The Competitive Impact of Vertical Integration by Multiproduct Firms*

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Abstract

We study the impact of vertical integration on pricing incentives in multiproduct industries. To do so, we exploit recent variation in vertical structure in the U.S. carbonated-beverage industry. While the elimination of double marginalization with vertical integration is normally characterized as procompetitive, economic theory predicts that it may cause anticompetitive price increases in multiproduct industries. We indeed find that vertical integration causes price decreases in products with eliminated double margins but price increases in the other products sold by the integrated firm. These results provide new evidence of anticompetitive effects of vertical mergers.

Keywords: vertical integration, multiproduct firms, carbonated-beverage industry

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1 Introduction

A series of recent high-profile vertical mergers (e.g., AT&T and Time Warner, CVS and Aetna, Comcast and NBC Universal, Google and ITA Software) has reinvigorated the long-standing debate on the impact of vertical integration on consumer welfare and market efficiency (Salop, 2018, Federal Trade Commission, 2018, Baker et al., 2019, Salop, 2019, Slade and Kwoka Jr, 2019, among others). This paper contributes to this debate by providing new empirical evidence of the competitive impact of vertical mergers in multiproduct industries. We show that the elimination of double marginalization caused by vertical integration introduces anticompetitive pricing incentives when the vertical merger involves a multiproduct firm. These findings stand in contrast to the common intuition that the elimination of double marginalization is benign.

The anticompetitive incentives that we examine arise when a subset of the products sold by a firm are exposed to an elimination of double marginalization.[1] In this context, vertical integration impacts pricing incentives in two ways. On the one hand, the products with eliminated double margins become cheaper to sell, which creates a downward pressure on the prices of these goods. This is the *efficiency effect* associated with the elimination of double marginalization. On the other hand, products with eliminated double margins become relatively more profitable to sell. This gives the firm incentives to divert demand toward these products by increasing the prices of products for which double marginalization was not eliminated. We call this the *Edgeworth-Salinger effect*.[2] This is an anticompetitive effect that counteracts the efficiency effect of vertical integration and may lead to price increases (Edgeworth, 1925, Hotelling, 1932, Salinger, 1991).

[1] These incentives were present in a broad set of past vertical transactions in multiproduct industries. These transactions include, for example, mergers in the media industry (e.g., AT&T's acquisition of Time Warner and Disney's acquisition of 21st Century Fox, both in 2019); mergers in the eyeware industry (e.g., the merger between Luxottica and Essilor in 2018); health insurance companies acquiring hospitals and clinics (e.g., Humana's acquisition of Concentra in 2010, WellPoint Inc.'s acquisition of CareMore Health Group in 2011); drug manufacturers acquiring pharmacy benefit managers (e.g., Merck & Co., Inc.'s acquisition of Medco Managed Care, L.L.C. in 1993, Eli Lilly and Company's acquisition of McKesson Corporation in 1995); retailers integrating with one of their suppliers (e.g., McKesson Canada Corporation's acquisition of Rexall Pharmacy Group Ltd. (2016) and Uniprix (2017), Brown Shoe Co., Inc.'s acquisitions of Wohl Shoe Company and Wetherby-Kayser in 1951 and 1953, respectively); and joint ventures in network industries (e.g., MCI Communications Corporation's joint venture with British Telecommunications PLC in 1994); among others.

[2] This name gives credit to Francis Edgeworth's work on how taxes affect the pricing incentives of multiproduct firms (Edgeworth, 1925) and Michael Salinger's theoretical work linking Edgeworth's work to the analysis of vertical mergers (Salinger, 1991).

The main contributions of this paper are twofold. First, we provide causal estimates of these efficiency and anticompetitive effects of vertical integration in the context of the carbonated-beverage industry in the United States. We do so by leveraging rich variation in vertical structure caused by a recent wave of vertical integration in this industry. Second, we discuss the implications of our findings for the ongoing debate on vertical-merger enforcement.

At least three factors make the carbonated-beverage industry ideal for the purposes of our study. First, this industry is one where multiple upstream and downstream firms interact. Upstream firms such as The Coca-Cola Company or PepsiCo produce concentrate; downstream bottlers purchase concentrate from the upstream firms, mix it with carbonated water, and produce the multiple products that are sold to retailers. Importantly, bottlers purchase concentrate from one or more upstream firms. For example, The Coca-Cola Company's main bottler bottles both The Coca-Cola Company brands and Dr Pepper Snapple Group brands in many locations across the United States.

Second, a number of vertical transactions took place in 2009 and 2010 involving The Coca-Cola Company, PepsiCo, and some of their bottlers. Because The Coca-Cola Company and PepsiCo merged with only a subset of their bottlers, vertical integration took place in only some parts of the country. This geographical variation in vertical integration generated rich longitudinal and cross-sectional variation in vertical structure, which is key for our identification strategy.

Third, the transactions that took place in 2009 and 2010 eliminated double marginalization for the brands owned and bottled by The Coca-Cola Company and PepsiCo. However, because Dr Pepper Snapple Group remained independent in selling inputs to the bottlers, double marginalization was not eliminated for Dr Pepper Snapple Group's brands bottled by the integrated bottlers. As a consequence of this partial elimination of double marginalization, we expect these vertical transactions to have yielded both the efficiency and the Edgeworth-Salinger effects of vertical integration.

To measure the effects of vertical integration on prices, we use a unique combination of data sources. We use weekly scanner data at the product–store level for 50 metropolitan areas in the United States from the IRI Marketing Data Set (Bronnenberg et al., 2008). We complement these data with industry publications and Federal Trade Commission documents to identify the products exposed to vertical integration in each store in the scanner data.

The rich heterogeneity in vertical structure resulting from the mergers allows us to identify the causal effects of vertical integration on prices using two complementary research designs that rely on different sources of variation and identification assumptions. First, we compare the price changes of a product across locations differentially exposed to vertical integration (i.e., a differences-in-differences analysis); second, we compare the price changes within a store across products differentially exposed to vertical integration (i.e., a within-store analysis).

We find that vertical integration caused price increases of 1.2 to 1.5 percent for Dr Pepper Snapple Group products bottled by vertically integrated bottlers. Estimates allowing for dynamic effects also show that these price increases started only after the vertical transactions took place, and the price increases persisted in time. Vertical integration also caused a decrease of 0.8 to 1.2 percent in the prices of The Coca-Cola Company and PepsiCo products bottled by integrated bottlers, though some of these efficiency-effect estimates are noisy. Finally, we also show that while vertical integration increased the revenues of The Coca-Cola Company and PepsiCo products, vertical integration decreased the revenues of Dr Pepper Snapple Group products by 1.3 percent relative to their revenues in areas unaffected by vertical integration. These results are consistent with joint manifestations of the efficiency and Edgeworth-Salinger effects of vertical integration.

From a policy perspective, our work contributes to the ongoing debate on vertical-merger enforcement in at least three ways. First, we provide new causal evidence of the anticompetitive effects of vertical mergers. Second, our estimates of the anticompetitive effects are as large or larger in absolute value than the efficiency effects of vertical integration. This suggests that the elimination of double marginalization cannot be presumed to be procompetitive when examining vertical integration by multiproduct firms. Lastly, we argue that these anticompetitive pricing incentives of vertical integration were relevant for many vertical transactions that have taken place in the last decades (see Footnote 1). These points combined call for the Edgeworth-Salinger effect to be incorporated in the evaluation of future vertical-merger enforcement actions.

Our research also contributes to a recent empirical literature on how changes in market structure affect market outcomes in bilateral oligopoly. Ho and Lee (2017) study the impact of insurer competition in the U.S. health care industry and show that the relationship between insurer competition and insurance premiums is ambiguous because of bargaining externalities. Gowrisankaran et al. (2015) study the impact of hospital mergers on hospital prices when the prices are the result of negotiations between hospitals and managed-care organizations. Crawford et al. (2018) study the impact of vertical integration on welfare in the U.S. pay-television industry and find that vertical integration can result in the integrated firm either refusing to sell some of its content to rival firms or selling it but at higher prices. We contribute to this strand of the literature by providing new evidence of anticompetitive pricing effects that arise when a multiproduct firm vertically integrates with a subset of its suppliers.

Our paper is related more generally to the large literature that examines the competitive impact of vertical mergers.[3] This question has been studied both theoretically (see, for example, Spengler, 1950, Salinger, 1988, Perry, 1989, Ordover et al., 1990, Hart et al., 1990, Bolton and Whinston, 1991, Salinger, 1991, Reiffen, 1992, Riordan, 1998, Choi and Yi, 2000, Chen, 2001, Levy et al., 2018, Salop, 2018) and empirically. On the empirical side, Hortaçsu and Syverson (2007) show that vertical integration in the cement and ready-mixed-concrete industries led to lower prices, consistent with efficiency gains dominating potential foreclosure effects. Similar studies in the U.S. pay television industry (Waterman and Weiss, 1996, Chipty, 2001, Suzuki, 2009) and the wholesale-gasoline industry (Hastings and Gilbert, 2005) have reached the opposite conclusion.[4] We contribute to this literature by providing causal evidence of the anticompetitive effects that are unique to vertical mergers involving multiproduct firms. These effects are distinct from the foreclosure and related pricing effects that have dominated economists' thinking in this area (see Section 2).

