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VERTICAL INTEGRATION IN THE CARBONATED SOFT DRINKS INDUSTRY

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Abstract

This dissertation examines the impacts of vertical integration between Coca-Cola, PepsiCo, and their formerly partially owned bottlers. While such integration can generate efficiency gains, it also raises concerns about foreclosure effects on rival firms like Dr Pepper. Using a difference-in-differences approach, I find that integration is associated with lower prices for Coca-Cola and PepsiCo products and higher prices for Dr Pepper. I then estimate a structural demand model to quantify brand-level elasticities, showing that consumers primarily substitute within the diet and sugary categories, with low brand-level price elasticities. Finally, I develop a vertical model of the supply chain that incorporates partial ownership between syrup producers and bottlers. The results suggest that pricing incentives from vertical integration may lead to soft foreclosure, outweighing potential efficiency gains. These findings contribute to the understanding of modern vertical mergers and their implications for antitrust policy.

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q	Quarter
c	County
j	Product (brand-package)
η	Coefficients of the event study
t	Market id (county-quarter)
i	Consumer id
p	Retail price
s	Market share
b	Bottler
f	Syrup producer
α	Demand parameter for price
β	Demand parameter for exogenous product characteristics
ρ	Nesting parameter of the demand model
h	Nest id of the products
mc	Marginal costs
λ	Coefficients of bottler marginal costs parameterization
p^f	Syrup price
r	Regular drink category
d	Diet drink category
M	Market size
O^{fb}	Syrup producer f's ownership of bottler b

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Chapter 1
Vertical Integration in the Carbonated Soft Drinks Industry

1.1 Introduction

The impacts of vertical integration have received significant attention. This phenomenon is characterized by two opposing forces: efficiency and foreclosure. An integrated upstream firm no longer charges positive margins to downstream firms, potentially reducing retail prices through the elimination of double marginalization (Spengler, 1950). However, unintegrated rivals may be subject to foreclosure effects, where integrated firms may engage in practices such as raising input or retail prices to rivals, creating entry barriers, or even refusing to deal (Asker and Bar-Isaac, 2014). The ultimate implications of vertical integration on prices, profits, and consumer welfare will thus depend on the specific market structure of the industry in question.

The aim of this study is to empirically evaluate the impact of vertical integration in the carbonated soft drinks (CSD) industry by analyzing two recent vertical integration events involving PepsiCo and the Coca-Cola Company (henceforth TCCC). In 2009, PepsiCo acquired two of its largest bottlers, Pepsi Bottling Group and Pepsi Americas; in 2010, TCCC acquired its largest bottler Coca-Cola Enterprises. Understanding the price changes resulting from these events is essential for disentangling the potential effects of vertical integration.

The elimination of double marginalization suggests that integrated bottlers can purchase inputs at zero markup, which should lead to lower prices for consumers. However, integrated bottlers may also have an incentive to raise prices for rival products, such as Dr Pepper Snapple Group (DPSG) drinks, to steer demand toward their own integrated products. This behavior could lead to higher equilibrium prices for both integrated and unintegrated drinks—a phenomenon known as the Edgeworth-Salinger effect, a form of foreclosure studied by Luco and Marshall (2020).

Moreover, the pre-existing partial ownership of bottlers by PepsiCo and Coca-Cola adds complexity to the analysis. Since the bottlers were already partially owned before the full integration, the magnitude of price changes might differ from a case where ownership goes from zero to full. Therefore, if we fail to disentangle the elimination of double marginalization from foreclosure and account for partial ownership, we risk producing inaccurate estimates of price change channels, misinterpreting the vertical integration effects, and drawing incorrect policy conclusions.

To explore elimination of double marginalization and Edgeworth-Salinger effects, this study uses a comprehensive retail dataset and auxiliary data on bottlers' operating areas. I first conduct a difference-in-differences study to quantify changes in prices and shares of integrated and unintegrated drinks prior and post integration. Vertical integration results in small and insignificant price decreases for integrated drinks, with reductions of 1.3% after PepsiCo Event and 0.69% after TCCC event. In contrast, it leads to larger and significant price increases for piggybacking Dr Pepper drinks, rising by 6.64% and 0.8% respectively To quantify the mechanisms behind the changes, I estimate a discrete choice model to recover consumers' taste parameters for prices and other product characteristics, and develop a vertical pricing model that incorporates exclusive territories, partial ownership, and other key features of the industry to analyze the firms' pricing strategies. I find that consumers are moderately sensitive to prices, with the magnitude of brand-level price elasticities around -4. Estimation results at the bottler level suggest that bottlers' markups (Lerner index) range from 10% to 50%, which may facilitate the downward pricing effects of vertical integration. Integrated Coke bottlers show higher marginal production costs, suggesting that vertical integration may not have led to cost savings in bottlers' production. On the other hand, integrated Pepsi bottlers have lower marginal costs. Using these results, I back out syrup producers' marginal costs. To quantify the implications of vertical integration, I conduct three counterfactual exercises: removing efficiency effects, removing foreclosure incentives, and implementing a full divestiture. Removing efficiency gains lead to 0.687% loss in total surplus, while removing foreclosure leads to 1.2% gains, suggesting that foreclosure behavior may play a more significant role than efficiency gains in terms of total surplus. A full divestiture reduces total surplus (17.765%) due to lower consumer surplus, despite a mixture of gains and losses of producer surplus. These results highlight the complex trade-offs between firm incentives and consumer outcomes in vertical mergers.

This paper is related to several strands of literature. To begin with, recent empirical studies on changes in market structure in the markets of bilateral oligopolies (Berto Villas-Boas, 2007; Crawford, Lee, Whinston and Yurukoglu, 2018; Yang, 2020) build vertical structure models using consumer taste parameters from demand estimation, incorporating rich institutional details while remaining estimable. I draw on their approach in this paper.

This paper contributes to the empirical literature of the CSD industry. Several studies have estimated demand with scanner data to reveal consumers' substitution patterns (Dubé, 2005; Dhar, Chavas, Cotterill and Gould, 2005; Chan, 2006; Lopez, Liu and Zhu, 2015; Chen, Reinhardt and Syed Shah, 2022). I adopt a discrete choice model which generates similar price elasticities to these studies, and use the estimates in the vertical model of suppliers. On the other hand, the vertical integration of PepsiCo and Coca-Cola is the subject of only two studies, Luco and Marshall (2020) and Adachi (2020), both of which use difference-in-differences designs. The first study finds that vertical integration causes price decreases in products with eliminated double margins but price increases in Dr Pepper drinks sold by the integrated bottlers; the second finds that vertical integration contributed to efficiency gains in PepsiCo drinks and had little effects on Dr Pepper drinks, but did not improve TCCC's internal process. Compared with these two studies, my paper aims to disentangle the mechanisms behind the price changes using a model of vertical structure. In addition, both studies assume a binary vertical integration status in their event study, which does not consider the partial ownership that was present before integration. This paper aims to understand the role of partial ownership by using a structural model to conduct counterfactuals of alternative ownership structures and pricing strategies.

Finally, this paper is relevant to the theoretical literature studying partial ownership in vertical relations (Levy, Spiegel and Gilo, 2018; Hunold, 2020). It also contributes to the empirical studies that incorporate the possibility of partial alignment of firms' incentives. For example, Miller and Weinberg (2017) examines horizontal mergers in the beer industry by allowing non-binary values in the ownership matrix. Crawford et al. (2018) and Cuesta, Noton and Vatter (2019) examines vertical integration in the multichannel television and hospital-insurer industries respectively, in which they develop models of Nash-in-Nash bargaining and assume the integrated firms consider a weighted sum of its own and the partner's profits. The former incorporates a foreclosure parameter, while the latter represent foreclosure incentives using differences in profits. Given the institutional details of the CSD industry, I adopt a supply model without bargaining, and assume a similar weighted sum of profits.

The remainder of the paper is organized as follows. Section 2 describes the market structure and major vertical acquisitions in the CSD industry, Section 3 describes data, Section 4 describes some reduced-form analysis of the effects of vertical integration on prices of integrated and piggybacking products, Section 5 presents the demand-side model and elasticity estimates, Section 6 presents the supply-side model and results of producers marginal costs and markups, Section 7 (ongoing) presents the counterfactuals, and Section 8 (ongoing) concludes.

1.2 Background

1.2.1 Vertical Structure of the CSD industry

The supply chain in the CSD industry is characterized by a two-layer vertical structure, comprised of syrup producers and bottlers. Syrup producers, including industry giants such as the Coca-Cola Company (TCCC), PepsiCo, and Dr Pepper Snapple Group (DPSG), produce syrup concentrates, which are then sold to bottlers at wholesale prices. Bottlers, on the other hand, are responsible for producing and distributing CSD drinks by mixing the syrup concentrates with water, carbon dioxide, and other ingredients, before packaging the mixture in bottles or cans and distributing the final products to retailers and other customers. In contrast to warehouse delivery, the majority of CSD drinks are delivered via the direct-store-door (DSD) system, where the employees of the bottlers deliver the products to the store and keep the shelves stocked (Fry, Spector, Williamson and Mujeeb, 2011).

TCCC and PepsiCo have each established their own franchised systems of bottlers to facilitate the production and distribution of CSD drinks. This strategic move was driven by the high costs associated with establishing independent distribution networks, including transportation costs and the limitations posed by the use of glass bottles, which were the primary packaging material at the time. [1] In contrast, DPSG, initially a regional brand based in Texas, adopted a different approach by relying on the parts of TCCC's or PepsiCo's franchised systems, as well as independent bottlers for production and distribution. This practice is commonly referred to as piggybacking within the industry, which enabled DPSG to expand its national presence without incurring the substantial costs to establish its own distribution network.

It is important to note that both TCCC and PepsiCo impose flavor restrictions on their bottlers. That is, one bottler cannot produce drinks from two syrup producers of the same flavor. PepsiCo, for example, has a "no other cola" provision in the Pepsi-Cola franchise agreements with bottlers (Court of Appeals, 2005).

> The Bottler will not bottle, distribute or sell, directly or indirectly, any other cola beverage or beverages with the name cola... or any other beverage which could be confused with Pepsi-Cola's.

However, this flavor restriction does not prevent DPSG's piggybacking behavior, because it has been ruled by a federal court in 1963 that Dr Pepper was not a cola product, since it did not

[1]TCCC retains exclusive rights to produce and distribute fountain drinks, while PepsiCo has delegated this responsibility to its bottlers. I have chosen to focus solely on the retailer channel in my analysis due to its larger volumes compared with fountain drinks and the data limitations surrounding fountain drinks.

contain any kola nut. Figure 1.1 illustrates the two-layer vertical structure. In this illustration, both TCCC and PepsiCo have their own bottling systems that do not overlap, while DPSG relies on parts of both systems.

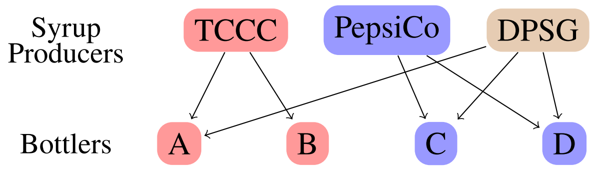


Figure 1.1: Typical Vertical Structure of CSD Industry

The bottlers distribute their products in exclusive territories, a perpetual arrangement dictated by contractual terms between syrup producers and bottlers. For example, Coca-Cola USA's bottling contract dictates as below (Saltzman, Levy and Hilke, 1999).

> The Bottler has the sole, exclusive and perpetual right and license in the Bottler's territory (i) to manufacture and market all Covered Products for ultimate consumer purchase in such territory, and (ii) to use and vend on all Covered Products the trademarks and trade names associated with such Covered Products and any Modifications thereof, and all labels, designs, distinctive containers or other trade symbols associated therewith.

The rights to these exclusive territories are protected by the Soft Drinks Interbrand Competition Act of 1980.

Figure 1.2 provides a snapshot of the bottlers' territories in the distribution of Coke, Pepsi, and Dr Pepper drinks in the Philadephia Designated Media Markets (DMA), with bottler names retained due to proprietary concerns. There are 2 Coke bottlers and 3 Pepsi bottlers operating in this area, dividing the territories using county borders. Intriguingly, Dr Pepper piggybacks on 1 Coke bottler and 2 Pepsi bottlers, which means that the same bottler operates in different territories for its franchised products (Coke or Pepsi) and piggybacking products (Dr Pepper). As a result, foreclosure incentives may only occur in the overlapping territories, which influences the overall magnitude of vertical integration effects. Exclusive territories are relevant for assessing vertical integration for two reasons. First, they enable us to track sales volumes by each bottler in every county using retail data. Second, they offer geographic variation in the magnitude of vertical integration's impacts. For instance, efficiency gains may occur in territories of vertically integrated bottlers, while foreclosure risks are heightened in piggybacking territories of integrated bottlers. Conversely, when DPSG piggybacks on unintegrated bottlers in rival franchising systems or independent bottlers, foreclosure concerns are less pronounced.

