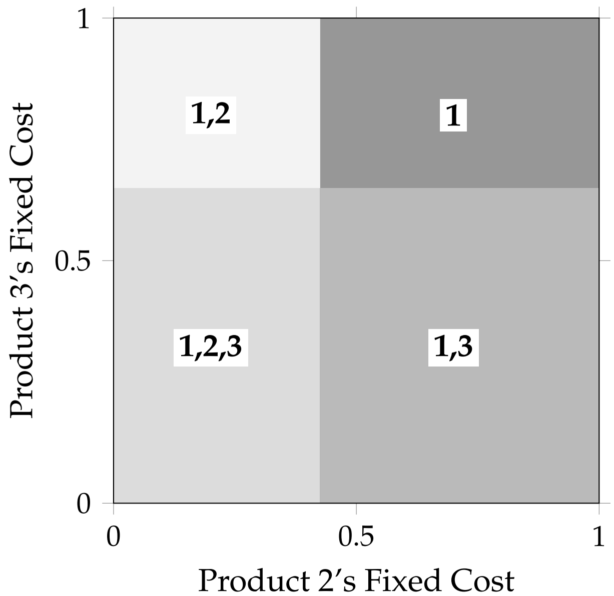


(a) No reward (r=0) (b) Optimal r

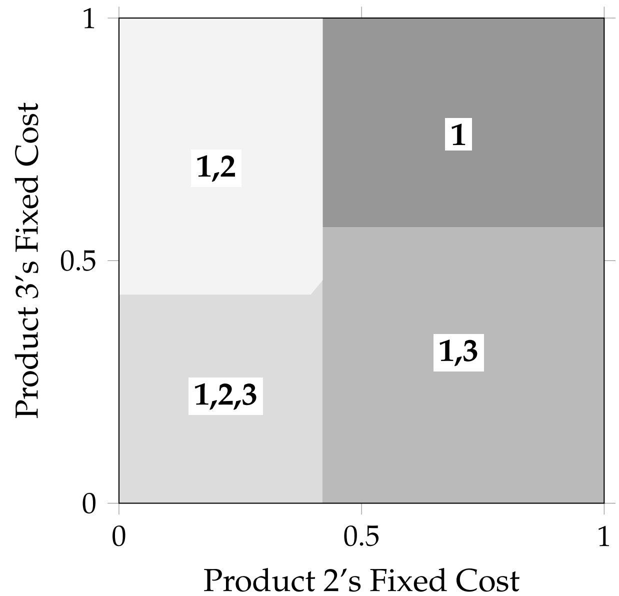
Notes: The labels on each region indicate equilibrium product choices.

D Weak Substitution Case

Figure 18: Equilibrium Product Offerings, Weak Substitution Case



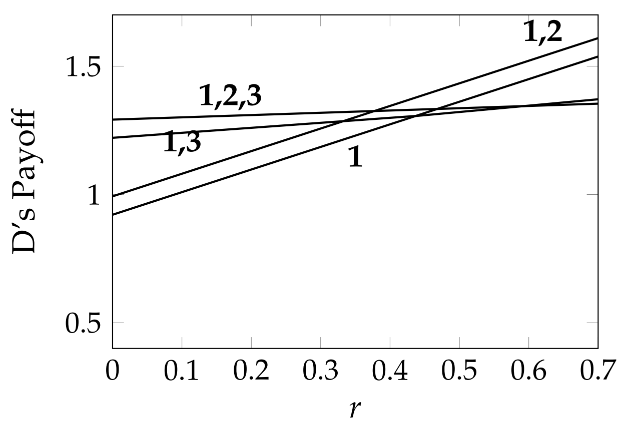
(a) No reward (r=0)



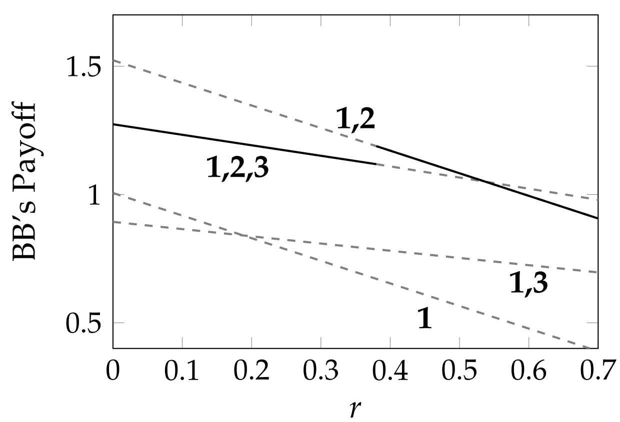
(b) Optimal r

Notes: The labels on each region indicate equilibrium product choices.

Figure 19: Stages 1 and 2 Payoffs with $f_2 = f_3 = 0.35$ and $\rho = 0.25$



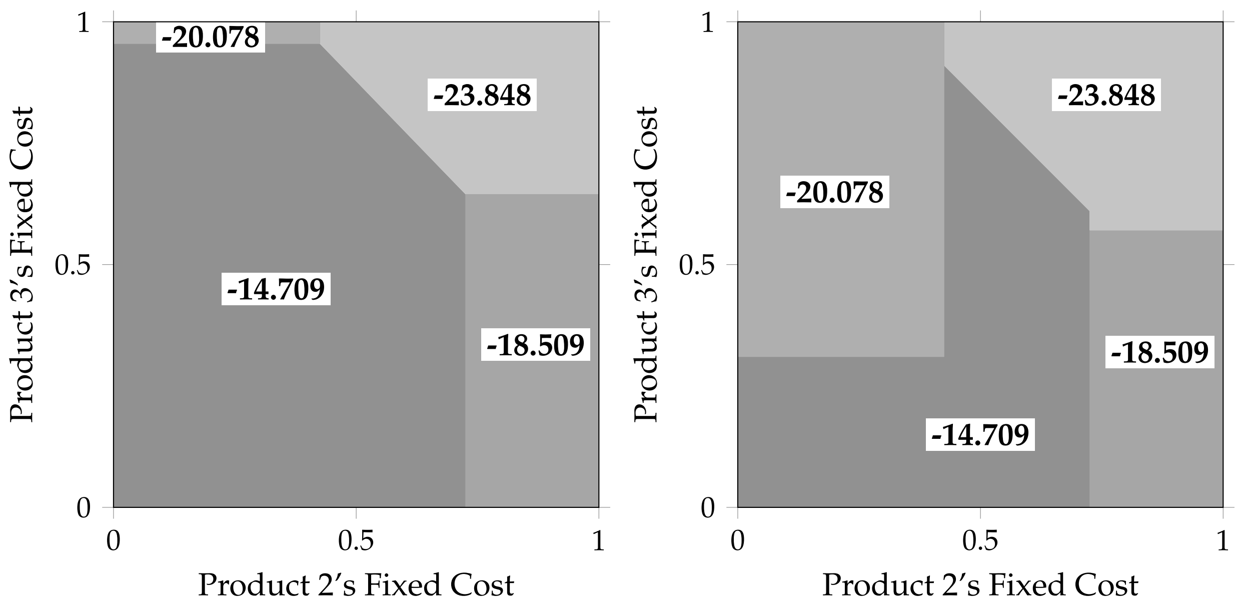
(a) Stage 2: D's Payoff



(b) Stage 1: Big Beer's Payoff

Notes: The labels on each line indicate D's product choices.

Figure 20: Consumer Surplus



(a) No reward (r=0) (b) Optimal r

Notes: The labels on each region indicate equilibrium product choices.