Finally, we contribute to an empirical literature studying the vertical arrangements between upstream and downstream firms. Villas-Boas (2007) and Bonnet and Dubois (2010) compare different models of vertical relationships between manufacturers and retailers. Both studies find evidence in favor of nonlinear pricing. These findings are in contrast with our estimates of the price effects of vertical integration, which suggest the existence of a linear-pricing component along the vertical chain.

The paper is organized as follows. Section 2 presents a conceptual discussion of the impact of vertical integration on the pricing incentives of a multiproduct firm. The industry background for our empirical analysis and a description of the data are presented in Sections 3 and 4, respectively. Section 5 presents our empirical framework and the main results of our analysis of the effects of vertical integration on prices.

[3] See Lafontaine and Slade (2007) and Slade (2019) for a review of this literature.

[4] Other recent empirical studies on vertical integration include Mortimer (2008), Houde (2012), Lee (2013), Atalay et al. (2014), and Asker (2016).

We discuss our analysis on the impact of vertical integration on the revenues of the upstream firms in Section 6. We conclude in Section 7 with a discussion of policy implications.

2 Multiproduct Pricing and Vertical Integration

To examine the impact of vertical integration on the pricing incentives of a multiproduct firm, consider the following example in which an independent downstream monopolist (henceforth, "the bottler") sells two substitute products, product 1 and product 2, at prices p_1 and p_2. The bottler produces product 1 using an input it purchases from the upstream firm U_1, and it produces product 2 using an input it purchases from the upstream firm U_2. In this setting the first-order necessary conditions for the equilibrium prices set by the bottler, p_1^* and p_2^*, are given by

$$\begin{aligned} q_1(p_1^*, p_2^*) + (p_1^* - c_1)\frac{\partial q_1}{\partial p_1} + (p_2^* - c_2)\frac{\partial q_2}{\partial p_1} &= 0 \\ q_2(p_1^*, p_2^*) + (p_2^* - c_2)\frac{\partial q_2}{\partial p_2} + (p_1^* - c_1)\frac{\partial q_1}{\partial p_2} &= 0, \end{aligned}$$

where c_1 and c_2 are the input costs of the bottler.

Consider now a vertical merger between upstream firm U_1 and the bottler. Vertical integration eliminates the double margin in product 1, which causes the input cost of product 1 to drop to the marginal cost of production of the input producer (i.e., zero in this example). For simplicity, assume that c_2 remains at its original value (we relax this assumption below). Then, at the premerger prices p_1^* and p_2^*, we have that

$$\begin{aligned} q_1(p_1^*, p_2^*) + p_1^*\frac{\partial q_1}{\partial p_1} + (p_2^* - c_2)\frac{\partial q_2}{\partial p_1} &< 0 \\ q_2(p_1^*, p_2^*) + (p_2^* - c_2)\frac{\partial q_2}{\partial p_2} + p_1^*\frac{\partial q_1}{\partial p_2} &> 0, \end{aligned}$$

both because demand is downward sloping (i.e., $\partial q_1/\partial p_1 < 0$) and the products are substitutes (i.e., $\partial q_1/\partial p_2 > 0$). These inequalities suggest that vertical integration has two effects on prices. First, the elimination of the double margin creates an incentive to decrease the price of product 1 because of its lower marginal cost. This corresponds to the efficiency effect of eliminating double marginalization. Second, the elimination of the double margin in product 1 gives the bottler greater marginal incentives to sell this product because it now earns the bottler a higher margin (i.e., p_1^* versus the premerger margin of $p_1^* - c_1$). This creates an incentive to increase the price of product 2 to induce consumers to choose product 1 instead of product 2. This anticompetitive effect, which we call the Edgeworth-Salinger effect, only exists in the context of multiproduct firms.[5]

How the efficiency and Edgeworth-Salinger effects impact equilibrium prices depends on the magnitude of the efficiency gains as well as the degree of substitution between products. Because prices are strategic complements and the efficiency and Edgeworth-Salinger effects push prices in opposite directions, the impact of vertical integration on equilibrium prices is theoretically ambiguous. That is, if the Edgeworth-Salinger effect is sufficiently large, the price of product 1 could stay constant or increase relative to the premerger equilibrium price despite the downward pressure on p_1 caused by the efficiency effect. This is illustrated in Salinger (1991), who shows examples featuring an increase in the price of product 2 and even an increase in the price of both products in equilibrium.

Section A in the Online Appendix extends this analysis both by adding a retail sector and allowing for the upstream firms to reoptimize their input prices after the vertical merger. We show that the economic effects discussed above still arise in this extended framework, with the effects of vertical integration manifesting both at the wholesale and retail levels.[6]

Lastly, we note that the Edgeworth-Salinger effect is a form of foreclosure caused by vertical integration. In general, foreclosure incentives are classified into two categories, input foreclosure and customer foreclosure (Salop, 2018). Input foreclosure refers to situations in which an integrated firm decreases the amount of inputs sold to downstream competitors. This case does not apply to our setting as bottlers are granted exclusivity within their territories for each product they bottle (see Section 3). Customer foreclosure refers to situations in which an integrated firm decreases the amount of inputs it purchases from upstream rivals. A common form of customer foreclosure arises when the integrated firm is able to change its mix of inputs so as to favor integrated inputs, but this does not apply to our setting (i.e., each carbonated soda makes

[5]We acknowledge that input transactions along the vertical chain may involve nonlinear prices. We note, however, that the Edgeworth-Salinger effect will arise as long as the unit price in the vertical contract has a nonzero markup.

[6]Upstream firm U_2 has incentives to decrease the price at which it sells to the bottler to counteract the impact of the Edgeworth-Salinger effect. We find, however, that the Edgeworth-Salinger effect still manifests itself because the effect of an eliminated double margin dominates this strategic response by U_2.

use of a single concentrate). Instead, the Edgeworth-Salinger effect is a form of customer foreclosure that arises because of how vertical integration changes the marginal incentives to sell integrated versus nonintegrated products when the downstream firm controls the downstream prices of these products.[7]

3 The Carbonated-Beverage Industry

3.1 Industry

The U.S. carbonated-beverage industry was born when Coca-Cola was created in 1886.[8] From its early days, the vertical structure of the industry has had two sets of players: upstream firms (or concentrate producers) and bottlers. Upstream firms such as The Coca-Cola Company (henceforth, Coca-Cola), Dr Pepper Snapple Group (henceforth, Dr Pepper SG), and PepsiCo produce and sell concentrate—the key ingredient in carbonated beverages—to a number of local franchised bottlers who produce, market, and distribute carbonated beverages.

The costs and the logistical difficulties of transporting carbonated beverages have motivated this industrial organization throughout the industry's existence. The original bottling operations were atomized, with hundreds of local bottlers operating across the United States (Stanford, 2010a,b). Over time, bottler consolidation has taken place because of economies of scale and a decrease in transportation costs. Although more than six thousand bottling plants were operating in 1950, less than a thousand of these were left by 1990 (Saltzman et al., 1999).

In the early days of the industry, concentrate producers had difficulties monitoring local market conditions and bottler behavior. These difficulties were some of the reasons that led concentrate producers and local bottlers to sign contracts that regulated their relationships. Since then, these contracts have established that bottlers are responsible for manufacturing the final product as well as for local advertising and promotion. Bottlers have also enjoyed discretion in choosing the prices at which they sell to retailers and other establishments. Because bottling operations require dedicated investments,

[7]The Edgeworth-Salinger effect relates to raising rivals' costs arguments to the extent that the quantity changes caused by vertical integration lead to an increase in the costs of rival upstream firms via economies of scale.

[8]For an in-depth presentation of the historical evolution of the industry, see Muris et al. (1993).

bottlers were granted perpetual rights to manufacture and distribute their products in exclusive territories (Katz, 1978).[9]

Although the original contracts fixed the price of concentrate—e.g., Coca-Cola fixed the price of concentrate at $1.30 per gallon in its early years (Muris et al., 1993)—new contracts written during the 20th century gave the upstream firms the right to change this price at will (see Section B in the Online Appendix).[10] Under these modern agreements, upstream firms face no obligation to participate with bottlers in the bottlers' marketing activities, though bottlers still benefit from the upstream firms' national marketing campaigns.[11]

Throughout the history of the industry, bottlers have often transacted with more than one upstream firm (e.g., the bottler Pepsi Bottling Group transacted with both PepsiCo and Dr Pepper SG prior to 2009). This practice is allowed by upstream firms subject to two restrictions (Saltzman et al., 1999). First, a bottler cannot bottle two beverages of the same flavor from two upstream firms (e.g., a bottler producing PepsiCo's Pepsi products cannot also produce cola-flavored products from other upstream firms).[12] Second, a bottler producing PepsiCo products cannot also produce Coca-Cola products (and vice versa).