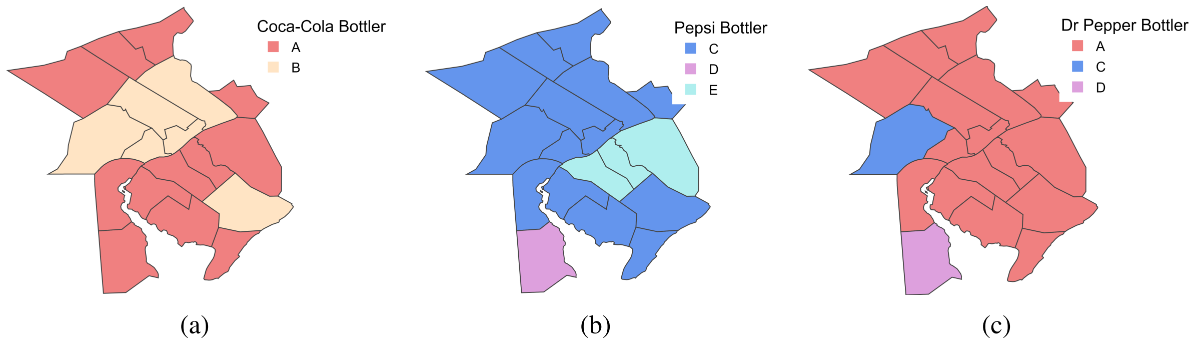


Figure 1.2: Exclusive Territories: Example

1.2.2 Pricing Dynamics and Ownership Structure

The syrup producers charge bottlers a wholesale price for concentrates. Wholesale prices reported by industry publications are expressed as annual prices per 288 ounces, thus including a linear component. Since evidence of nonlinear pricing such as lump-sum transfers is rare (Luco and Marshall, 2020), I proceed with the assumption of linear pricing, uniformly set annually across all bottlers. [2]

In terms of bottlers' pricing, I assume that bottlers choose retail prices in each market while handling the distribution and stocking of drinks at retailers. Consequently, I abstract from the interactions between the bottlers and the retailers, focusing solely on bottlers' pricing decisions. There is also practical concerns in that I only observe the retail prices at the bottle level of the vertical structure.

Both TCCC and PepsiCo have partial or full ownership of certain bottlers within their franchising systems, as illustrated in Table 1.1. The data is from Beverage Digest described in Section 3. Before the integration cases described below, TCCC held 38.4% equity in CCE and 30% in Coke Consolidated, with the former reaching 100% ownership post-acquisition. Similarly, PepsiCo owned approximately 40% of PBG and PAS, which also transitioned to complete ownership following acquisition. Additionally, PepsiCo holds a 35% stake in PBV. These partially-owned bottlers collectively account for a significant volume share of drinks for both TCCC and PepsiCo, with CCE representing over 75% of TCCC volume, and PBG and PAS combined contributing to 75% of PepsiCo volume. Although Coke Consolidated and PBV have smaller proportions, their quantities remain notable. These bottlers also play a crucial role in distributing DPSG drinks, with CCE's distribution share increasing from 14% to 21%

[2]Starting from 2008, TCCC has introduced incidence-based pricing through contracts with bottlers, linking prices to bottlers' revenue. This introduces variation in prices across bottlers within a year. However, due to limited information on the implementation specifics, I maintain the linear pricing assumption.

post-integration. While data is unavailable for DPSG volume distributed by Coke Consolidated and PBV, they do distribute Dr Pepper drinks in certain territories.

This table offers several insights. First, it suggests that the alignment of incentives between syrup producers and their key bottlers may already be partially established before integration, thereby influencing the magnitude of effects. Secondly, the equity shares indicate that both TCCC and PepsiCo wield influence over franchised bottlers crucial for DPSG, potentially facilitating foreclosure practices.

Table 1.1: Syrup Producers' Ownership and Volumes by Bottler (Percentage)

Parent	Bottlers	Equity Before	Equity After	Own Volume Before	Own Volume After	DPSG Volume Before	DPSG Volume After
TCCC	CCE	38.4	100	75.7	76.8	14	21
	Coke Consolidated	30	30	7.3			
PepsiCo	PBG	41	100	56	75.3	15	30
	PAS	43	100	19.2		5	
	PBV	35	35	4.1			

1.2.3 TCCC and PepsiCo Vertical Integration Cases

In 2009 and 2010, several vertical integration events occurred between syrup producers and bottlers. In August 2009, PepsiCo acquired PBG and PAS. The two bottlers were merged into Pepsi Beverages Company (PBC) to enable PepsiCo to innovate and distribute new products, as well as respond quickly to changes in consumer tastes. [3] In February 2010, TCCC acquired the North American territories of CCE, and established Coca-Cola Refreshments (CCR). The primary objective was to reduce costs and driving profitability over the long term by developing an evolved franchising system [4].

The changes in the bottlers' ownership automatically triggered the termination of the piggybacking contracts of DPSG and the integrated bottlers, but both PepsiCo and TCCC reached agreement with DPSG to obtain new exclusive licenses to distribute DPSG products. Specifically, PepsiCo obtained the exclusive right to distribute Dr Pepper, Crush, and Schweppes in the former PBG and PAS territories, while TCCC retained the exclusive rights to distribute Dr Pepper and Canada Dry in the former CCE territories (Federal Trade Commission, 2010a,b). Despite PepsiCo and TCCC finding it more aligned to their interests to carry DPSG brands, the FTC was concerned that PBC or CCR might disclose confidential information about DPSG's brand and marketing strategies. Both acquisitions were approved by the FTC, on the condition that PepsiCo and TCCC establish a "firewall" to prevent their employees from accessing DPSG's

[3] See `https://www.nytimes.com/2009/08/05/business/05pepsi.html`.

[4] See `https://investors.coca-colacompany.com/news-events/press-releases/detail/471/the-coca-cola-company-and-coca-cola-enterprises`.

confidential information (Federal Trade Commission, 2010a,b). However, due to challenges in obtaining data on the effectiveness of the firewall and quantifying information spillover between syrup producers, I omit this aspect.

1.3 Data

This section provides an overview of the data used in this paper. To identify the effects of vertical integration, I need to determine the territories served by each bottler, measure consumer prices and quantities in those territories, and estimate bottlers' costs using bottler locations as a proxy (since transportation is a key cost factor), alongside syrup producers' wholesale prices.

1.3.1 Territory Maps of Major TCCC and PepsiCo bottlers

To accurately determine the areas affected by vertical integration, it is vital to pinpoint the territories of both integrated and unintegrated bottlers handling TCCC and PepsiCO products, on which DPSG also piggybacks. I have acquired two sets of territory maps: firstly, the US bottling-system maps provided by Beverage Digest, a prominent data analysis company in the industry. Table 1.2 displays the county coverage for each major bottler that distributes the franchised products, as well as their intersections within my sample. In the first two rows and three columns, each entry is the number of overlapping counties in the territories of the row (TCCC) and column (PepsiCo) bottler. The last row and column shows the total number of counties in their territories. Specifically, out of 2533 counties in my sample, CCE covers 1704 counties, and PBG and PAS covers 1017 and 446 counties respectively. In total, 1185 [5] counties were affected by both events, and 1982 [6] counties were affected by at least one event. This underscores the necessity of investigating their effects thoroughly.

Table 1.2: County Coverage of Major TCCC and PepsiCo Bottlers in Coke and Pepsi

		PepsiCo				
		PBG	PAS	PBV	Other	Total
TCCC	CCE	792	393	17	502	1704
	Coke Consolidated	114	6	42	104	266
	Other	111	47	14	391	563
	Total	1017	446	73	997	2533

[5] It is the sum of overlapping counties of CCE and PBG (792), and those of CCE and PAS (393)

[6] It is the sum of the number of counties affected by both events (1185) and those affected by only 1 event (PepsiCo: 114 + 111 + 6 + 47 = 278; TCCC: 17 + 502 = 519)

While the bottling system maps encompass territories of major bottlers distributing Dr Pepper, I supplement them with maps from the FTC's investigation into both cases. These FTC maps delineate regions where integrated bottlers distribute Dr Pepper drinks. Reassuringly, the maps largely align, and I rely on the FTC's maps in instances of slight misalignment. Table 1.3 displays the number of counties where integrated bottlers distribute Dr Pepper. In my sample of 2533 counties, DPSG piggybacks on CCE, PBG and PAS in 625 (24.67%), 509 (20.09%) and 250 (9.87%) of the counties respectively. Therefore, it is important to consider the potential foreclosure effects on Dr Pepper when DPSG relies on bottlers fully owned by rivals for the distribution of more than 50% of its most prominent brand.

Table 1.3: County Coverage of Major TCCC and PepsiCo Bottlers in Dr Pepper

CCE	Coke Consolidated	PBG	PAS	PBV	Other	Total
625	86	509	250	37	1026	2533

1.3.2 Nielsen Retail Scanner Data

To analyze the pricing behavior of bottlers, it is essential to have retail prices and quantities of their products. Note that since bottlers have exclusive territories, it is possible to track the quantities produced and retail prices set by bottlers from the retail scanner data. For this purpose, I use the Nielsen Retail Scanner Data, which comprises weekly pricing, volume, and store environment information obtained from point-of-sale systems across over 90 retail chains nationwide. The dataset covers the years 2009 to 2011, coinciding with the occurrences of the TCCC and PepsiCo vertical integration cases. Geographically, the data encompasses counties served by the major bottlers listed in Table 1.1 and additional areas, spanning 2533 counties in 48 continental states and encompassing 205 Designated Media Areas (DMA). Given that bottlers' territories are delineated at the county level, I define a market as a county-quarter pair. Aggregating weekly sales data to quarters helps mitigate potential stockpiling behavior (Hendel and Nevo, 2006). Market size is quantified as the total sales within the soft drinks category as per the Nielsen dataset.

To investigate the interactions among TCCC, PepsiCo, and DPSG, my analysis focuses on six flagship brands: regular (sugary) coke, diet coke, regular Pepsi, diet Pepsi, regular Dr Pepper, and diet Dr Pepper. By leveraging product characteristics such as packaging, volume, and sugary/diet indicators, products are aggregated from the UPC level to the brand-package-volume level (e.g., 12-pack 12-oz diet coke), resulting in a total of 46 distinct products. Table 1.4 shows the mean price per 100 oz and market share of the products sorted by popularity within each brand. It is evident that 12-pack 12-oz drink is the most popular package for all six brands. In addition, the prices of larger packages are lower. Including packages is crucial to capture the consumers' substitution patterns within and between brands, as well as to account for the variation in production costs.

1.3.3 Wholesale Prices of Flagship Products

To precisely gauge the extent of reducing double marginalization, it is essential to differentiate between the wholesale margin and the retail margin. I have incorporated the wholesale prices of the six brands mentioned earlier from Beverage Digest (reported in $ per 288 oz) after converting the prices to $ per 100 oz. These wholesale prices are reported to change annually and remain uniform across bottlers. However, to accommodate the variation induced by TCCC's incidence-based pricing scheme and the possibility that integrated bottlers receive unreported discounts, I have assumed the actually wholesale prices to be a proportion of the observed data in the bottlers' cost decomposition.

1.3.4 Bottlers' Plant Locations

To approximate the transportation costs borne by bottlers, I have used the plant locations of bottlers sourced from Beverage Digest. Under the assumption that bottlers distribute drinks to counties within their territories from the closest plant, I calculated the distance as the distance between the center of the county where the drinks are consumed and the center of the county where the plant is located, using NBER County Distance Database. On average, the distance is 101.83 miles.

1.4 Evidence from Event Study

The FTC focused on the information aspect of the vertical integration cases, speculating that the benefits from elimination of double marginalization would outweigh the foreclosure effects. Among the studies on pricing effects, Luco and Marshall (2020) does not distinguish the two merger events. Moreover, they use a different scanner dataset and coverage. To test the validity of their results in my data, I use an event-study design similar to this paper.

Since the data spans from 2009 to 2011, it allows me to test both cases. I define the treatment as vertical integration cases, and the time of treatment as the quarter when the cases consummated, which is 2009Q3 for PepsiCo case and 2010Q2 for TCCC case. Since each observation is a product-market pair, the treated group of the TCCC case include the

Table 1.4: Mean Prices and Shares of Products

Brand	Pack	Size per Pack	Price ($/ 100 oz)	Share (%)
Regular Coke	12	12	2.434129	6.61654
Regular Coke	1	67.6	1.946428	3.699938
Regular Coke	1	20	6.809952	1.014974
Regular Coke	20	12	2.407024	0.916767
Regular Coke	8	12	3.696722	0.51784
Regular Coke	6	12	1.731665	0.383792
Diet Coke	12	12	2.432625	4.136524
Diet Coke	1	67.6	1.862616	2.648681
Diet Coke	32	12	2.382205	1.186832
Diet Coke	24	12	2.373245	0.717761
Diet Coke	1	20	6.841077	0.645542
Diet Coke	6	16.9	2.960116	0.627413
Diet Coke	6	24	2.443001	0.576641
Diet Coke	20	12	2.404194	0.499929
Diet Coke	8	12	3.693576	0.302173
Regular Pepsi	12	12	2.306922	5.163414
Regular Pepsi	1	67.6	2.008721	2.232753
Regular Pepsi	1	67.2	1.83274	1.78792
Regular Pepsi	24	12	2.205806	1.68786
Regular Pepsi	36	12	2.195816	1.596452
Regular Pepsi	6	24	2.388994	0.91778
Regular Pepsi	20	12	2.377448	0.545501
Regular Pepsi	1	20	7.141491	0.536569
Regular Pepsi	6	16.9	2.809635	0.356503
Regular Pepsi	6	8	0.891186	0.343035
Regular Pepsi	8	12	3.617033	0.288582
Diet Pepsi	12	12	2.293036	2.578166
Diet Pepsi	6	24	2.335923	0.990238
Diet Pepsi	1	67.2	1.816025	0.915062
Diet Pepsi	24	12	2.195668	0.788214
Diet Pepsi	1	20	7.142978	0.341086
Diet Pepsi	6	16.9	2.824095	0.244299
Diet Pepsi	8	12	3.632767	0.166038
Regular Dr Pepper	12	12	2.455425	2.831789
Regular Dr Pepper	1	67.6	1.875196	1.762048
Regular Dr Pepper	1	20	6.928152	0.588056
Regular Dr Pepper	24	12	2.275898	0.548197
Regular Dr Pepper	6	24	2.307736	0.403605
Regular Dr Pepper	6	16.9	2.863567	0.354571
Regular Dr Pepper	8	12	3.644564	0.217883
Diet Dr Pepper	12	12	2.454528	1.070576
Diet Dr Pepper	1	67.6	1.845527	0.654729
Diet Dr Pepper	6	24	2.297676	0.347562
Diet Dr Pepper	6	16.9	2.851457	0.277009
Diet Dr Pepper	24	12	2.248538	0.26913
Diet Dr Pepper	1	20	6.967564	0.254733

observations in counties in the territory of CCE, and the treated group of the PepsiCo case include the observations in counties in the territories of PBG and PAS. The control group are observations in counties in the territories of unintegrated bottlers. In addition, within the treated or control group, I distinguish the counties where Dr Pepper drinks distributed by TCCC bottlers versus those distributed other bottlers in the TCCC case, and those by PepsiCo bottlers versus other bottlers in the PepsiCo case.

I use difference-in-differences method to examine the impacts of vertical integration. The regression equation is Equation 1.1, with the outcomes focusing on prices and market shares. I regress them for Coke, Pepsi and Dr Pepper respectively.

$$\log y_{jcq} = \eta_1 Post_q + \eta_2 Treat_{jc} + \eta_3 Treat * Post_{jcq} + \eta_4 Piggybacking * Treat * Post_{jcq} + c + FE_{DMA} + FE_{Quarter} + FE_j + \epsilon_{jcq} \quad (1.1)$$

In Equation 1.1, $\log y_{jcq}$ is the outcome variable of product j in county c and quarter q, which can be prices $\log p_{jcq}$ or shares $\log s_{jcq}$. $Post_q$ equals 1 if the quarter is past the treatment, $Treat_{jc}$ equals 1 if j is an integrated product sold by an integrated bottler in c. $Piggybacking_{jcq}$ equals 1 if j is a product piggybacking on an integrated bottler in c and q. FE_{DMA},$FE_{Quarter}$, FE_j are DMA, quarter, and product fixed effects, and ϵ_{jcq} is an error term. To interpret the parameters, the changes of integrated products in treated counties is $\eta_1 + \eta_3$, while those of the same products in untreated counties are η_1, so that η_3 can be interpreted as the impact of vertical integration on the integrated products. The changes of piggybacking products in treated counties are $(\eta_1 + \eta_3 + \eta_4)$, while those of the same non-piggybacking products in treated counties are $\eta_1 + \eta_3$, so that η_4 can be interpreted as the impact of vertical integration on the piggybacking products.

Table 1.5 and 1.6 show the results of the regressions with data on PepsiCo event and TCCC event. First, Both events have contributed to lower and insignificant price drops of the integrated drinks, while resulting in higher and significant prices increases of piggybacking products. For example, Pepsi drinks sold by integrated bottlers have experienced 1.3% lower prices compared with those sold by unintegrated bottlers. This magnitude is 0.69% for Coca-Cola. Meanwhile, Dr Pepper drinks produced by PBG or PAS have experienced 6.6% increase in price after they were integrated, compared with those produced by other bottlers. The magnitude is higher for Dr Pepper produced by CCE after the TCCC integration at 0.8%. Second, in terms of changes in market shares, both integration events have contributed to higher market shares of integrated products and lower shares of the piggybacking products. Compared with existing work (Luco and Marshall, 2020; Adachi, 2020), the qualitative implications and magnitude are similar, except that the coefficient of PepsiCo integration on Dr Pepper price is higher in my results.

Table 1.5: Effects on Prices and Shares of PepsiCo Integration

	(1) Log Price	(2) Log Share
Post PepsiCo VI	-0.00307	-0.183***
	(0.00288)	(0.00859)
PepsiCo Treat	-0.0934***	-0.286***
	(0.00245)	(0.00730)
PepsiCo Treat * Post	-0.0127***	0.100***
	(0.00282)	(0.00841)
Piggybacking * Treat * Post	0.0664***	-0.532***
	(0.00247)	(0.00736)
Constant	1.173***	-5.165***
	(0.00805)	(0.0240)
DMA FE	Yes	Yes
Quarter FE	Yes	Yes
Num. Obs	847253	847253

Standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

The above results provide evidence for both efficiency and foreclosure effects of vertical integration. However, to disentangle the mechanisms behind these changes, as well as taking partial ownership into account, I develop a structural model that consists of both a demand and a supply side.

1.4.1 Model and Estimation

A demand-side model is necessary to capture consumer substitution patterns and quantify their responses to price changes due to shifts in market structure. These responses are later used to back out the costs and markups for bottlers and syrup producers in Section 6.

I use a nested logit model to capture flexible consumer substitution behavior across CSD products. Berry (1994) introduced this approach, estimating supply and demand models in oligopoly markets with differentiated products. This framework was extended by Berry, Levinsohn and Pakes (1995) and Nevo (2000), though I focus on a version without random coefficients due to computational constraints.

Table 1.6: Effects on Prices and Shares of TCCC Integration

	(1) Log Price	(2) Log Share
Post TCCC VI	0.000690	-0.193***
	(0.00282)	(0.00843)
TCCC Treat	0.0914***	0.356***
	(0.00196)	(0.00585)
TCCC Treat * Post	-0.00687***	0.0613***
	(0.00256)	(0.00763)
Piggybacking * Treat * Post	0.00801**	-0.366***
	(0.00317)	(0.00946)
Constant	1.121***	-5.354***
	(0.00800)	(0.0239)
DMA FE	Yes	Yes
Quarter FE	Yes	Yes
Num. Obs	847253	847253

Standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

The model addresses price endogeneity and unobserved characteristics, assuming Bertrand competition. By inverting market share equations, it derives implied mean utility, allowing for instrumental variable estimation. Compared to the simple logit model, the nested logit offers richer substitution patterns, enabling consumers to shift toward specific product groups. Recent applications of this model include studies by Brenkers and Verboven (2006) and Miller and Weinberg (2017).

Assume that in market t, a consumer i's indirect utility of consuming product j is a function of its price, product characteristics, and consumer's idiosyncratic tastes, expressed in Equation 1.2 (for simplicity, we omit the notation t). In Equation 1.2, p_j is the price of product j, the observable characteristics x_j include diet/sugary indicator and small/family size indicator, where I define a small- or individual-sized products as single-unit beverages that are no more than one liter (33.8 oz) in volume following Powell and Leider (2022). ξ_j is the product-level unobservable characteristics. The last two terms denote the idiosyncratic taste, which is allowed to be correlated among products within the same nest h.

Cardell (1997) shows that the group preference $\bar{\varepsilon}_{ih(j)}$ follows the distribution such that if $\bar{\varepsilon}_{ih(j)}$ is an extreme value random variable, then $\bar{\varepsilon}_{ih(j)} + (1-\rho)\bar{\varepsilon}_{ij}$ is also an extreme value random variable.

$$u_{ij} = \alpha p_j + \beta x_j + \xi_j + \bar{\varepsilon}_{ih(j)} + (1-\rho)\bar{\varepsilon}_{ij}. \tag{1.2}$$

I assume the nest structure is based on the six brands, and a separate nest includes the outside good ($j = 0$), representing other CSD brands. Figure 1.3 illustrates this structure, with seven nests at level 1 (six brands and the outside good) and multiple products (package-volume pairs) at level 2. ρ represents the within-group correlation of utility levels, which goes up to 1 as ρ approaches 1, and goes to 0 as ρ approaches 0.

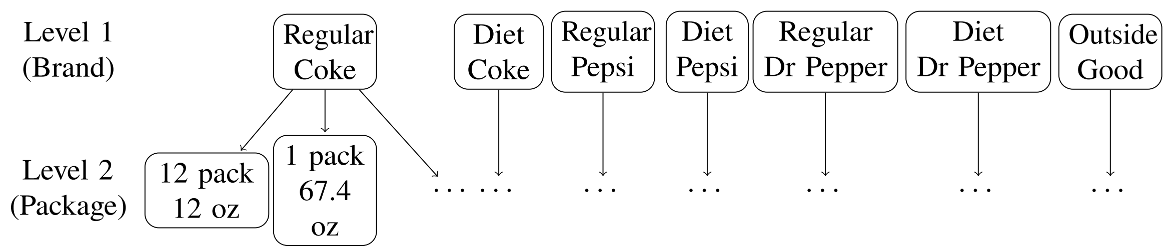


Figure 1.3: Nest Structure of the Demand Model

The consumer chooses the product that gives them the highest indirect utility. Denote J_h as the set of products in the nest h, the selection probability of product j conditional on group h being selected is

$$\bar{s}_{j|h} = \frac{exp\left(\frac{\delta_j}{1-\rho}\right)}{D_h}, \tag{1.3}$$

where

$$\delta_j = \alpha p_j + \beta x_j + \xi_j,$$

and

$$D_h = \sum_{k \in J_h} exp\left(\frac{\delta_k}{1-\rho}\right)$$

The probability that group h is selected is

$$\bar{s}_h = \frac{D_h^{1-\rho}}{\sum_h D_g^{1-\rho}}. \tag{1.4}$$

Thus the unconditional selection probability of product j in group h equals

$$s_j = \bar{s}_{j|h}\bar{s}_h = \frac{exp\left(\frac{\delta_j}{1-\rho}\right)}{D_h\left[\sum_h D_g^{1-\rho}\right]}. \tag{1.5}$$

Rearranging Equation 1.5, and adding the market notation t, equalizing the selection probability with the market shares, we can derive an estimable equation that takes the form

$$ln(s_{jt}) - ln(s_{0t}) = x_{jt}\beta - \alpha p_{jt} + (1-\rho)ln(s_{j|ht}) + \xi_{jt}. \tag{1.6}$$

We need instruments for both the within-group market shares $s_{j|h}$ and the prices p_j, both of which can be correlated with the unobservable product characteristics. It is common practice to use the number of products in a nest in each market as an instrument for $s_{j|h}$ (Brenkers and Verboven, 2006; Miller and Weinberg, 2017), which is relevant to the competition within the nest, and is uncorrelated with individual product characteristics, since the formula of the brands has been fixed for decades. Moreover, it varies across the markets due to different offering of the packages. On the other hand, there are several sets of instruments for prices. The first set is differentiation IVs from Gandhi and Houde (2019). The intuition is that the closeness of product j and the other products in the characteristic space influences demand only through supply equilibrium on the bottler level. Suppose product j produced by firm f (so that $j\ inJ_{ft}$) has characteristics x_jlt, the IV takes the form of

$$Z_{jtl}^{\text{Local, Other}}(X) = \sum_{k \in J_{ft}\{j} \mathbf{1}(|d_{jktl}| < SD_l),$$

$$Z_{jtl}^{\text{Local, Rival}}(X) = \sum_{k \notin J_{ft}\{j} \mathbf{1}(|d_{jktl}| < SD_l),$$

where $d_{jktl} = x_{jlt} - x_{klt}$ is the difference in l between products j and k, SD_l is the standard deviation of these pairwise differences across all markets, and $\mathbf{1}(|d_{jktl}| < SD_l)$ indicates the closeness between products j and k in terms of characteristics l. The second set is the product-specific vertical relation status, which takes 1 if the product was bottled by an vertically integrated bottler after the integration occurred, and 0 otherwise. This instrument influences demand through the vertical supply relations. The third set is the distance (1000 miles) between the market and the closet plant of the bottler whose territory includes the market, which is a bottler-level cost shifter because the bottlers are responsible for delivery. Table 1.7 displays the first-stage results showing that the instruments are relevant.

The parameters to be estimated are the price coefficient α, characteristics coefficients β, and nesting parameter ρ. I use a two-step GMM method. In the first step, the moments are constructed using the lack of correlation between ξ and the instruments described above, while the optimal weighting matrix are used in the second step. I use the PyBLP package that incorporates many of the best practices in estimation (Conlon and Gortmaker, 2020).