3.2 Vertical Transactions

In 2009 and 2010, a number of vertical transactions took place in the carbonated-beverage industry involving upstream firms and bottlers. First, PepsiCo Inc. merged with Pepsi Bottling Group Inc. (PBG) and Pepsi Americas Inc. (PAS) in August of 2009. Second, Coca-Cola merged with Coca-Cola Enterprises Inc. (henceforth, CCE) in February of 2010. Lastly, PepsiCo acquired Pepsi-Cola Bottling Co. of Yuba City Inc. (PYC) in April of 2010. The Federal Trade Commission (henceforth, FTC) reviewed the transactions and cleared them in October and November of 2010 subject

[9] The use of exclusive territories in the carbonated-beverage industry is now protected by the Soft Drink Interbrand Competition Act of 1980.

[10] In the 1990s, for example, a series of increases in the price of concentrate by Coca-Cola caused protests by Coca-Cola bottlers. See "Coca-Cola seeks to supersize its bottlers," *Financial Times*, March 23, 2013.

[11] See, for example, The Coca Cola Company (2009), PepsiAmericas, Inc. (2009), The Pepsi Bottling Group, Inc. (2009).

[12] In 1963, a federal court ruled that the beverage Dr Pepper is not a "cola product." This ruling facilitated the expansion of Dr Pepper Snapple Group products across the country, as it allowed Coca-Cola and Pepsi bottlers to also bottle Dr Pepper Snapple Group products.

to behavioral remedies related to information management and compensation (Federal Trade Commission, 2010a,b).[13]

The magnitude of these transactions can be illustrated in two ways. First, Figure 1 shows the areas of the United States impacted by vertical integration. The figure shows that the integrated territories were vast, spanned all regions of the United States, and covered heterogeneous areas (e.g., urban and rural, high and low income, warm and cold). Second, the integrated bottlers accounted for about 75 percent of Coca-Cola's and PepsiCo's sales of bottled and canned soft drinks in 2009 (Federal Trade Commission, 2010a,b). The integrated bottlers—which bottled Dr Pepper SG brands in a subset of their territories—also accounted for 34 percent of the sales of bottled and canned soft drinks of Dr Pepper SG in 2009 (Federal Trade Commission, 2010a,b).[14]

After the firms entered into their respective merger agreements, both Coca-Cola and PepsiCo acquired new exclusive licenses to continue selling and distributing Dr Pepper SG's brands. Under these licenses, Coca-Cola retained exclusive rights to sell Dr Pepper and Canada Dry in former CCE territories, while PepsiCo retained exclusive rights to sell Dr Pepper, 7UP, A&W, Canada Dry, Crush, Sunkist, Squirt, Schweppes, and Vernors in former PBG and PAS territories.[15] These licenses were acquired because the change in ownership of the bottlers triggered the termination of the original licenses. The acquisition of the new licenses suggests that it was in the best interest of the integrated firms to continue selling Dr Pepper SG brands rather than to drop them to increase Dr Pepper SG's cost of selling them.

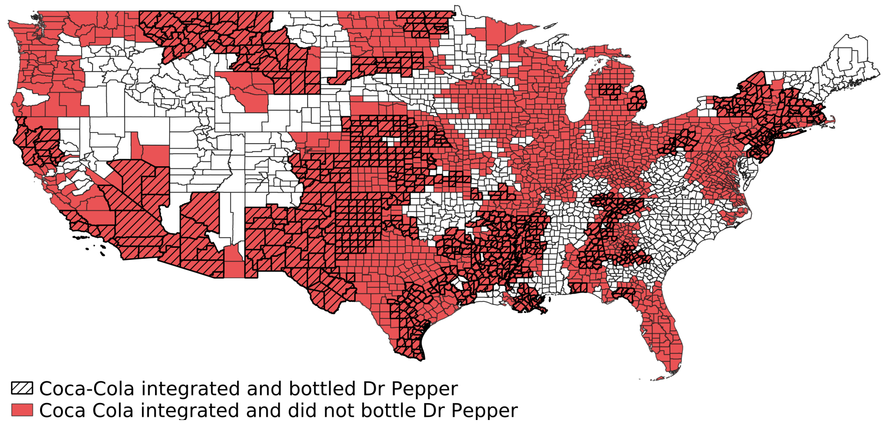
Lastly, industry observers argue that Coca-Cola and PepsiCo were seeking to reduce costs and gain control over retail prices with the mergers.[16] Eliminating double marginalization was a way to compensate for the increase in input costs faced by the firms in the 2000s (e.g., plastic, high-fructose corn syrup). By both eliminating double margins and gaining control over downstream prices, Coca-Cola and PepsiCo could

[13] We provide a summary of the FTC's complaints and decision orders of these transactions in Section C in the Online Appendix.

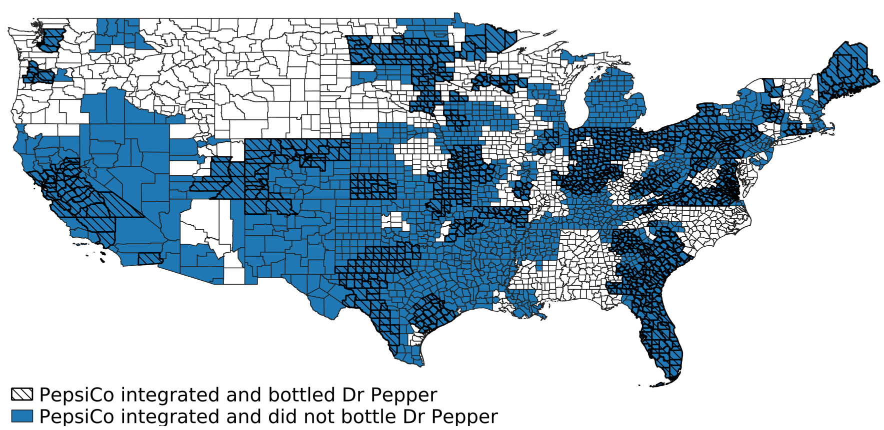
[14] Figure 1 presents the territories in which the integrated bottlers bottled the product Dr Pepper before and after vertical integration. The bottlers also bottled other Dr Pepper SG brands, though the territories in which they did so varied across products. Similar maps can be created for each of the Dr Pepper SG brands involved in the transactions.

[15] See points 17 and 24 of the FTC's complaints regarding the Coca-Cola and PepsiCo transactions, respectively, for details (Federal Trade Commission, 2010a,b).

[16] See "Coke Near Deal for Bottler," *The Wall Street Journal*, February 25, 2010, and "Bottler Consolidation at Coke, Pepsi Adds Pressure to Small Players," *The Wall Street Journal*, March 15, 2010, for media coverage of the mergers.



(a) Coca-Cola



(b) PepsiCo

FIGURE 1: Cross-sectional variation in vertical integration by upstream firm

Source: Created by the authors based on Stanford (2010a,b) and the maps produced by the FTC during its investigation, using QGIS (2019) and a county-level shapefile created by the U.S. Census Bureau. Importantly, the maps depict the territories in which both the Coca-Cola and PepsiCo integrated bottlers had the right to distribute the product Dr Pepper. The FTC documents allow us to construct a different map for each Dr Pepper SG product that was part of the licensing agreements.

market their products at lower prices, giving the firms greater flexibility to counter a decline in the consumption of carbonated soft drinks.

4 Data

Our data come from three sources: territory maps of the U.S. bottling system (Stanford, 2010a,b), public documents produced by the FTC's investigation of the PepsiCo and Coca-Cola vertical mergers, and the IRI Marketing Data Set (see Bronnenberg et al. 2008 for details).

We use the U.S. bottling-system territory maps to identify the territories of PBG, PAS, and PYC in the case of PepsiCo and CCE in the case of Coca-Cola. This information allows us to determine which areas of the country were impacted by vertical integration. We present this information for the entire United States in Figure 1 and for the counties in the IRI Marketing Data Set in Table 1. Table 1 (Panel A) shows that 357 of the 443 counties in our data were served by CCE and 397 by PBG, PAS, or PYC. That is, a majority of the counties in our sample were somehow affected by vertical integration in 2010, which is a pattern that also holds true at the national level (see Figure 1). Three hundred thirty-four counties were served both by CCE and by PBG, PAS, or PYC. Eighty-six counties were served by at most one bottler that integrated, while 23 counties were served by bottlers that did not integrate.

We complement this information with the FTC documents to identify the counties in which Dr Pepper SG brands were bottled by the integrated bottlers. Table 1 (Panel B) shows that in about 29 percent of the counties in our sample that were served by CCE, CCE also bottled and distributed at least one Dr Pepper SG brand, whereas in 80 percent of the counties served by PBG, PAS, or PYC, the PepsiCo bottler distributed at least one Dr Pepper SG brand.