Table 1.7: First-Stage Results of Instruments

	(1) prices	(2) Within-Group Shares
Differentiation IV 1	0.0299***	0.000414**
	(0.000352)	(0.000195)
Differentiation IV 2	0.00962***	-0.00355***
	(0.000342)	(0.000190)
Differentiation IV 3	0.0248***	-0.00101***
	(0.000339)	(0.000188)
Differentiation IV 4	0.0215***	-0.00272***
	(0.000352)	(0.000196)
VI Status	0.0504***	0.00582***
	(0.00159)	(0.000883)
Transportation Distance	0.000386***	-0.0000199***
	(0.00000787)	(0.00000437)
Num. Prod. in Nest	-0.0249***	-0.0553***
	(0.000655)	(0.000364)
small	4.060***	-0.131***
	(0.00490)	(0.00272)
diet	0.0228***	-0.00545***
	(0.00143)	(0.000794)
Constant	2.086***	0.833***
	(0.00362)	(0.00201)
Observations	847253	847253
R^2	0.886	0.072
F	734800.9	7319.7

Standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

1.4.2 Results

Table 1.8 displays the parameter estimates. The negative sign of the price coefficient is as expected. Consumers derive higher utility from small-sized drinks compared with family-sized drinks, and lower utility from diet drinks than sugary drinks. The nesting parameter is high, indicating that the consumers are loyal to a brand, and mainly substitute among the packages within the same brand. Appendix A presents additional results to show the robustness of the demand model.

Table 1.8: Demand Estimates

	Estimates
Prices	-1.4818
	(0.0104)
Small	6.6614
	(0.0465)
Diet	-0.4578
	(0.0025)
Nesting Parameter	0.8252
	(0.0034)

Using these estimates, we can derive the price elasticities of demand. Table 1.9 shows the product-level elasticities for 12-pack, 12 oz drinks, which is the most popular package among all brands. Each entry in the table represents the elasticity of the row product when the price of the column product changes. For example, when the price of 12-pack, 12 oz diet Coke increases by 1%, the quantity demanded falls by 12%, while the quantity demanded for the same package of other brands increases by around 0.13%. Table 1.10 shows the diversion ratio for 12-pack, 12 oz drinks. The diversion ratio $\mathcal{D}_{jk}$ defined below can be interpreted as the proportion of consumers that leave the column product following a price change for the row product. The diagonal entries are the diversion ratios towards the outside good. For all brands except regular Coke, around 18% consumers shift to the outside good following a 1% price increase, while the diversion ratio for regular Coke is around 27%. The diversion ratio shows price changes induced by vertical integration can have important implications on the demand for outside good, such as smaller brands or private-label drinks studied by Lopez et al. (2015).

Table 1.9: Product-Level Elasticities: 12-pack, 12 oz Drinks

Q\P	Diet Coke	Regular Coke	Diet Dr Pepper	Regular Dr Pepper	Diet Pepsi	Regular Pepsi
Diet Coke	-11.9638	0.1968	0.03	0.0645	0.0681	0.1405
Regular Coke	0.1334	-8.0598	0.03	0.0645	0.0681	0.1405
Diet Dr Pepper	0.1336	0.192	-12.1134	0.0646	0.0682	0.1407
Regular Dr Pepper	0.1329	0.1924	0.03	-12.1406	0.0681	0.1406
Diet Pepsi	0.1343	0.1872	0.0294	0.0614	-11.6341	0.1406
Regular Pepsi	0.1343	0.1871	0.0294	0.0615	0.0681	-11.2827

Table 1.10: Product-Level Diversion Ratios: 12-pack, 12 oz Drinks

Q\P	Diet Coke	Regular Coke	Diet Dr Pepper	Regular Dr Pepper	Diet Pepsi	Regular Pepsi
Diet Coke	0.1861	0.0172	0.0026	0.0057	0.0062	0.0129
Regular Coke	0.0164	0.2687	0.0037	0.0081	0.0088	0.0182
Diet Dr Pepper	0.0112	0.0162	0.1817	0.0055	0.006	0.0125
Regular Dr Pepper	0.0111	0.0161	0.0025	0.1826	0.006	0.0124
Diet Pepsi	0.0108	0.015	0.0024	0.005	0.1781	0.0119
Regular Pepsi	0.0112	0.0154	0.0025	0.0052	0.0059	0.1835

$$\mathcal{D}_{jk} = -\frac{\partial s_{kt}}{\partial p_{jt}} / \frac{\partial s_{jt}}{\partial p_{jt}}$$

Table 1.11 shows the price elasticities of different packages of diet Coke. Due to the high nesting parameter estimate, the cross-price elasticities are higher than those in Table 1.9, further suggesting that consumers tend to substitute among different packages of the same brand.

Table 1.11: Product-Level Elasticities: Diet Coke

Q\P	12 Pack 12.0 Oz	1 Pack 20.0 Oz	1 Pack 67.6 Oz	20 Pack 12.0 Oz	24 Pack 12.0 Oz	32 Pack 12.0 Oz	6 Pack 16.9 Oz	6 Pack 24.0 Oz	8 Pack 12.0 Oz
12 Pack 12.0 Oz	-11.9638	2.5948	2.8373	0.9102	1.044	1.6829	1.5717	1.055	0.9284
1 Pack 20.0 Oz	8.663	-55.8583	2.8185	0.9108	1.0441	1.6829	1.5697	1.0549	0.9262
1 Pack 67.6 Oz	8.6411	2.5935	-12.7252	0.9102	1.044	1.6829	1.5717	1.055	0.9281
20 Pack 12.0 Oz	9.0192	2.2429	2.3464	-19.2787	0.8612	1.6344	1.4904	1.0905	0.9636
24 Pack 12.0 Oz	8.954	2.1139	2.2348	0.6436	-18.2749	1.5716	1.5108	1.1101	0.93
32 Pack 12.0 Oz	7.8981	2.3931	2.9512	0.5658	0.167	-18.2264	1.283	0.0606	0.7769
6 Pack 16.9 Oz	8.5878	2.4142	2.8636	1.1501	0.7208	1.7426	-23.4699	0.087	1.0298
6 Pack 24.0 Oz	9.3137	2.0862	1.98	0.5146	1.4747	1.3773	1.5193	-19.5403	0.7984
8 Pack 12.0 Oz	8.8205	2.3453	2.6665	0.9026	1.0222	1.6774	1.5793	1.061	-30.2411

Given that the FTC's decisions focus on the syrup producer level, it is informative to examine the elasticities at an aggregated level. Table 1.12 displays the median brand-level elasticities, which represent the percentage change in quantities sold at the row brand level following a 1% increase in the price of all packages of the column brand. For example, if all packages of diet Coke increase the price by 1%, the quantity of diet Coke sold would drop by 3.38%, and that of other brands would increase by about 28%. This table reveals two insights. First, All own-price elasticities are negative and above 1, indicating that consumers substitute among different package sizes within the same brand. Second, There is moderate cross-price effect between different brands, suggesting pricing effects due to efficiency foreclosure could be important to consumers' substitution. The magnitudes of the elasticities are slightly lower than or similar to those found in existing literature that estimates CSD demand using scanner data.

Table 1.12: Brand-Level Price Elasticities of Demand

Q\P	Diet Coke	Regular Coke	Diet Dr Pepper	Regular Dr Pepper	Diet Pepsi	Regular Pepsi
Diet Coke	-3.3778	0.3256	0.0669	0.1402	0.1533	0.3067
Regular Coke	0.2898	-3.5678	0.0669	0.1403	0.1534	0.3067
Diet Pepsi	0.2839	0.3156	-3.6668	0.1464	0.1595	0.316
Regular Pepsi	0.2839	0.3157	0.0694	-3.5633	0.1597	0.3161
Diet Dr Pepper	0.2787	0.3025	0.0668	0.1382	-3.3107	0.33
Regular Dr Pepper	0.2788	0.3026	0.0668	0.1382	0.169	-3.0668

The demand estimates are helpful for us to understand consumers' behavior in the industry, and to recover the parameters in the supply model to understand the effects of vertical integration. Specifically, the bottlers' and syrup producers' production costs are inferred by solving their profit maximization problems. Section 7 will present counterfactual scenarios, assuming the consumer substitution patterns are fixed.

1.5 Supply

In this section, I use a two-tier vertical model of bottlers and syrup producers, derive their profit-maximizing conditions, and estimate their marginal costs of production, as well as the relationships between the costs and vertical integration status.

1.5.1 Bottlers

Assume bottlers have Nash-Bertrand competition to maximize their profit, which includes its revenue from sales and costs of production, and do not internalize the syrup producers' profits. Assume the bottlers set a linear per 100 oz retail price for each product. It incurs a constant marginal cost mc_j^b for each ounce of drink sold. The marginal cost includes the wholesale price $p^{f(j)}$, where $f(j)$ corresponds to the type of syrup used to produce product j. It may also include transportation and product-specific packaging materials. The profit of a bottler b is

$$\Pi_t^b = \sum_{j \in \mathcal{J}_t^b} (p_{jt} - mc_{jt}^b) s_{jt}(p), \tag{1.7}$$

where $\mathcal{J}_t^b$ is the bottler's product offering, including both franchised products and piggybacking products (if any). This suggests the bottler internalizes the loss in the rival products' sales if vertical integration had exerted foreclosure effects on them, and may make up for the loss by diverting sales to the franchised products. The profit-maximizing condition, written in vector form, is

$$p_t - mc_t^b = -(T_t * \Delta_{bt})^{-1} s_t(p), \tag{1.8}$$

where T_t is the $|\mathcal{J}_t|$ by $|\mathcal{J}_t|$ ownership matrix at the bottler level, which takes 1 if the column and row products are produced by the same bottler. Δ_{bt} is the consumers' substitution matrix on the bottler level, with element (j,k) = $\Delta_{j,k} = \frac{\partial s_{kt}}{\partial p_{jt}}$.

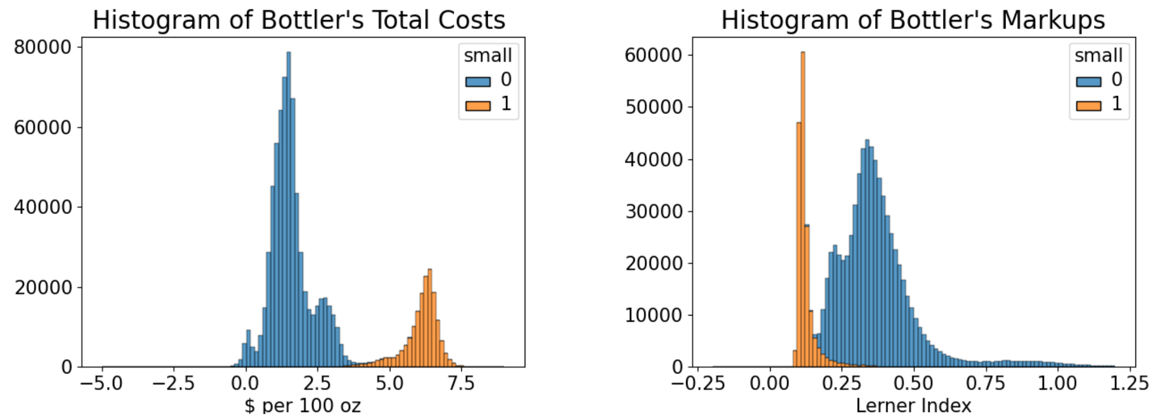
We can deduce the bottlers' price-cost margins and markups without observing wholesale prices from Equation 1.8 (Berto Villas-Boas, 2007), which allows us to analyze the disparities in bottlers' markups before and after integration. The derivation is presented in Appendix B. It sheds light on whether and to what extent the bottlers derived benefits from the integration, and the impact on rival bottlers' markups. The marginal costs are important for several reasons. First, by incorporating parameters on the vertical integration, we can estimate the cost efficiencies brought by the vertical integration. Second, by holding these parameters constant with alternative market structures in the counterfactuals, we can see how equilibrium quantities and prices change with alternative market structures.

Figure 1.4 shows the histogram the marginal costs mc_t^b and markups (Lerner Index) on the bottler level derived from Equation 1.8. The left panel displays the distribution of margins categorized by small or family size, which is also an important indicator of retail prices. The small sized-drinks have higher margin, around \$6 per 100 oz, and the family-sized drinks have lower marginal costs, around \$1 per 100 oz. The right panel shows that small-size drinks have around 10% markup, while the family-sized drinks have around 37% markup.

Assume the integrated bottlers receive a different wholesale price that is a proportion (λ_1) of the reported wholesale price. Then we can parameterize mc_t^b as in equation

$$mc_{jt}^b = \lambda_1 p_t^f + \lambda_2 \text{VI}_{bjt} + \lambda_3 \text{dist}_{bt} + \sigma_{package} + \sigma_{quarter} + \eta_{bjt} \tag{1.9}$$

To interpret Equation 1.13, λ_1 recognizes that the bottlers may receive a different wholesale price than reported, regardless of the integration status. This captures the unobserved variation



(a) (b)

Figure 1.4: Distribution of Bottlers' MC and Markups

in incidence-based pricing prevalent in the TCCC bottling system, but the details are lacking in the contract terms. λ_2 captures the potential eliminated wholesale margin that may reduce the bottlers' marginal costs. λ_3 captures the part of marginal costs incurred due to transportation costs, approximated by the distance between the bottler's nearest plant and the market. This is in accordance with the Direct Store Delivery (DSD) systems adopted by the bottlers, in which the bottlers incur transportation costs. λ_4 captures differences in marginal costs across products due to package sizes. In addition, σ is the fixed effects, and η_{bjt} is a structural error term.

With the marginal costs backed out from Equation 1.8, Table 1.13 shows the estimates of Equation 1.13 using OLS regression by brand. The standard errors are computed using The wholesale price is positively linked to marginal costs, as expected. The difference from 1 may be caused by unknown contractual terms or measurement errors. Integrated Coke bottlers receive 3∼7 cents of discount, and integrated Pepsi bottlers receive about 3 cents of wholesale discount. This discount ranges from 21%∼72% of discount. This reduction in double marginalization is in line with Luco and Marshall (2020) but is smaller in magnitude. Longer transportation distances are correlated with higher marginal costs, except that the distance coefficient is negative for regular Coke.

After estimating bottlers' costs and how their profits relate to vertical integration, we can apply this information to analyze syrup producers' incentives. This is relevant because syrup producers account for bottlers' responses (as in standard vertical models), and the partial internalization of bottlers' profits may alter their incentives to integrate.

Table 1.13: Bottlers' MC Components

	(1) Diet Coke	(2) Regular Coke	(3) Diet Pepsi	(4) Regular Pepsi	(5) Diet Dr Pepper	(6) Regular Dr Pepper
Concentrate Price	19.08***	161.3***	6.424***	10.10***	1.694***	3.725***
	(2.295)	(9.206)	(0.413)	(0.577)	(0.555)	(0.709)
VI	-0.0364***	-0.0779***	-0.0388***	-0.0355***		
	(0.00305)	(0.00408)	(0.00225)	(0.00202)		
Distance	0.000143***	-0.0000446**	0.000326***	0.000248***	0.000486***	0.000549***
	(0.0000158)	(0.0000206)	(0.0000117)	(0.0000105)	(0.0000108)	(0.00000983)
Quarter FE	Yes	Yes	Yes	Yes	Yes	Yes
Package FE	Yes	Yes	Yes	Yes	Yes	Yes
Num. Obs	162695	120744	142983	167500	114183	139148

Standard errors (in parentheses) are computed using the Huber/White/Sandwich estimator to be robust from heteroskedasticity of the errors.
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

1.5.2 Syrup Producers

This section uses the bottlers' results to estimate the syrup producers' costs, which remain constant throughout the counterfactual analysis. I present a model where syrup producers maximize their profits not only from syrup sales but also by partially incorporating the bottlers' profits. These estimates provide the foundation for evaluating counterfactual scenarios in the next section.

Assume each syrup producer f competes in setting linear wholesale prices p^f (measured in 100 ounces), and have a constant marginal cost of production (mc^{f_r} for sugary syrup and mc^{f_d} for diet syrup). To be consistent with the institutional details presented in Section 2, assume the price is uniform across all bottlers for product of the same sugary/diet category, so each syrup producer sets two prices p^{f_r} and p^{f_c} in each quarter. The syrup producer's profit function is

$$\Pi_q^f = \sum_t M_t \Bigg\{ (p^{f_r} - mc^{f_r}) \sum_{j \in \mathcal{J}_t^{fr}} s_{jt}(p) + (p^{f_d} - mc^{f_d}) \sum_{j \in \mathcal{J}_t^{fd}} s_{jt}(p) + O_t^{fb} \times \sum_{j \in \mathcal{J}_t^{b}} \Big[(p_{jt} - p_t^{f(j)} - mc_{jt}^{b}) s_{jt}(p) \Big] \Bigg\} \quad (1.10)$$

where t denotes counties in a given quarter, $\mathcal{J}_t^{fr}$ is the set of products that use f's sugary syrup, which are the set of drinks of the same regular brand and different package sizes, and $\mathcal{J}_t^{fd}$ is the set of products that use its diet syrup. In each county, f takes two elements into account in their profit function: syrup sales and affiliated bottlers' profits. The first element is its own profit of selling syrup that are used to produce $\mathcal{J}^{f_r}$ and $\mathcal{J}^{f_d}$, calculated by aggregating their market shares. The second element is its affiliated bottler's profit weighted by equity ownership $O_t^{f_b} \in [0,1]$. As explained in Section 2,both TCCC and PepsiCo consider this element while DPSG does not. It is important to note that the bottler's set of products $\mathcal{J}_t^b$ includes both the profit from selling the syrup producers' own brand and the piggybacking Dr Pepper drinks. The former partially offsets the double marginalization, while the latter provides additional incentives to induce price increases of the rival products in order to divert sales to its own products, which may in turn induce the increase in costs of its own products known as Edgeworth-Salinger effect explained by Luco and Marshall (2020).

Unlike the bottler's problem, due to the assumption that the syrup price is uniform across bottlers, we cannot solve the problems market by market. The first-order conditions with respect to p^{f_r} and p^{f_d} are

$$\sum_t M_t \Bigg\{ \sum_{j\in\mathcal{J}_t^{f_r}} s_{jt} + (p^{f_d} - mc^{f_d}) \sum_{j\in\mathcal{J}_t^{f_r}} \frac{\partial s_{jt}}{\partial p^{f_r}} + (p^{f_r} - mc^{f_r}) \sum_{j\in\mathcal{J}_t^{f_d}} \frac{\partial s_{jt}}{\partial p^{f_r}} + \\ + O_t^{fb} \times \left[- \sum_{j\in\mathcal{J}_t^{f_r}} s_{jt}(p) + \sum_{j\in\mathcal{J}_t^{b}} \left(\frac{\partial s_{jt}(p)}{\partial p^{f_r}} (p_{jt} - p^{f(j)} - mc^b_{jt}) + \frac{\partial p_{jt}}{\partial p_{f_r}} s_{jt}(p) \right) \right] \Bigg\} = 0 \quad (1.11)$$

$$\sum_t M_t \Bigg\{ \sum_{j\in\mathcal{J}_t^{f_d}} s_{jt} + (p^{f_d} - mc^{f_d}) \sum_{j\in\mathcal{J}_t^{f_r}} \frac{\partial s_{jt}}{\partial p^{f_d}} + (p^{f_r} - mc^{f_r}) \sum_{j\in\mathcal{J}_t^{f_d}} \frac{\partial s_{jt}}{\partial p^{f_d}} + \\ + O_t^{fb} \times \left[- \sum_{j\in\mathcal{J}_t^{f_r}} s_{jt}(p) + \sum_{j\in\mathcal{J}_t^{b}} \left(\frac{\partial s_{jt}(p)}{\partial p^{f_d}} (p_{jt} - p^{f(j)} - mc^b_{jt}) + \frac{\partial p_{jt}}{\partial p^{f_d}} s_{jt}(p) \right) \right] \Bigg\} = 0 \quad (1.12)$$

In both Equations 1.11 and 1.12, the first line is the impact of syrup price changes on the profit of selling syrup. Specifically, an increase in the syrup price contributes to an increase in the profits of the infra-marginal sales for the same brand, as well as a loss in its market shares due to a higher margin. The syrup producer also internalizes the increase in the sales of its other brand due to the substitution effects. The second line is the impact on affiliated bottlers' profit, weighted by equity ownership. Specifically, an increase in syrup prices raises retail prices due to pass-through effects, potentially reducing sales of this brand and lowering the bottler's margins. By internalizing these profit changes, the syrup producer has less incentive to raise syrup prices, reducing double marginalization—considered a positive effect of vertical integration.

Conversely, the syrup producer also internalizes the effect on rival brands including Dr Pepper, suggesting an incentive to set a syrup price to decrease Dr Pepper's market share to divert sales to its own brands. The specific magnitude of the impacts depends on the demand estimates in Section 5, as well as the syrup producer's costs of production, which can be estimated by solving Equations 1.11 and 1.12.

Figure 1.5 presents estimates of the syrup producers' marginal costs. We can note several key points. First, diet syrup is generally more expensive to produce than sugary syrup, aligning with industry knowledge that the use of artificial sweeteners increases production costs. Second, production costs of Dr Pepper have been largely stable, while there is a sharp increase in both Pepsi and Coke following the integration events. One explanation is that when the syrup producer internalizes the bottlers' profits to a high extent, the marginal costs have to be high to rationalize the realized price. Third, Coke and Pepsi have lower marginal costs than Dr Pepper, which may due to input costs or technology advantages. Figure 1.6 presents estimates of the syrup producers' markups. The key takeaways include: first, Dr Pepper syrup markups have remained around 60%. Coke and Pepsi's had high markups prior to integration, but dropped following the vertical integration events, suggesting the alignment in the incentives between the syrup producers and the bottlers. The syrup producers charge similar markups from unintegrated and integrated bottlers, suggesting the magnitude of the reduction of double marginalization is small.

Equipped with both demand- and supply-side estimates, we can simulate the counterfactual scenarios of alternative market structures.

1.6 Counterfactual Exercises

The counterfactual exercises aim to disentangle the efficiency and foreclosure effects of vertical integration. I conduct three sets of exercises. The first two sets maintain ownership relations, in which the syrup producer continues internalizing bottler profits as in reality. The first exercise isolates foreclosure by setting equal syrup prices for integrated and unintegrated bottlers, removing efficiency effects. The second exercise eliminates foreclosure by restricting the syrup producer's ability to influence Dr Pepper's retail price through concentrate pricing. The third exercise is a full divestiture, where syrup producers no longer internalize bottler profits. The divestiture eliminates both double marginalization and foreclosure. Comparing this scenario with the first set sheds light on the magnitude of these effects under partial ownership.

Each exercise uses observed market data and follows a two-step estimation: the inner loop computes downstream equilibrium given syrup prices, while the outer loop optimizes syrup

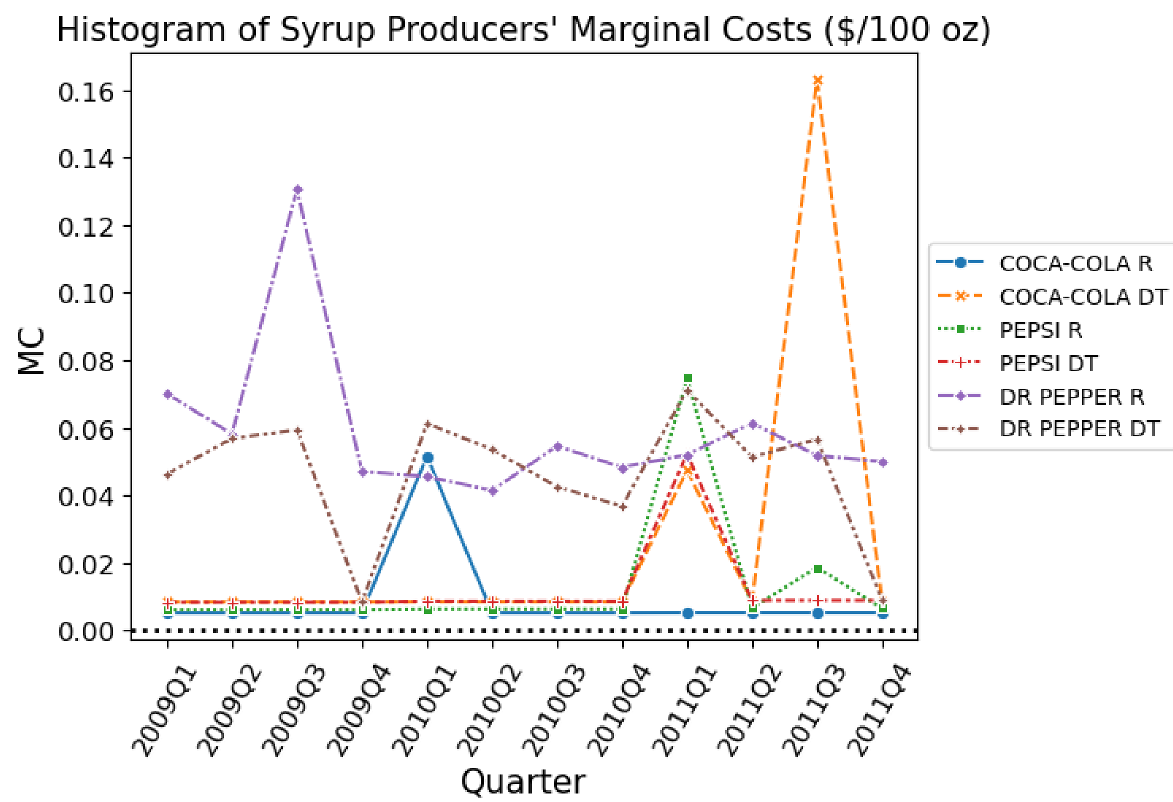
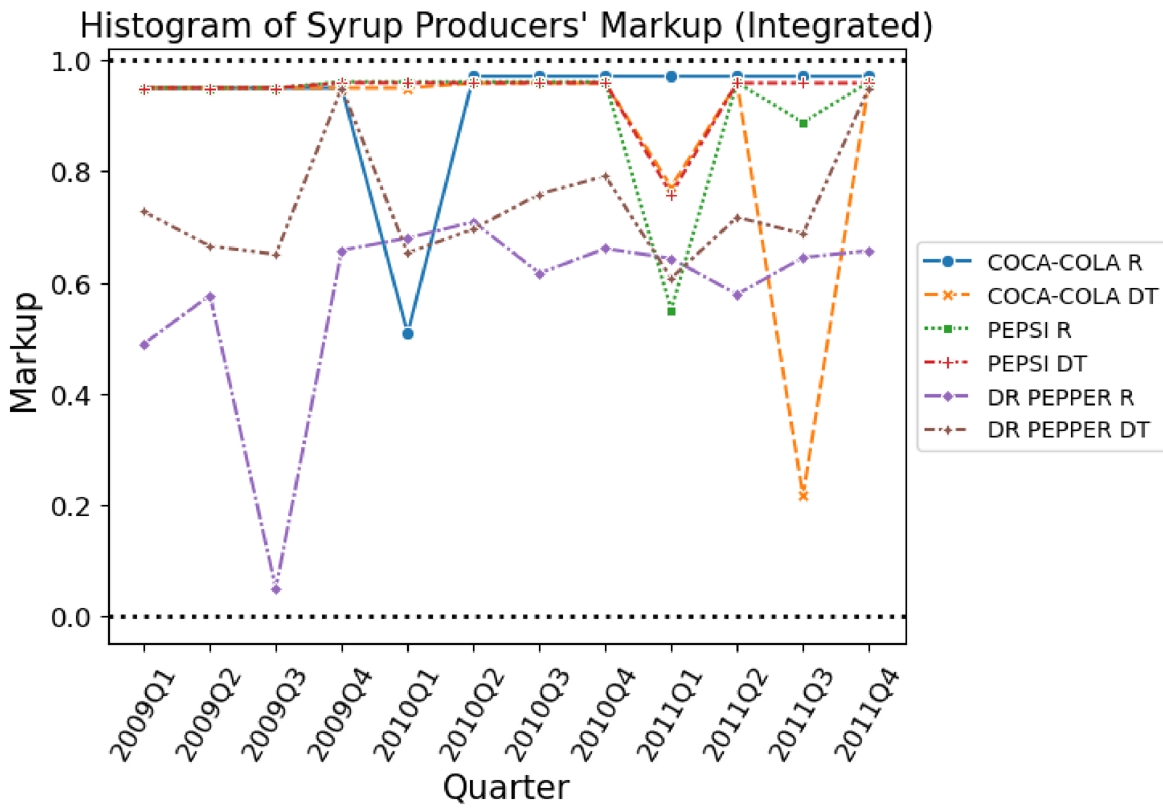