We use price and sales information on the carbonated-beverage industry at the store–week–product level for the years 2007 to 2012 from the IRI Marketing Data Set. The sample includes carbonated drinks only (i.e., carbonated soda or seltzer water).[17] We define a product as a brand–size combination (e.g., Diet Pepsi 20 oz bottle) and prices as the average price paid by consumers for each product in a store–week combination. In our analysis, we include brands with at least 0.1 percent of the market and we restrict attention to three product sizes: 20 and 67.6 oz bottles and the 144 oz box of cans.[18] These sample restrictions leave us with about 49 million store–week–product

[17]Noncarbonated substitutes, such as iced tea or energy drinks, are not included in the IRI Marketing Data Set.

[18]Brands with less than 0.1 percent of the market are often local or regional brands that are sparsely available.

Table 1: Summary statistics: Vertical structure

Panel A: Counties in which PBG–PAS–PYC and CCE bottled PepsiCo and Coca-Cola products, respectively

	No VI (Pepsi)	PBG–PAS–PYC integration	Total counties
No VI (Coca-Cola)	23	63	86
CCE integration	23	334	357
Total counties	46	397	443

Panel B: Counties in which PBG–PAS–PYC and CCE bottled Dr Pepper SG products

	Bottled Dr Pepper SG products		Total counties
	No	Yes	
CCE	253	104	357
PBG–PAS–PYC	81	316	397

Notes: An observation is a county. A county is labeled as PBG–PAS–PYC if PBG, PAS, or PYC bottled PepsiCo products in the county before vertical integration. A county is labeled as CCE if CCE bottled Coca-Cola products in the county before vertical integration.

combinations, which comprise 72 brands (216 products) and represent 88.6 percent of the industry revenues that correspond to the three product sizes we consider (or 67.2 percent of the overall revenue in this time period). Section D in the Online Appendix presents the list of products in our sample, product-level summary statistics, and an examination of the sources of price variation in our data.

With respect to measurement, we note that though our discussion has focused on the impact of vertical integration on pricing incentives at the bottler level, our price data are at the retail level. However, as we argue in Section A in the Online Appendix, the changes in incentives at the retail level mirror those at the bottler level, which makes retail prices informative about the competitive impact of vertical integration.

Summary Statistics

We next make a first approximation to measuring the effects of vertical integration using the raw data. In Table 2, we report the (unconditional) average prices of a number of 67.6 oz products, before and after vertical integration, for treated and untreated

Table 2: Prices and market shares across counties before and after vertical integration

		(1)	(2)	(3)	(4)	(5)	(6)	(7)
		Before VI			After VI			
Firm	Variable	Untreated	Treated	(2)-(1)	Untreated	Treated	(5)-(4)	(6)-(3)
Coca-Cola	Price	1.379	1.442	0.064	1.48	1.544	0.064	0
		(0.169)	(0.145)	[0]	(0.135)	(0.153)	[0]	[0.987]
Dr Pepper SG	Price	1.343	1.435	0.092	1.367	1.508	0.142	0.05
		(0.166)	(0.16)	[0]	(0.179)	(0.172)	[0]	[0]
PepsiCo	Price	1.326	1.365	0.039	1.432	1.442	0.01	-0.029
		(0.13)	(0.133)	[0]	(0.104)	(0.143)	[0.129]	[0]
Coca-Cola	Market share	0.044	0.042	-0.002	0.043	0.045	0.002	0.003
		(0.031)	(0.026)	[0.147]	(0.024)	(0.029)	[0.143]	[0.039]
Dr Pepper SG	Market share	0.014	0.009	-0.005	0.02	0.01	-0.01	-0.005
		(0.015)	(0.007)	[0]	(0.021)	(0.008)	[0]	[0]
PepsiCo	Market share	0.036	0.036	0	0.034	0.035	0.001	0.002
		(0.032)	(0.029)	[0.868]	(0.025)	(0.028)	[0.334]	[0.387]

Notes: An observation is a store–product–period combination, where period $\in \{premerger, postmerger\}$. The table reports averages of prices and market shares (based on unit count), before and after vertical integration, for treated and untreated counties. The Coca-Cola products include 67 oz Coca-Cola and Diet Coke; the Dr Pepper SG products include 67 oz Dr Pepper and Diet Dr Pepper; the PepsiCo products include 67 oz Pepsi and Diet Pepsi. Standard deviations are in parentheses. p-values of two-sided tests for equality of means in brackets.

counties.[19] The table shows that the prices of PepsiCo products decreased in areas impacted by vertical integration after the vertical mergers (relative to areas not impacted by vertical integration), whereas we see no such differential change for the Coca-Cola products. The table also shows that the prices of the Dr Pepper SG products increased by 5 percent in treated counties relative to untreated ones. These price changes are consistent with joint manifestations of the efficiency and Edgeworth-Salinger effects of vertical integration.

Table 2 also shows that the market share of the Dr Pepper SG products decreased in treated counties relative to untreated counties, while the market share of the Coca-Cola products increased and the market share of the PepsiCo products did not change. The decrease in the market share of the Dr Pepper SG products is also consistent with the Edgeworth-Salinger effect of vertical integration—i.e., the integrated bottlers have incentives to increase the prices of Dr Pepper SG products to divert demand toward their own brands.

Lastly, in Table 3 we examine whether vertical integration impacted relative prices

[19] We often illustrate empirical points restricting the data to the subset of 67.6 oz products to abstract away from between-size price differences. The relative popularity of the 67.6 oz format motivated us to lead with it (44.6 percent of all transactions involved a 67.6 oz product).

within a store. To do this, we rank products from lowest (1) to highest price (N) in every store–week combination, and we make before-and-after comparisons of price rankings between areas affected and unaffected by vertical integration. The exercise reveals that Dr Pepper SG products became relatively more expensive within the store in areas where these products were bottled by an integrated bottler. The table also shows that Coca-Cola products became relatively cheaper in treated counties, whereas PepsiCo products became relatively more expensive (but less so than Dr Pepper SG products). These results complement Table 2 in suggesting that vertical integration changed pricing incentives as discussed in Section 2.

TABLE 3: Price rankings across counties before and after vertical integration

		(1)	(2)	(3)	(4)	(5)	(6)	(7)
		Before VI			After VI			
Firm	Variable	Untreated	Treated	(2)-(1)	Untreated	Treated	(5)-(4)	(6)-(3)
Coca-Cola	Ranking	15.023	17.704	2.681	17.446	19.783	2.336	-.344
		(6.9)	(6.246)	[0]	(6.132)	(7.601)	[0]	[.042]
Dr Pepper SG	Ranking	14.94	15.628	.688	14.102	17.285	3.183	2.495
		(7.197)	(6.377)	[0]	(6.932)	(7.091)	[0]	[0]
PepsiCo	Ranking	12.466	14.48	2.014	12.958	15.66	2.702	.688
		(5.665)	(5.852)	[0]	(5.167)	(6.384)	[0]	[0]

Notes: An observation is a store–product–period combination, where period $\in \{premerger, postmerger\}$. The table reports averages of price rankings, before and after vertical integration, for treated and untreated counties. Prices are ranked from low to high, where 1 is the lowest price and N is the highest price. The analysis considers all 67 oz products in our sample. Standard deviations are in parentheses. p-values of two-sided tests for equality of means in brackets.

5 The Impact of Vertical Integration on Prices

How does vertical integration impact the prices of multiproduct firms? Is the Edgeworth-Salinger effect economically relevant? To answer these questions, we exploit the rich variation in vertical structure in our data and implement two complementary research designs. A strength of our analysis is that these approaches rely on different sources of variation in vertical structure and identification assumptions.

5.1 Differences-in-Differences Analysis

We first exploit the rich regional variation in vertical structure that resulted from the vertical mergers to implement a differences-in-differences research design. That is, we compare within-product price changes in locations that were affected by the vertical mergers to within-product price changes in locations unaffected by the vertical mergers. In our main specification, we separately estimate

$$\log(price_{j,s,w}) = VI_{j,s,w}\beta_k + \eta_{j,s} + \phi_{j,w} + x'_{j,s,w}\delta + \varepsilon_{j,s,w} \quad (1)$$

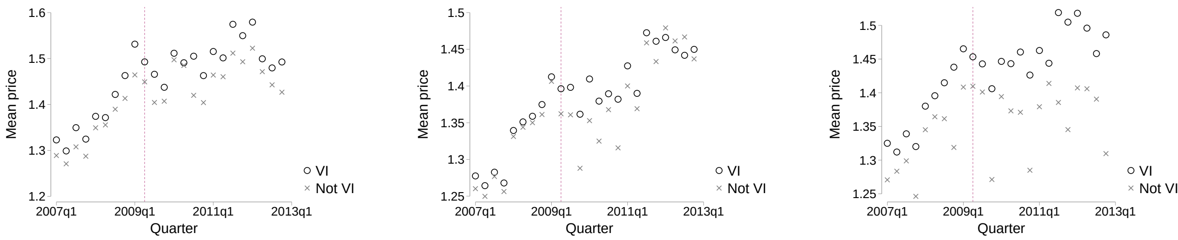
for every $k \in$ {PepsiCo, Coca-Cola, Dr Pepper SG}. In this specification, $VI_{j,s,w}$ is equal to one if product j sold at store s in week w was bottled by a vertically integrated bottler, and zero otherwise. $\eta_{j,s}$ and $\phi_{j,w}$ correspond to product–store and product–week fixed effects, which allow us to control for persistent differences in local tastes and national shocks at the product level (e.g., changes in costs and advertising intensity), respectively; $x_{j,s,w}$ is a vector of product characteristics at the store–week level (e.g., advertising intensity); and $\varepsilon_{j,s,w}$ is an error term clustered at the county level (i.e., the treatment unit).[20] The coefficients of interest in Equation 1 are $\beta_{\text{Coca-Cola}}$, β_{PepsiCo}, and β_{DPSG}, which measure the impact of vertical integration on the prices of products bottled by an integrated bottler relative to the prices of the same product when bottled by a nonintegrated bottler.

Identification

The identification assumption in the differences-in-differences analysis is that the prices of products exposed to vertical integration would have followed the same trend as the prices of the same products not exposed to vertical integration had vertical integration not happened. In Figure 2 we show that the prices of products that were and were not bottled by vertically integrated bottlers were not diverging from one another prior to the vertical mergers.[21] Below, we also find no evidence of differential pre-trends between groups when estimating a version of Equation 1 that includes leads and lags of our indicator for vertical integration (we discuss these findings below). The finding that treated and untreated products followed the same trend prior to the vertical transactions suggests that untreated products are a good control group for treated

[20] County-level demographic covariates are also included in the estimation of Equation 1, but we have omitted the county-level subindex c to save on notation, as these covariates vary only at the county–year (or county–month) level. See Table D.4 in the Online Appendix for a list of these covariates.

[21] In Section D in the Online Appendix we show that we cannot reject the hypothesis that the prices of products in both groups followed the same trend before the vertical mergers. We also report there the same plots for the other sizes. Because the figure for the 20 oz products suggests that the prices of the products in the treated and control groups for Dr Pepper SG may have followed differential trends before the vertical mergers, Section G.3 in the Online Appendix examines the robustness of our estimates to excluding this product category. Our findings do not change.



A) Coca-Cola B) PepsiCo C) Dr Pepper SG

FIGURE 2: The evolution of prices before and after the mergers by whether the products were ever sold by a VI firm (67 oz products)

Notes: An observation is a firm–VI status–quarter combination, where VI status takes the value of one if the product was ever bottled by a VI firm (e.g., Coke or Dr Pepper bottled by CCE). The dotted vertical lines indicate the first transaction. Figures for other product sizes can be found in the Online Appendix (Figure D.2).

products, which provides support for our identification assumption.

Though selection is always a concern with differences-in-differences research designs, a number of facts render this threat unlikely in our application. First, the footprint of the integrated bottlers was large and covered locations with diverse characteristics (e.g., urban and rural, high and low income) across multiple states (see Figure 1). Second, neither Coca-Cola nor PepsiCo divested any part of the acquired territories after the vertical mergers and through the end of our sample period, which combined with the previous point suggests that they were not seeking locations with specific characteristics. Third, while there are differences in observable characteristics between areas affected and unaffected by vertical integration, these characteristics changed similarly in both types of locations during our sample period (see the covariate balance discussion in Section D in the Online Appendix). Nevertheless, we conduct a series of exercises to examine whether selection is empirically relevant (e.g., propensity-score matching), which we discuss in Section 5.3.

Results

Table 4 presents our estimates of Equation 1. The two panels reflect differences in how we define the treatment and control groups, but are otherwise identical. In Table 4 (Panel A), the treatment group includes all the product–store–week combinations directly impacted by vertical integration (i.e., a product sold by an integrated bottler in week t at store s), whereas the control group includes all product–store–week combinations that were not directly impacted by vertical integration. The estimates show that vertical integration caused a 1.5 percent increase in the prices of Dr Pepper SG products bottled by vertically integrated bottlers and show no statistically significant effects of vertical integration on the prices of Coca-Cola and PepsiCo products, on average.

The increase in the prices of Dr Pepper SG products bottled by vertically integrated bottlers is consistent with a manifestation of the Edgeworth-Salinger effect. As discussed in Section 2, the elimination of double margins in Coca-Cola and PepsiCo products incentivized integrated bottlers to increase the price of Dr Pepper SG products to divert demand to integrated products. At the same time, vertical integration also created a downward pressure on the prices of integrated products (i.e., efficiency effect). However, the estimates reported in Panel A do not show price decreases in these products, which may be due to a number of factors.

First, as we argued in Section 2, if the Edgeworth-Salinger effect is large enough, the prices of integrated products may remain at their premerger level (or even increase). Second, we note that because prices are strategic complements, one integrated product is enough for all the other products sold in the same store to be indirectly impacted by vertical integration.[22] Third, an additional layer of equilibrium feedback effects arises if more than one firm vertically integrates (i.e., the price effects for Coca-Cola products may be different if PepsiCo also integrated in that area). In what follows, we seek to insulate our estimates from these equilibrium feedback effects by modifying the treatment and the control groups.

Table 4 (Panel B) presents the differences-in-differences estimates with the restricted treatment and control groups. In Column 1 of Panel B, we define the treatment group as treated observations in areas in which *only* Coca-Cola vertically integrated and the Coca-Cola bottler did not bottle Dr Pepper SG products (i.e., areas in which only the efficiency effect manifests itself). We define the treatment group in Column 3 analogously. The treatment group in Column 2 restricts the sample to treated observations in areas in which either Coca-Cola or PepsiCo integrated (but not both) and the integrated bottler bottled Dr Pepper SG products. The control group is defined as observations in areas unaffected by vertical integration throughout.

[22]Under the premise that vertical integration caused efficiency effects, the prices of indirectly treated products likely decreased via equilibrium feedback effects. By comparing treated with indirectly treated products, our estimates of the efficiency and Edgeworth-Salinger effects of vertical integration may be biased toward and away from zero, respectively.

Table 4: The effect of vertical integration on prices (differences-in-differences estimates)

	Dependent variable: log(price)		
	Coca-Cola	Dr Pepper SG	PepsiCo
	(1)	(2)	(3)
Panel A: Baseline estimates			
Vertical integration	0.003	0.015	-0.006
	(0.005)	(0.003)	(0.005)
Observations	15,756,886	15,935,207	17,051,189
R^2	0.910	0.903	0.891
Panel B: Restricted treatment subsample			
Vertical integration	-0.009	0.012	-0.008
	(0.006)	(0.003)	(0.005)
Observations	1,750,697	2,458,215	1,665,107
R^2	0.936	0.923	0.924

Notes: Standard errors clustered at the county level (443 clusters). All specifications include product–week and product–store fixed effects, as well as time-varying county-level controls and controls for feature and display. Panel A includes the full sample. Panel B drops the observations that were indirectly treated (i.e., products bottled by nonintegrated bottlers in store–week combinations where at least one product was bottled by an integrated bottler) and restricts the sample to counties that were either untreated or where only Coca-Cola integrated and the Coca-Cola bottler did not bottle Dr Pepper SG products (column 1); counties in which either Coca-Cola or PepsiCo integrated while bottling Dr Pepper SG products (column 2); and counties where only PepsiCo integrated and the PepsiCo bottler did not bottle Dr Pepper SG products (column 3).

The estimates reported in Panel B show that vertical integration caused a 1.2 percent increase in the prices of Dr Pepper SG products bottled by vertically integrated bottlers. The estimates also show that vertical integration caused a 0.9 and 0.8 percent decrease in the prices of Coca-Cola and PepsiCo products, though their p-values are 0.133 and 0.104, respectively.[23] These estimates (and the direction in which they move from Panel A to Panel B) are consistent with manifestations of both the efficiency (Columns 1 and 3) and Edgeworth-Salinger effects (Column 2) of vertical integration.

Because the magnitude of the price effects may vary with the popularity of the products, we also conduct a differences-in-differences analysis using price indexes. Price in-

[23] These results also speak to the literature studying the vertical arrangements between upstream and downstream firms (see, for example, Villas-Boas 2007 and Bonnet and Dubois 2010). Our findings provide indirect evidence of the existence of a linear component in the price of concentrate (see discussion in Section 2).

Table 5: The effect of vertical integration on price indexes (differences-in-differences estimates)

	Dependent variable: log(price index)			
	All products	Coca-Cola	Dr Pepper SG	PepsiCo
	(1)	(2)	(3)	(4)
Vertical integration	-0.001	-0.006	0.048	-0.022
	(0.006)	(0.007)	(0.008)	(0.006)
Observations	528,838	528,491	526,527	524,762
R^2	0.809	0.860	0.867	0.878

Notes: Standard errors clustered at the county level (431 clusters). An observation is a store–week combination. Price indexes are computed based on pre-vertical-integration average quantities at the store–product level, where the weight of each product in a given store–week combination is its average quantity in that store in the pre-merger period. The price index in column 1 includes all products, whereas the price indexes in columns 2 to 4 restrict the set of products to Coca-Cola, Dr Pepper SG, and PepsiCo products, respectively. All specifications include store and week fixed effects, as well as time-varying county-level controls.