Figure 1.5: Estimates of the Syrup Producers' MC

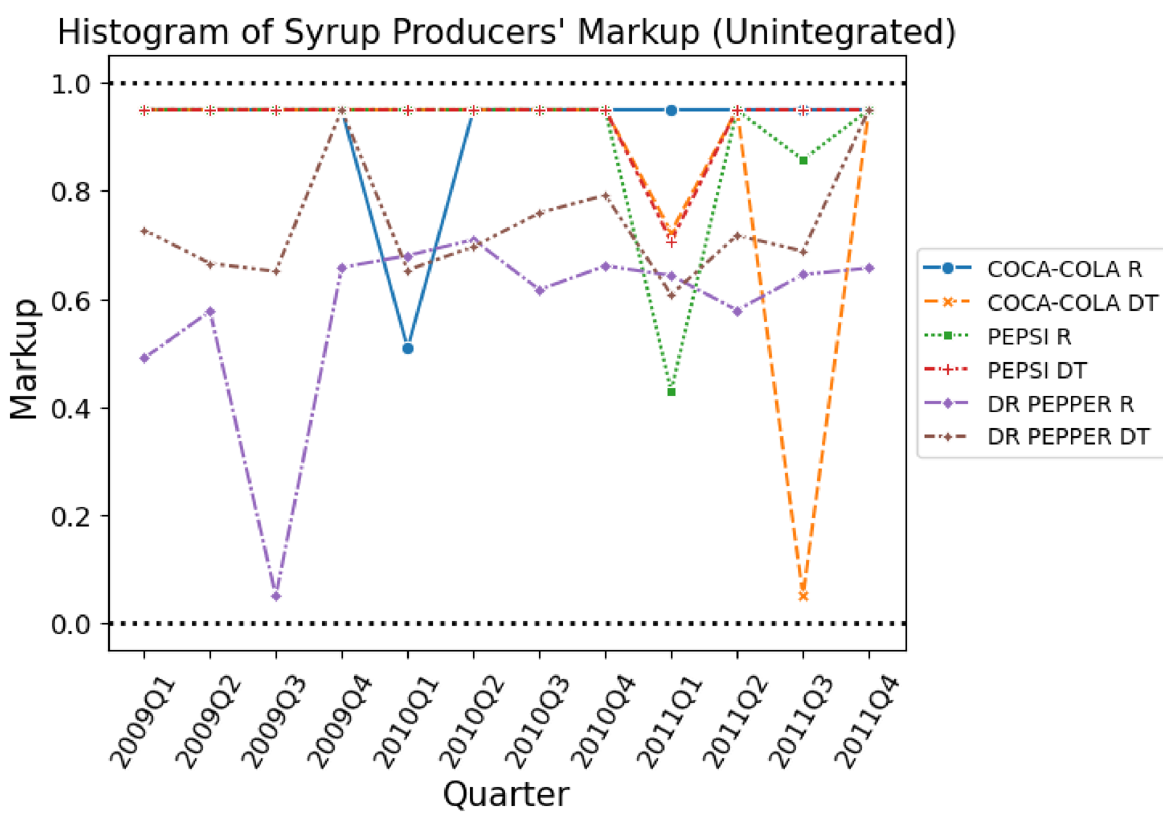
producers' pricing under the new structure. In the following subsections, I compare each counterfactual scenario to the baseline (actual) equilibrium and report the changes in outcomes, measured as the difference between the counterfactual and actual results, both in absolute and percentage terms ((counterfactual - actual) / actual).

1.6.1 Counterfactual 1: Removing Efficiency

In this set of counterfactual exercises, I isolate the efficiency effect of vertical integration by assuming that the vertically integrated bottlers did not receive the discount estimated from Equation 1.13 ($\$\lambda_2$ per 100 oz.). The analysis consists of three exercises: (1) removing the discount for both vertical integration events, (2) removing it only for the TCCC event, and (3) removing it only for the PepsiCo event. These exercises are conducted using the observed market data. For each exercise, I solve the counterfactual equilibrium prices and quantities and calculate the resulting changes in bottlers' profits, syrup producers' profits, and consumer surplus (measured as counterfactual - actual, summarized across the post-integration quarters).



(a)



(b)

Figure 1.6: Estimates of the Syrup Producers' Markups

$$mc^b_{jt} = \lambda_1 p^f_t + \lambda_2 \text{VI}_{bjt} + \lambda_3 \text{dist}_{bt} + \lambda_4 \text{Small}_j + \sigma_b + \sigma_t + \eta_{bjt} \tag{1.13}$$

1.6.1.1 Bottler Profit Changes

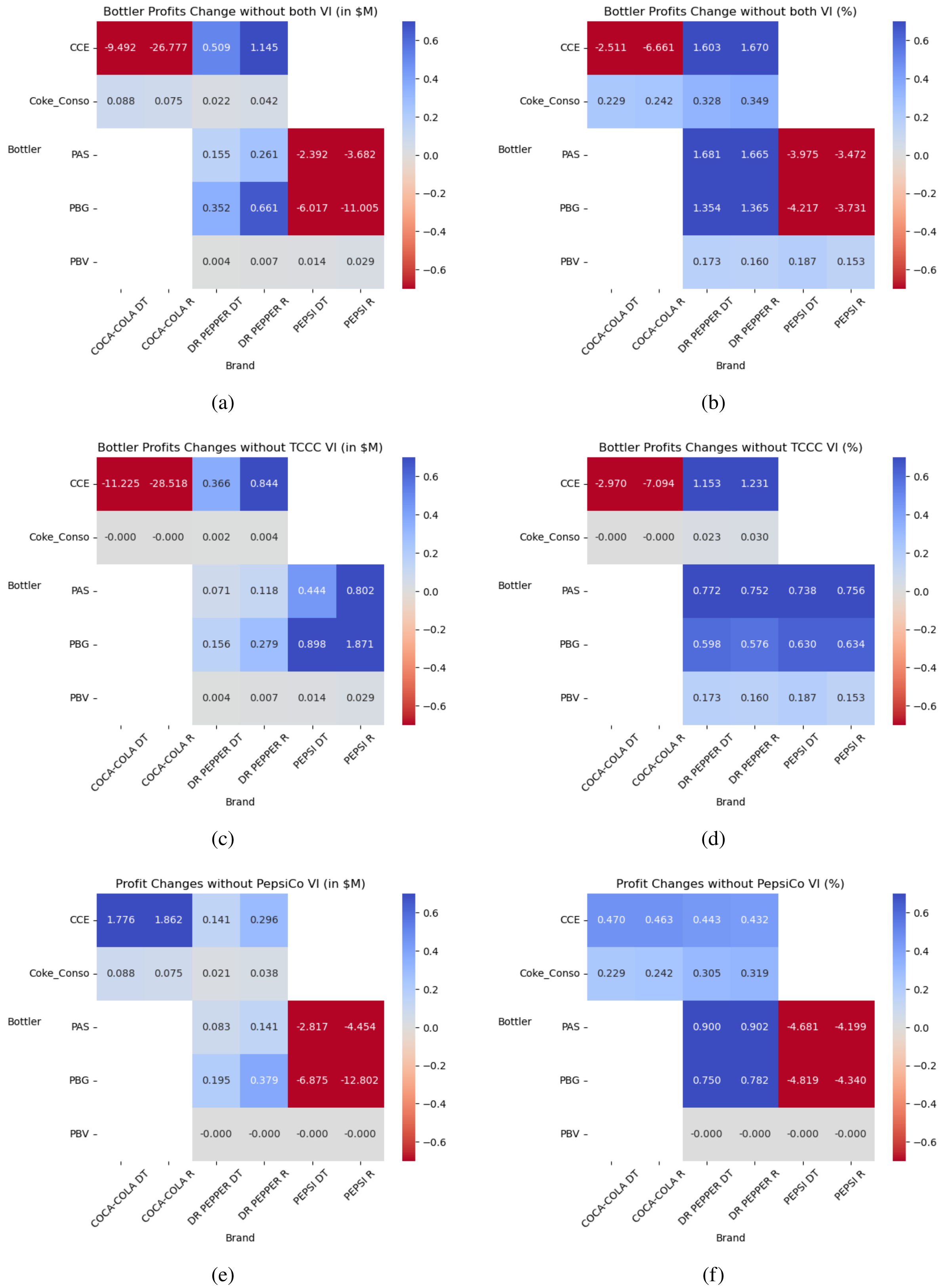
Figure 1.7 presents the changes in bottlers' profits by brand across the three exercises. The first row shows the results of eliminating the efficiency effects from both events, the second row shows the effects of eliminating only the TCCC event, and the third row shows the effects of eliminating only the PepsiCo event. In each row, the first column displays the changes in millions of dollars, while the second column shows the corresponding percentage changes.

In the first row, removing the efficiency effects of both events together leads to substantial profit losses for the parent brands due to increased marginal costs for the integrated bottlers compared with the actual scenario. For instance, in the case without both integration events, CCE's profits would have been reduced by \$36M (9.492+26.777) in from selling Coca-Cola products, PAS's profits would have been reduced around \$6M from Pepsi sales, and PBG's profits would have been reduced around \$17M, representing reductions of 2% to 6% across these brands. In contrast, compared with the actual scenario, there would have been modest gains in the profits of Dr Pepper sold by the integrated bottlers, ranging from 0.155 to 1.145 million dollars. This suggests that the efficiency effects increased profits through reduced marginal costs and lower prices, consistent with the theory of double marginalization, albeit at the expense of Dr Pepper's profits due to substitution effects. The profit of the unintegrated bottlers would have changed little due to exclusive territories and a lack of intrabrand competition.

When removing the efficiency effects of only TCCC event, CCE would have seen a decrease around \$40M of profits from selling Coca-Cola products, and an increase around \$1M from Dr Pepper. In contrast, PAS and PBG would have earned approximately \$1M and \$3M more in profits from Pepsi, respectively, compared to the actual outcomes, along with modest gains from Dr Pepper. This may stem from the fact that consumers perceive Coca-Cola and Pepsi as closer substitutes compared with Dr Pepper. Similarly, when removing the efficiency effects of only PepsiCo event, PBG and PAS would have earned around \$19M and \$7M less in profits from Pepsi respectively, compared to the actual outcomes. CCE would have increased the profits around \$3.6M. In addition, the profit from selling Dr Pepper would have increased slightly.

1.6.1.2 Syrup Producer Profit Changes

Table 1.14 displays the changes in syrup producers' profit when eliminating the efficiency effects. When eliminating either event, the syrup producer would have earned more profits from selling syrup due to a higher wholesale price. The magnitude ranges between 18% and 26%.



(a) (b) (c) (d) (e) (f)

Figure 1.7: Bottler Profit Changes After Removing Efficiency

Table 1.14: Syrup Producer Profit Changes After Removing Efficiency

	Without Both VI		Without TCCC VI		Without PepsiCo VI	
Syrup Producer	Profit Δ ($M)	Profit Δ (%)	Profit Δ ($M)	Profit Δ (%)	Profit Δ ($M)	Profit Δ (%)
TCCC	40.084	26.596	0	0	40.084	26.596
PepsiCo	26.828	18.374	26.828	18.374	0	0
DPSG	0	0	0	0	0	0

1.6.1.3 Consumer Surplus Changes

Table 1.15 presents the changes in consumer surplus across the three exercises, aggregated by the overlapping areas of major bottlers. When eliminating the efficiency effects from both events, consumers in the overlapping areas of CCE and PBG would have reduced their surpluses approximately $34M, representing a 3.37% decline. Similarly, consumers in the overlapping areas of CCE and PAS would have seen a decline around $12.7M (3.34%). In areas served by unintegrated bottlers, the decrease in surplus range from 0.9% to 1.9%. Overall, total consumer surplus would have decreased by $55M, accounting for an inconsiderable amount of the actual total surplus. These findings suggest that the efficiency effects from vertical integration are passed on to consumers through lower prices.

When eliminating the efficiency effects of only one event, the losses are concentrated in the areas served by the respective integrated bottlers. For instance, compared with the actual outcomes, removing the TCCC efficiency effects would have resulted in losses of approximately $27M for consumers served by CCE. In total, it contributes to 1.1% reduction of the total welfare losses. Similarly, eliminating PepsiCo's efficiency effects would have led to 0.786% lower consumer surplus compared to the actual case.

Table 1.15: Consumer Surplus Changes After Removing Efficiency

	Without Both VI		Without TCCC VI		Without PepsiCo VI	
Bottler	CS Δ ($M)	CS Δ (%)	CS Δ ($M)	CS Δ (%)	CS Δ ($M)	CS Δ (%)
CCE - PBG	-33.974	-3.368	-20.398	-2.022	-13.542	-1.343
CCE - PAS	-12.639	-3.347	-7.156	-1.895	-5.471	-1.449
CCE - PBV	-0.232	-1.979	-0.232	-1.979	0	0
Coke Conso - PBG	-1.163	-1.433	0	0	-1.163	-1.433
Coke Conso - PAS	-0.012	-0.905	0	0	-0.012	-0.905
Coke Conso - PBV	0	0	0	0	0	0
Other	-7.044	-0.244	-4.503	-0.156	-2.541	-0.088
Total	-55.064	-1.906	-32.29	-1.118	-22.728	-0.786

1.6.1.4 Total Surplus Changes

Table 1.16 shows the changes of the total surplus, and Table 1.17 shows the changes on a more disaggregated level. The efficiency effects of the two VI events together have contributed to 0.687% increase of the total surplus. Similarly, eliminating the efficiency effect of one event alone would reduce the total surplus, with 0.62% and 0.062% for the TCCC and PepsiCo event respectively.

Table 1.16: Total Surplus Changes After Removing Efficiency

	Actual ($M)	Without Both VI ($M)	Without TCCC VI ($M)	Without PepsiCo VI ($M)
	6115.339	6073.3	6077.438	6111.556
Total Surplus Δ (%)	/	-0.687	-0.62	-0.062

To sum up, eliminating the efficiency effects would have resulted in lower bottler profits, higher syrup producers' profits, and lower consumer surplus. The losses outweigh the gains in terms of total surpluses.

Table 1.17: Total Surplus Changes After Removing Efficiency (Disaggregated)

		Actual ($M)	Without Both VI ($M)	Without TCCC VI ($M)	Without PepsiCo VI ($M)
Bottlers	CCE	1208.774	1174.16	1170.242	1212.849
	Coke Conso	123.702	123.931	123.708	123.925
	PAS	259.739	254.081	261.174	252.693
	PBG	705.851	689.842	709.055	686.747
	PBV	46.064	46.117	46.117	46.064
	Other: DPSG	143.817	144.889	144.577	144.125
	Other: PepsiCo	221.561	222.25	222.25	221.561
	Other: TCCC	164.772	165.177	164.772	165.177
	Total	2874.28	2820.447	2841.895	2853.141
Syrup Producers	Coca-Cola	150.714	190.798	150.714	190.798
	DPSG	52.196	52.196	52.196	52.196
	PepsiCo	146.013	172.841	172.841	146.013
	Total	348.923	415.835	375.751	389.007
Consumer		2892.136	2837.018	2859.792	2869.408
Total Surplus		6115.339	6073.3	6077.438	6111.556
Changes ($M)			-42.039	-37.901	-3.783
Changes (%)			-0.687	-0.62	-0.062

1.6.2 Counterfactual 2: Removing Foreclosure

Counterfactual II removes the foreclosure incentive by assuming that TCCC and PepsiCo no longer influence the retail pricing decisions of Dr Pepper products in the case of piggybacking. This scenario reflects a setting in which integrated bottlers set Dr Pepper prices independently, without considering the parent company's profits from Dr Pepper alongside its own brands.

In the absence of this competitive concern, bottlers may lower Dr Pepper prices relative to the actual case. To implement this counterfactual, we modify Equations 1.11 and 1.12 by excluding Dr Pepper products from the profit internalization term. Specifically, we adjust the summation from $\sum_{j \in \mathcal{J}_t^b}$ to $\sum_{j \in \mathcal{J}_t^b \setminus \mathcal{J}_t^{DPSG}}$, where $\mathcal{J}_t^{DPSG}$ denotes the set of Dr Pepper products.

The pseudo code for Counterfactual II is presented in Appendix C. For each candidate value of the syrup producers' wholesale price, I recompute the bottlers' marginal costs, the resulting equilibrium retail prices and market shares, and the corresponding consumer substitution and pass-through matrices. These values are then substituted into the syrup producers' FOC, and the candidate price that satisfies the FOC equation is selected.

1.6.2.1 Bottler Profit Changes

The top panel of Figure 1.8 presents the changes in bottler profits under Counterfactual II relative to the actual outcomes. When foreclosure is removed, bottlers would have earned higher profits from Coca-Cola, Dr Pepper, and diet Pepsi. Notably, diet Dr Pepper shows the largest profit increase (0.9%–1%), followed by diet Pepsi (around 0.7%). Regular Dr Pepper shows a modest increase of 0.1%, while CCE experiences a slight decrease of 0.07%. These magnitudes are lower than those for Coca-Cola products (around 0.4%) but higher than for regular Pepsi (a 0.1% decrease). These patterns suggest that foreclosure has limited bottlers' ability to extract profits from piggybacking products, particularly diet Dr Pepper. Due to substitution patterns, bottlers appear more capable of profiting from Coca-Cola and diet Pepsi in the absence of foreclosure. Overall, the magnitude of profit changes is smaller than those shown in Figure 1.7, implying that the efficiency channel may play a more significant role in affecting bottler profits."

1.6.2.2 Syrup Producer Profit Changes

The second column of Table 1.18 presents the changes in syrup producers' profits from concentrate sales after removing foreclosure. All syrup producers would have earned higher profits, with PepsiCo showing the largest increase (16.771%), followed by DPSG (12.836%) and TCCC (8.509%). Under foreclosure, a syrup producer has an incentive to lower its syrup price to encourage lower retail prices for its own products, thus gaining a competitive advantage over piggybacking products. This strategic pricing leads to lower equilibrium syrup prices. When foreclosure is removed, equilibrium prices rise, and substitution patterns shift in a way that boosts profits for all syrup producers, including DPSG. These results highlight the importance of empirical demand patterns and substitution elasticities in shaping the impact of foreclosure.

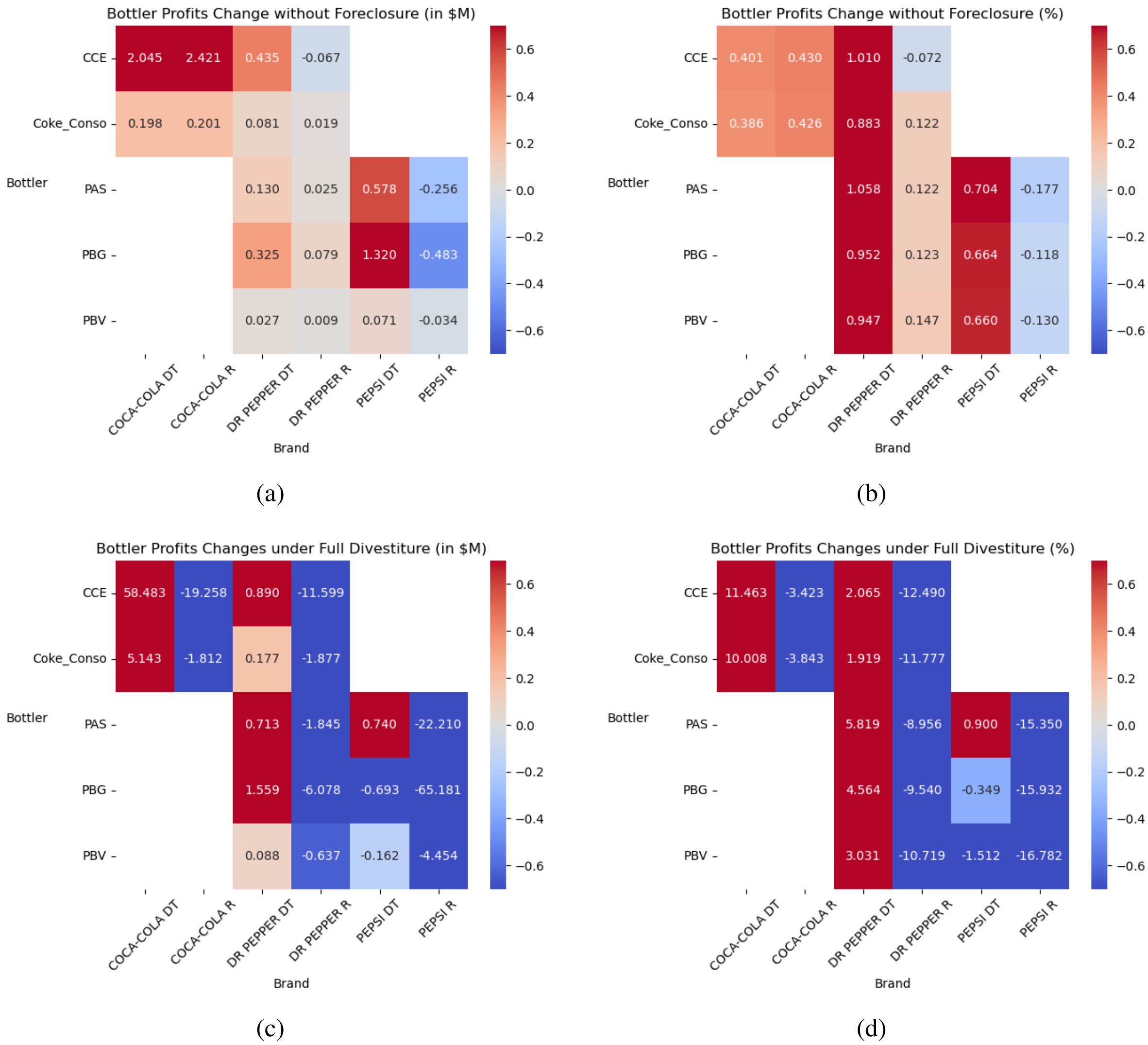


Figure 1.8: Bottler Profit Changes After Removing Foreclosure and under Full Divestiture

Table 1.18: Syrup Producer Profit Changes After Removing Foreclosure and under Full Divestiture

	Without Foreclosure		Full Divestiture	
Syrup Producer	Profit Δ ($M)	Profit Δ (%)	Profit Δ ($M)	Profit Δ (%)
TCCC	16.235	8.509	24.518	12.85
PepsiCo	28.987	16.771	-17.181	-9.94
DPSG	6.7	12.836	-13.903	-26.636

1.6.2.3 Consumer Surplus Changes

The left two columns of Table 1.19 show changes in consumer surplus, grouped by Coke and Pepsi bottlers' territories. Compared to the actual outcomes, when foreclosure is removed, consumers would have experienced a surplus loss ranging from 1.491% to 1.983%. A larger magnitude would have been observed in the integrated bottlers' territories (CCE, PBG, PAS).Overall, removing foreclosure results in a 1.684% net decrease in consumer surplus, which is similar to the results of eliminating efficiency. This suggests that consumers are slightly better off under the actual market structure. While this may appear counter-intuitive, it aligns with the observed outcomes for producers: foreclosure-induced price reductions on both integrated and piggybacking products may have created localized consumer benefits. In equilibrium, these price distortions, motivated by strategic interests, could translate into lower retail prices in certain markets, ultimately benefiting consumers.

Table 1.19: Consumer Surplus Changes After Removing Foreclosure and under Full Divestiture

	Without Foreclosure		Full Divestiture	
Bottler	CS Δ ($M)	CS Δ (%)	CS Δ ($M)	CS Δ (%)
CCE - PBG	-23.123	-1.665	-503.242	-36.247
CCE - PAS	-8.229	-1.603	-182.406	-35.523
CCE - PBV	-0.312	-1.887	-6.238	-37.779
Coke Conso - PBG	-1.959	-1.762	-42.094	-37.878
Coke Conso - PAS	-1.214	-1.983	-24.306	-39.712
Coke Conso - PBV	-0.027	-1.491	-0.619	-34.208
Other	-13.844	-1.743	-296.571	-37.34
Total	-48.707	-1.684	-1055.477	-36.49

1.6.2.4 Total Surplus Changes

When foreclosure effects are removed, total surplus would have increased by 1.208%. This gain is primarily driven by higher profits for bottlers and syrup producers, while consumer surplus sees a slight decline. The magnitude exceeds that of the efficiency counterfactual (0.687%), suggesting that the foreclosure channel plays a more substantial role in shaping overall market surplus.