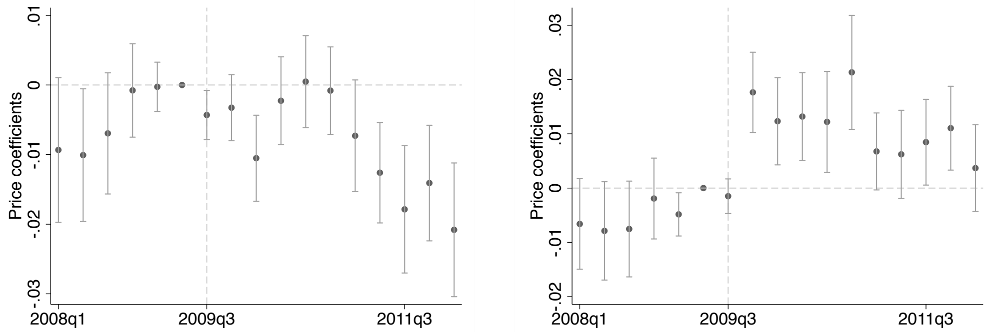
dexes allow us to summarize potentially heterogeneous price effects by putting greater weight on the price effects of more popular products. We compute the price indexes at the store–week level and define these as weighted-average prices. The weights are given by the average weekly quantities of each product–store combination before the transactions.[24]

Table 5 (Column 1) shows that vertical integration did not have a significant effect on the price index when considering the full set of products. However, the table shows that vertical integration caused an increase in the price index of Dr Pepper SG products (4.8 percent) and a decrease in the price indexes of Coca-Cola and PepsiCo (0.6 and 2.2 percent, respectively, though the effect is only significant for PepsiCo products).[25] These results provide additional evidence of manifestations of both the Edgeworth-Salinger and the efficiency effects of vertical integration.

Finally, we estimate a version of Equation 1 to examine both when the changes in

[24]See Section F.1 in the Online Appendix for more details. There, we also show that our results are robust to using weights that are defined as the national average weekly quantities of each product before the transactions. We report estimates using both types of weights because the store level weights have the benefit of better reflecting the choices of consumers in each store, whereas the national-level weights have the benefit of being uncorrelated with the mergers.

[25]We note that the magnitudes of the effects of vertical integration on Dr Pepper SG and PepsiCo price indexes are larger (in absolute value) than those reported in Table 4. This is consistent with evidence presented in Section 6 showing that vertical integration caused heterogeneous effects across products, with more popular products exhibiting relatively large effects (in absolute value).



A) Coca-Cola and PepsiCo products B) Dr Pepper SG products

FIGURE 3: Dynamics of the impact of vertical integration on prices (differences-in-differences estimates)

Notes: Standard errors clustered at the county level (443 clusters). The coefficient for Q2/2009 is normalized to zero. All specifications include controls for feature and display, time-varying county-level controls, and product–week and product–store fixed effects. The sample of prices is restricted to regular prices and includes all directly treated observations in the treated group and both untreated and indirectly treated observations in the control group.

the prices of products bottled by vertically integrated bottlers occurred and whether there were differential trends before the vertical mergers. Figure 3 (Panel A) presents estimates for both Coca-Cola and PepsiCo products and suggests no statistical evidence of pre-vertical-merger differential trends specific to products eventually sold by a vertically integrated bottler. Panel A also shows that while prices of Coca-Cola and PepsiCo products did not immediately change, they did decrease by between 1 to 2 percent after seven quarters.[26] On the other hand, Panel B shows immediate and lasting price effects in Dr Pepper SG products following vertical integration, which is consistent with the Edgeworth-Salinger effect. In line with Table 4, the figure suggests price increases of 1 to 2 percent on average. The figure also shows no evidence of differential trends before the vertical mergers.

5.2 Within-Store Analysis

Our second analysis examines how the prices of products sold in the same store changed after vertical integration as a consequence of a subset of them becoming integrated.

[26]These price decreases could be evidence of long-run efficiencies caused by the vertical mergers. However, we note that because of the timing of the price decreases, these could have been caused by factors unrelated to the elimination of double marginalization.

From the perspective of the discussion in Section 2, this amounts to comparing the prices faced by the customers of a particular store in the equilibria with and without vertical integration. The theory predicts that the efficiency and Edgeworth-Salinger effects should have made brands owned by an integrated bottler cheaper and Dr Pepper SG brands bottled by an integrated bottler more expensive relative to nonintegrated products (see Table 3 for motivating evidence).

We implement this analysis by pooling the products of all upstream firms and modifying Equation 1 to include store–week fixed effects, which capture store–week price levels. That is, we estimate

$$\log(price_{j,s,w}) = VI_{j,s,w}^{\text{CC/Pepsi}}\beta^{\text{CC/Pepsi}} + VI_{j,s,w}^{\text{Dr P}}\beta^{\text{Dr P}} + \eta_{j,s} + \phi_{j,w} + \gamma_{s,w} + x'_{j,s,w}\delta + \varepsilon_{j,s,w}, \tag{2}$$

where $VI_{j,s,w}^{\text{CC/Pepsi}}$ equals one if product j sold at store s in week w was a Coca-Cola or PepsiCo product bottled by a vertically integrated bottler, and zero otherwise; $VI_{j,s,w}^{\text{Dr P}}$ is defined similarly but for Dr Pepper SG products; $\gamma_{s,w}$ are store-level time effects; $\eta_{j,s}$, $\phi_{j,w}$, and $x_{j,s,w}$ are defined as in Equation 1; and $\varepsilon_{j,s,w}$ is an error term clustered at the county level.

In Equation 2, the coefficient $\beta^{\text{CC/Pepsi}}$ measures the effect of vertical integration on the prices of products owned by an integrated bottler relative to the prices of products bottled by nonintegrated bottlers (i.e., the omitted category). Similarly, $\beta^{\text{Dr P}}$ measures the impact of vertical integration on the prices of Dr Pepper SG products bottled by an integrated bottler relative to the prices of products bottled by nonintegrated bottlers. We note that because we compare prices within a store, and equilibrium prices are interdependent, $\beta^{\text{CC/Pepsi}}$ and $\beta^{\text{Dr P}}$ measure the impact of vertical integration on integrated and Dr Pepper SG brands net of equilibrium feedback effects.[27]

The identification assumption in this analysis is that the prices of products directly impacted by vertical integration would have remained constant *relative* to the prices of products bottled by nonintegrated bottlers that were sold in the same store, absent vertical integration. Our identification strategy leverages within-store variation in vertical structure (i.e., some products became integrated and some did not) and that every store has products that remained nonintegrated throughout.

[27]We note that the untreated observations (i.e., those in store–week combinations in which no product was treated) contribute to the identification of common trends, but not to the identification of the effects of vertical integration on prices.

Table 6 reports the estimates associated with this analysis. Consistent with the theory, Column 1 shows that vertical integration caused a 1.2 percent decrease in the prices of own brands (e.g., Coca-Cola or Pepsi) and a 1.5 percent increase in the prices of Dr Pepper SG bottled by a vertically integrated bottler relative to the prices of products bottled by nonintegrated bottlers. In Column 2 we allow the price effects to vary both by brand type (i.e., own or Dr Pepper SG brands) and by upstream company (i.e., Coca-Cola or PepsiCo). The results suggest that vertical integration decreased the prices of Coca-Cola and PepsiCo products bottled by vertically integrated bottlers by an average of 1.1 and 1.2 percent, respectively, relative to products bottled by nonintegrated bottlers. The average increase in the prices of Dr Pepper SG products bottled by a vertically integrated Coca-Cola and PepsiCo bottler relative to the prices of products bottled by nonintegrated bottlers is estimated to be 2.2 and 0.7 percent, respectively.[28]

Lastly, we discuss the connection between the differences-in-differences and the within-store estimators in Section E in the Online Appendix. We argue that both estimators would deliver the same point estimates if the prices of nonintegrated products in markets affected and unaffected by vertical integration had followed the same trends. This condition would fail to hold, for example, if vertical integration caused price changes in nonintegrated products in markets affected by vertical integration (e.g., via equilibrium feedback effects). To gauge this connection, we compare the estimates associated with both research designs using the sample considered in Table 4 (Panel B), which is designed to minimize the role of equilibrium feedback effects. As predicted, the analysis in Section E in the Online Appendix shows that the estimates are nearly identical in the absence of equilibrium feedback effects. The similarity between the estimates is a strength of our paper, as both research designs rely on different sources of variation and identification assumptions.

5.3 Robustness

In this section, we briefly describe a number of exercises meant to address econometric concerns and to explore the sensitivity of our estimates to alternative specifications and subsamples.