1.6.3 Counterfactual 3: Full Divestiture

Counterfactual III estimates a new market equilibrium under full divestiture between syrup producers and bottlers, thereby removing the effects of efficiency gains, foreclosure, and

Table 1.20: Total Surplus Changes After Removing Foreclosure and under Full Divestiture

	Actual ($M)	Without Foreclosure ($M)	Full Divestiture
	6115.339	6189.2	5028.96
Total Surplus Δ (%)	/	1.208	-17.765

Table 1.21: Total Surplus Changes After Removing Foreclosure and under Full Divestiture (Disaggregated)

		Actual ($M)	Without Foreclosure ($M)	Full Divestiture ($M)
Bottlers	CCE	1208.774	1213.609	1237.29
	Coca Conso	123.702	124.203	125.333
	PAS	259.739	260.217	237.137
	PBG	705.851	707.091	635.458
	PBV	46.064	46.136	40.899
	Other: DPSG	143.817	144.625	140.843
	Other: PepsiCo	221.561	222.023	199.331
	Other: TCCC	164.772	165.479	172.108
	Total	2874.28	2883.382	2788.399
Syrup Producers	Coca-Cola	150.714	207.033	215.317
	DPSG	52.196	58.897	38.294
	PepsiCo	146.013	201.828	155.66
	Total	348.923	467.758	409.271
Consumer		2892.136	2838.06	1831.29
Total Surplus		6115.339	6189.2	5028.96
Changes ($M)			6.949	-1153.291
Changes (%)			1.208	-17.765

partial ownership. To implement this, I restore double marginalization so that integrated and unintegrated bottlers face the same wholesale price. I also set $O^{fb} = 0$, ensuring that syrup producers no longer internalize bottlers' profits.

However, I retain the bottlers' existing product portfolios, including piggybacking behavior, as it may not be realistic for DPSG to identify alternative bottlers with similar capacity in the short run.

The pseudo code for Counterfactual III is presented in Appendix C.

1.6.3.1 Bottler Profit Changes

The bottom panel of Figure 1.8 shows the changes in bottler profits under Counterfactual III. Under full divestiture, Coke bottlers would have earned less from regular products (around 3% for regular Coke and 12% for regular Dr Pepper), and more from diet products (11% for diet Coke and 2% for diet Dr Pepper), compared to the actual outcomes. Pepsi bottlers would have earned less from Pepsi (around 15% for regular Pepsi and 0.3-1.5% for diet Pepsi, except diet Pepsi produced by PAS) and diet Dr Pepper(9-10%), but more from regular Dr Pepper (3-5%). This suggests that under divestiture, bottlers extract more profits from diet products, while under the current integrated structure, they benefit more from regular products.

A possible explanation is that, in the actual market, vertical integration incentivizes syrup producers to align pricing strategies with the more popular regular products, enhancing bottlers' ability to profit from them. In contrast, divestiture eliminates these strategic incentives, allowing bottlers to focus on differentiated segments such as diet products, where pricing power and consumer loyalty may offer better margins in the absence of integration-driven coordination.

1.6.3.2 Syrup Producer Profit Changes

The third column of Table 1.18 shows changes in syrup producers' profits from selling syrup under full divestiture. PepsiCo and DPSG would have experienced 10% and 27% lower profits, while TCCC would have earned 12.85% higher profits. This suggests that full divestiture benefits only Coca-Cola, likely due to differences in brand strength and substitution patterns. Coca-Cola may benefit from stronger consumer loyalty and less cannibalization across its product line, while DPSG and PepsiCo face tougher competition and greater reliance on coordinated pricing strategies that are disrupted under divestiture.

1.6.3.3 Consumer Surplus Changes

The right two columns of Table 1.19 show changes in consumer surplus, grouped by Coke and Pepsi bottlers' territories. When there is a full divestiture, consumers in all territories are worse off. In total, there is a 36.49% decrease in consumer surplus, suggesting that the current structure is more beneficial to consumers than a fully independent one.

1.6.3.4 Total Surplus Changes

Table 1.20 shows the changes in total surplus, while Table 1.21 presents more disaggregated results. Compared to the actual outcomes, under full divestiture, total surplus decreases by 17.765%, primarily due to reduced consumer surpluses.

1.7 Conclusions

This study examines the competitive effects of vertical integration between syrup producers (TCCC and PepsiCo) and their formerly partially owned bottlers, with a particular focus on potential foreclosure of rival brands such as Dr Pepper. Using a combination of reduced-form analysis and a structural demand model, I estimate brand-level substitution patterns and quantify changes in retail prices and profits under various counterfactual scenarios.

While previous work has documented evidence consistent with both efficiency gains and foreclosure effects in vertical mergers (Luco and Marshall, 2020; Adachi, 2020), this paper takes a novel step by decomposing the welfare impacts of each mechanism and identifying the distribution of gains and losses across syrup producers, bottlers, and consumers. By simulating surplus changes under counterfactual scenarios that selectively mute each mechanism, this analysis provides a more granular picture of how vertical integration reshapes market dynamics.

Compared to earlier studies that focused on price changes, this paper reveals more nuanced shifts in surplus. Compared to prior studies that emphasized price effects, this paper uncovers how vertical integration reshapes the distribution of surplus among market participants. Efficiency gains, while present, account for a modest 0.687% increase in total surplus. In contrast, foreclosure effects are more disruptive, as removing them would increase total surplus by 1.2%, primarily through higher profits for syrup producers and bottlers, though at the cost of slightly lower consumer surplus. A full divestiture, however, leads to a substantial 17.765% drop in total surplus, largely driven by a decline in consumer surplus, despite mixed impacts on producer profits.

These results suggest that foreclosure plays a more significant role than efficiency gains in shaping overall welfare. If consumer surplus is the primary policy objective, as often emphasized in antitrust enforcement, then the FTC's approval of the mergers may be justified. However, if total surplus is prioritized, then foreclosure effects warrant greater concern, as they reduce consumer welfare even when efficiency gains are present.

Overall, the analysis reveals complex trade-offs: efficiency enhances total surplus, foreclosure harms total surplus but may benefit consumers, while divestiture significantly reduces total surplus. These findings point to the need for careful scrutiny of foreclosure risks in future vertical mergers and suggest that the FTC's decisions should weigh not only average welfare but also the distributional consequences across firms and consumers.

Appendix A
Additional Results using Alternative Demand Models

This appendix presents results from alternative demand model specifications. Table A.1 reports estimates from a standard logit model and nested logit models with different nest definitions, and nested logit models with more granular packaging features.

Despite some differences in magnitude, the coefficients on price and the small-package indicator remain robust across specifications. The coefficient on the diet indicator is also consistent in all models except the nested logit with syrup producers as the nest.

However, the nesting parameters in all alternative nested logit models reach their upper bound, suggesting that these nest definitions imply implausibly low substitution across groups. In contrast, the current specification yields more reasonable substitution patterns and is therefore preferred.

Due to data limitations in bottler territories for brands beyond the six primary ones studied, I am unable to report demand estimates with an expanded brand set. However, incorporating more brands could enhance the robustness of the demand estimation and remains an important direction for future analysis.

Table A.1: Demand Parameters using Alternative Models

	Simple Logit	Nested Logit	Nested Logit	Nested Logit
Prices	-2.7447	-1.2705	-0.7565	-0.579
	(0.0156)	(0.0105)	(0.0076)	(0.0094)
Small	1.1885	5.8176	3.4944	/
	(0.0717)	(0.0465)	(0.0341)	
Diet	-0.2909	0.0084	-0.4331	-0.5338
	(0.0043)	(0.0002)	(0.0014)	(0.0016)
Nest	/	Syrup Producer	Diet	Brand
Nesting Parameter	/	0.99	0.99	0.99
		(0.0047)	(0.0025)	(0.0064)
Package FE	N	N	N	Y
Syrup Producer FE	Y	Y	Y	Y

Appendix B
Derivation of the Pass-through Rates

This appendix presents the derivation of the pass-through rate, building on the framework in Berto Villas-Boas (2007).

To obtain the pass-through rate Δ_{ft}, first note that $\Delta_{ft} = \Delta'_{pt}\Delta_{bt}$, where Δ_{pt} is a matrix of derivatives of all the retail prices with respect to all the wholesale prices, and Δ'_{bt} is the consumers' substitution matrix.

A key distinction is that in their setting, the number of products at the wholesale and retail levels is the same. In contrast, my setting involves six types of syrup concentrates at the wholesale level and up to 45 retail products, consisting of different packages of six brands. A change in the wholesale price of a concentrate affects all packaged drinks of that brand directly, and affects other products indirectly through consumer substitution. As a result, I modify both the derivation and the computational procedure to account for the mapping between wholesale and retail products.

Starting with the bottler's profit:

$$\Pi_t^b = \sum_{j \in \mathcal{J}_t^b} (p_{jt} - mc_{jt}^b) s_{jt}(p), \tag{B.1}$$

Take first-order condition with respect to p_{jt}:

$$s_{jt} + \sum_{m \in \mathcal{J}_t^b} \left[p_{mt} - p_{mt}^f - c_{mt}^b \right] \frac{\partial s_{mt}}{\partial p_{jt}} = 0 \quad \forall j \in \mathcal{J}_t^b. \tag{B.2}$$

Suppressing the subscript t for simpler presentation, taking total differentiation for a given j in B.2 with respect to all prices ($dpk, \quad k = 1, \ldots, |\mathcal{J}^b|$) and a wholesale price p_v^f, and denoting $|\mathcal{J}^b| = N$, we have

$$\sum_{k=1}^{N} \underbrace{\left[\frac{\partial s_j}{\partial p_k} + \sum_{i=1}^{N} \left(T(i,j) \frac{\partial^2 s_i}{\partial p_j \partial p_k} (p_i - p_i^f - c_i^b) \right) + T(k,j) \frac{\partial s_k}{\partial p_j} \right]}_{g(j,k)} dpk - \underbrace{T^{fb}(v,j) \frac{\partial s_v}{\partial p_j}}_{h(j,v)} dp_v^f = 0.$$

Let G be the matrix with element $g(j,k)$, H_v be row with general element $h(j,v)$, then $G dp - H_v dp_v^f = 0$, so $\frac{dp}{dp_v^f} = G^{-1} H_v$. Stacking together all columns of H_v, we have $\Delta_p = G^{-1} H$, with general element $\Delta_p(i,j) = \frac{\partial p_j}{\partial p_i^f}$.

The derivation of G follows Berto Villas-Boas (2007), using the consumer substitution matrix, bottlers' price-cost margins, and the ownership matrix. In the expression for $H(j,v)$, the matrix T_{vj}^{fb} takes the value 1 if packaged drink j is made from syrup v, or if j is made from a different syrup but its bottler also produces products made from v—either because they belong to the same syrup producer or due to piggybacking across different syrup producers. Since there are six types of syrups, the dimension of T^{fb} is $N \times 6$.

A change in the wholesale price p_v directly affects the shares of all products made with syrup v. The aggregate share of these products is denoted s_v. Consequently, the dimension of H, and therefore Δ_p and Δ_f is also $N \times 6$.

Appendix C
Pseudo Code for Counterfactuals II and III

This appendix presents the pseudo code for estimating Counterfactuals II and III in Section 1.7. The following pseudo code outlines the implementation.

Algorithm 1 Counterfactuals II & III

Input: starting values of syrup producer margin $margin_0^f$, syrup producer marginal costs mc^f, bottlers' marginal cost parameters λ, distance between bottlers' plants and consumers $dist$, ownership matrices T and T^{fb}, syrup ownership matrix O^{fb}, market size M,

Output: Syrup producers' margins $margin^f$

Outer loop:

Optimize over syrup producer margin $margin^f$ to minimize the difference between syrup producers' new FOCs and 0.

Inner loop:

for each candidate of $margin_{new}^f$ **do**
    for each market t **do**
        Feed mc^f
        if Counterfactual II **then**
            Feed λ, compute new concentrate prices for unintegrated bottlers and integrated bottlers $p_{new}^{f_u}$ and $p_{new}^{f_i}$ respectively
        end if
        if Counterfactual III **then**
            Compute new concentrate price p_{new}^f
        end if
        Feed λ and $dist$, compute bottlers' new marginal costs mc_{new}^b.
        Feed T, compute new equilibrium retail prices p_{new} and market shares s_{new}.
        Compute new Jacobian and Hessian matrices Jac_{new} and Hes_{new}, and bottlers' margin $margin_{new}^b$.
        Feed T^{fb}, compute pass-though matrix $\Delta_{p_{new}}$ and consumer substitution matrix with respect to wholesale prices $\Delta_{f_{new}}$.
    end for
    Feed syrup ownership matrix O^{fb} and market size M, aggregate across markets, compute the value of syrup producers' new FOCs.
    if Counterfactual II **then**
        Keep the original O^{fb}, replace $\sum_{j\in\mathcal{J}_t^b}$ with $\sum_{j\in\mathcal{J}_t^b\setminus\mathcal{J}_t^{DPSG}}$
    end if
    if Counterfactual III **then**
        Set $O^{fb} = 0$
    end if
end for
Update $margin_{new}^f$.

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Vita

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