[28]We cannot reject that the coefficients measuring the effect of vertical integration on own brands are equal across firms ($p = 0.93$). We do, however, reject the hypothesis that the coefficients measuring the effect of vertical integration on Dr Pepper SG brands are the same across firms ($p = 0.01$).

Table 6: The effect of vertical integration on prices (within-store estimates)

	Dependent variable: log(price)	
	(1)	(2)
Vertical integration	-0.012	
× Coca-Cola/PepsiCo product	(0.003)	
Vertical integration	0.015	
× Dr Pepper SG product	(0.002)	
Vertical integration (Coca-Cola)		-0.011
× Coca-Cola product		(0.003)
Vertical integration (Coca-Cola)		0.022
× Dr Pepper SG product		(0.003)
Vertical integration (PepsiCo)		-0.012
× PepsiCo product		(0.005)
Vertical integration (PepsiCo)		0.007
× Dr Pepper SG product		(0.003)
Observations	48,743,027	48,743,027
R^2	0.911	0.911

Notes: Standard errors clustered at the county level (443 clusters). All specifications include store–week, product–week, and product–store fixed effects, as well as controls for feature and display.

We first empirically evaluate whether selection on observables impacts our estimates. This is motivated by the differences in demographics between treated and untreated counties reported in Section D.4 in the Online Appendix. To do this, we replicate our differences-in-differences analysis using a blocking-regression approach based on propensity-score matching. In addition, we repeat our analysis restricting the sample to neighboring counties that were differentially impacted by vertical integration. Both of these exercises allow us to to compare price changes in counties that are similar except for having been differentially impacted by vertical integration. The estimates that we obtain across these exercises are similar to those reported in Table 4, which suggests that selection is empirically irrelevant (Section F.2 in the Online Appendix).

Second, we also explore the robustness of our results to different levels of aggregation for three reasons (Section F.3 in the Online Appendix). First, retail chains set similar prices across their stores (e.g., see DellaVigna and Gentzkow, 2019), which suggests that there may be spillover effects when two nearby counties are differentially exposed to vertical integration. Second, it is possible that the frequency with which retailers change prices varies across products, which could lead to prices of some products reacting to vertical integration faster than the prices of other products. Third, the serial correlation of prices may lead to inconsistent estimates of standard errors (see Bertrand et al., 2004). Throughout these aggregation exercises, which include aggregations at the temporal, geographical, and chain level, we find that the estimates of the Edgeworth-Salinger effect retain the sign and statistical significance in all cases and remain within one standard error of the estimate reported in Table 4 (Panel B) in all but one case.

Third, with respect to inference, we conduct a series of placebo exercises both in sample and in other product categories sold in the same store as the integrated products, to compute the likelihood of our estimates under the hypothesis of a null effect (Section F.4 in the Online Appendix). Across all these exercises, our estimated p-values range between 0.006 and 0.054. We also show that our estimates retain their level of statistical significance when clustering standard errors at the MSA rather than county level (Section F.5 in the Online Appendix).

In Section G in the Online Appendix, we conduct a series of exercises to study the sensitivity of our estimates to different subsamples and specifications. We first examine whether vertical integration had a differential impact on the subsamples of regular and sale prices because of the prevalence of price promotions in the carbonated soda product category (Section G.1). We find that our estimates of the Edgeworth-Salinger effect do not vary across samples (with estimated price increases of 1.3 and 1.5 percent for regular and sales prices, respectively) and that the regular prices of PepsiCo products decreased by more than the sales prices as a consequence of vertical integration.

Lastly, we acknowledge that larger retailers may have had access to rebates offered by upstream producers that may have counteracted the price effects of vertical integration (e.g., Dr Pepper SG may have attempted to counteract the Edgeworth-Salinger effect by offering rebates to large retailers). We study this possibility by examining whether the price effects of vertical integration varied across types of stores (e.g., national versus local chains, large versus small chains). We find that although the estimate of the Edgeworth-Salinger effect is positive and significant for all types of stores, the effect is larger for small and local chains (Section G.2).

6 The Impact of Vertical Integration on Revenues

We next examine the impact of vertical integration on the revenues of the upstream firms. To do this, we propose a framework that allows us to map our differences-in-differences research design to changes in revenues for Coca-Cola, Dr Pepper SG, and PepsiCo products.

Let q_{0j}^f and p_{0j}^f be the quantity and price of product j, sold by firm f, before vertical integration. Similarly, let q_{1j}^f and p_{1j}^f be the quantity and price of product j after vertical integration. We can write post-vertical-integration outcomes as $p_{1j}^f = p_{0j}^f(1 + \Delta_{p_j})$ and $q_{1j}^f = q_{0j}^f(1 + \Delta_{q_j})$, where Δ_x represents the percentage change in x caused by vertical integration. The revenues of firm f before vertical integration are $R_0^f = \sum_{j \in J_f} p_{0j}^f q_{0j}^f$, where J_f is the set of products of firm f. Similarly, revenues after vertical integration are given by $R_1^f = \sum_{j \in J_f} p_{0j}^f(1 + \Delta_{p_j}) q_{0j}^f(1 + \Delta_{q_j})$. The impact of vertical integration on the revenue of upstream firm f (in percentage terms) is thus

$$\Delta_{R^f} = \sum_{j \in J_f} s_{0j}^f(\Delta_{q_j} + \Delta_{p_j} + \Delta_{q_j}\Delta_{p_j}), \tag{3}$$

where $s_{0j}^f = p_{0j}^f q_{0j}^f / \left(\sum_{k \in J_f} p_{0k}^f q_{0k}^f\right)$ corresponds to the pre-integration revenue share of product j among the products sold by firm f.

An empirical implementation of Equation 3 requires estimates of the price and quantity effects of vertical integration for every product j (i.e., $\hat{\Delta}_{q_j}$ and $\hat{\Delta}_{p_j}$). We estimate these price and quantity effects, product by product, using our differences-in-differences framework.[29] We report the distribution of the estimates of Δ_{q_j} and Δ_{p_j} in Figure 4. The figure shows that vertical integration caused an increase in price and a decrease in quantity in most Dr Pepper SG products. The figure also presents mixed evidence for Coca-Cola and PepsiCo products.

With the estimates for Δ_{q_j} and Δ_{p_j} in hand, we use Equation 3 to compute the effects of vertical integration on the revenue of each upstream firm. This analysis suggests that vertical integration caused a 1.3 percent decrease in the revenue of Dr Pepper SG

[29] Specifically, we estimate $\log(outcome_{j,s,w}) = VI_{j,s,w}\beta_{VI}^j + \lambda_{j,s} + \phi_{j,w} + x'_{j,s,w}\delta + \varepsilon_{j,s,w}$ for every product j that was somewhere impacted by vertical integration, where $outcome_{j,s,w} \in \{price_{j,s,w}, quantity_{j,s,w}\}$, the indicator $VI_{j,s,w}$ takes the value one if product j at store s was bottled by a vertically integrated bottler at week w, and $\lambda_{j,s}$ and $\phi_{j,w}$ are product–store and product–week fixed effects, respectively. The vector $x_{j,s,w}$ includes product characteristics at the store–week level (e.g., advertising intensity), and $\varepsilon_{j,s,w}$ is an error term clustered at the county level.

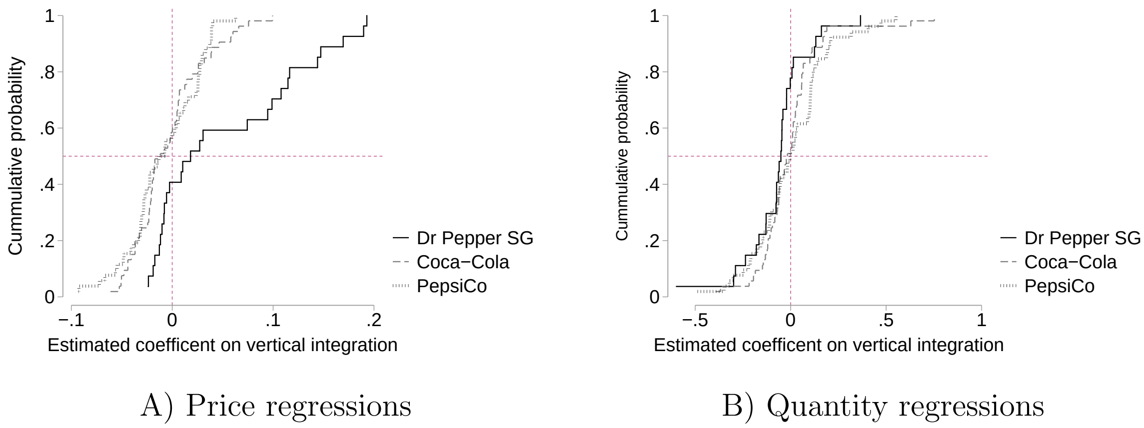


Figure 4: Empirical CDF of estimated product-level coefficients on vertical integration: OLS regressions

Notes: The figure reports the empirical CDF of the estimated coefficients on vertical integration on prices and quantities for Coca-Cola, PepsiCo, and Dr Pepper SG brands. The underlying regressions are at the product level and include store and week fixed effects, as well as controls for price promotions and county-level demographics. The treatment and control groups are defined as in Table 4 (Panel B).

products and an increase in the revenues of Coca-Cola and PepsiCo products of 1.7 and 2.2 percent, respectively, relative to the revenues in areas unaffected by vertical integration. These estimates show that while Coca-Cola and PepsiCo benefited from vertical integration, Dr Pepper SG suffered from it.

7 Discussion and Policy Implications

The debate on antitrust enforcement of vertical mergers has intensified in recent years amid a wave of large vertical transactions (see Federal Trade Commission 2018 for background on the debate, and Footnote 1 for a list of recent cases). We contribute to this debate by providing new evidence of the anticompetitive effects of vertical mergers in the context of multiproduct firms.

We consider a mechanism that arises when vertical integration eliminates the double margins in only a subset of the products sold by a downstream firm. The products with eliminated double margins become relatively more profitable to sell, which gives the multiproduct firm incentives to divert demand toward these products by increasing the prices of the products for which double margins were not eliminated. These price increases are anticompetitive because of how they harm the producer of the nonintegrated products.

We examine the relevance of this mechanism in the context of the U.S. carbonated-beverage industry by exploiting a recent wave of vertical mergers between upstream concentrate producers and downstream bottlers, which generated rich variation in vertical structure across time and space. Using this variation, we implement two complementary research designs to identify both the pro and anticompetitive effects of vertical integration. Our analysis shows that vertical integration in the U.S. carbonated-beverage industry caused anticompetitive price increases in products for which double margins were not eliminated.

Our research suggests that the impact of vertical integration on multiproduct pricing incentives is relevant for future vertical-merger enforcement actions for at least two reasons. First, the relative magnitude of our estimates of the anticompetitive and efficiency effects of vertical integration suggest that the elimination of double marginalization cannot be presumed to be procompetitive in the context of vertical integration by multiproduct firms. Second, because the pricing incentives that we study were present in many vertical transactions that have taken place in the last decades, our work suggests that the Edgeworth-Salinger effect should be incorporated in the evaluation of future vertical-merger enforcement actions. To this end, we note that economic tools used for horizontal-merger analysis, such as merger simulation and the estimation of own- and cross-price elasticities, could also be used to predict the magnitude of the Edgeworth-Salinger effect of vertical integration.

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Online Appendix: Not For Publication

The Competitive Impact of Vertical Integration by Multiproduct Firms

Fernando Luco and Guillermo Marshall

A Model

Consider a market with N_U upstream firms, N_B bottlers, and a retailer. There are J inputs produced by the N_U upstream firms and J final products produced by the N_B bottlers. Each final product makes use of one (and only one) input product. All J final products are sold by the retailer. The set of products produced by each upstream firm i and bottler j are given by J_U^i and J_B^j, respectively. In what follows, we restrict to the case in which the sets in both $\{J_B^j\}_{j \in N_B}$ and $\{J_U^j\}_{j \in N_U}$ are disjoint (i.e., Diet Dr Pepper cannot be produced by two separate bottlers or upstream firms). We allow for a bottler to transact with multiple upstream firms (e.g., a PepsiCo bottler selling products based on PepsiCo and Dr Pepper SG concentrates).

The model assumes that linear prices are used along the vertical chain. That is, linear prices are used both by upstream firms selling their inputs to bottlers and by bottlers selling their final products to the retailer. The price of input product j set by an upstream firm is given by c_j; the price of final good k set by a bottler is w_k; and the retail price of product j is p_j. We assume that the input cost of upstream firms is zero, and the marginal costs of all other firms equals their input prices. The market share of product j, given a vector of retail prices p, is given by $s_j(p)$.

We describe the pricing problem of each type of firm in reverse order. With respect to the retail sector, we assume that the retailer sets its prices taking as given the vector of wholesale prices set by the bottlers, w. We follow Miller and Weinberg (2017) in assuming that the retail prices are determined by

$$0 = \lambda s_j + \sum_{k \in J} \frac{\partial s_k(p)}{\partial p_j}(p_k - w_k) \tag{A.1}$$

for every $j \in J$ and where $\lambda \in [0, 1]$. This equation is the first-order condition of a multiproduct monopolist except for the presence of the retail scaling parameter λ. The parameter λ scales the retail markups between zero ($\lambda = 0$) and the monopoly markups ($\lambda = 1$), and allows us to capture the competitive pressure faced by the retailer in a simple way.

Every bottler i chooses a wholesale price w_j for each product $j \in J_B^i$, where J_B^i corresponds to the set of products sold by bottler i. We assume that the bottlers choose their wholesale prices taking as given the vector of input prices set by the upstream firms, c. When solving their problems, the bottlers use backward induction and take into consideration how their wholesale prices will affect the equilibrium retail prices, $p(w)$. Bottler i then solves

$$\max_{\{w_j\}_{j\in J_B^i}} \sum_{j\in J_B^i} (w_j - c_j) s_j(p(w)), \tag{A.2}$$

where J_B^i corresponds to the set of products sold by bottler i. The first-order necessary condition for product j sold by bottler i is given by

$$0 = s_j(p(w)) + \sum_{k\in J_B^i} \sum_{h\in J} \frac{\partial s_k(p(w))}{\partial p_h} \frac{\partial p_h(w)}{\partial w_j} (p_k - w_k).$$

Lastly, every upstream firm i chooses the input price c_j for each of their products $j \in J_U^i$. The upstream firms take into consideration how their input prices will impact both the wholesale prices set by the bottlers, $w(c)$, and the retail prices set by the retailer, $p(w)$, via the effect of input prices on wholesale prices. Upstream firm i solves

$$\max_{\{c_j\}_{j\in J_U^i}} \sum_{j\in J_U^i} c_j s_j(p(w(c))),$$

where J_U^i corresponds to the set of products sold by upstream firm i. The first-order necessary condition for product j sold by upstream firm i is given by

$$0 = s_j(p(w(c))) + \sum_{k\in J_U^i} \sum_{h\in J} \sum_{l\in J} \frac{\partial s_k(p(w(c)))}{\partial p_h} \frac{\partial p_h(w)}{\partial w_l} \frac{\partial w_l}{\partial c_j} c_k, \tag{A.3}$$

for every $j \in J_U^i$.

Equilibrium strategies are given by the correspondences $p(w)$, $\{w_i(c)\}_{i\in N_B}$, and $\{c_i\}_{i\in N_U}$ that simultaneously solve equations (A.1) - (A.3).

Example

We consider a set of numerical examples. We assume the existence of two products $J = 2$, where the demand for product j is given by

$$s_j(p) = \frac{\exp\{ap_j\}}{\exp\{\delta\} + \sum_{k\in J} \exp\{ap_k\}},$$

Table A.1: Numerical examples: Equilibrium prices

Example 1: $a = -1.5$, $\delta = -2$, $\lambda = 0.2$

	Upstream		Bottler		Retailer	
	No VI	VI	No VI	VI	No VI	VI
Product 1	1.0882	0	2.1392	1.4618	2.3321	1.6993
Product 2	1.0882	0.8734	2.1392	2.1575	2.3321	2.3949

Example 2: $a = -1.6$, $\delta = -1.9$, $\lambda = 0.1$

	Upstream		Bottler		Retailer	
	No VI	VI	No VI	VI	No VI	VI
Product 1	0.9458	0	1.9412	1.3268	2.0359	1.4439
Product 2	0.9458	0.8229	1.9412	2.0436	2.0359	2.1607

Example 3: $a = -1.25$, $\delta = -1.75$, $\lambda = 0.1$

	Upstream		Bottler		Retailer	
	No VI	VI	No VI	VI	No VI	VI
Product 1	1.1468	0	2.4004	1.6357	2.5199	1.7813
Product 2	1.1468	1.0379	2.4004	2.5505	2.5199	2.6960

with $a < 0$ and $\delta \in \mathbb{R}$.[30] We assume the existence of a single bottler producing both final products, and the existence of two upstream firms selling a single input product each.

In these examples, we compare the equilibria without vertical integration (as described in the previous section) with the equilibrium with vertical integration. In the case of vertical integration, we consider the case in which one of the upstream firms vertically integrates with the bottler. The only difference in this case is that with vertical integration, the integrated upstream firm transfers the input product to the bottler at marginal cost (i.e., zero). These examples allow us to quantify the impact of vertical integration on prices in equilibrium.

The examples in Table A.1 show a manifestation of both the efficiency and Edgeworth-Salinger effects of vertical integration, with an increase in the equilibrium price of product 2 at both the bottler and retail level. The increase in the price of product 2 at the bottler level is motivated by the eliminated double margin in product 1. That is, product 1 becomes relatively more profitable to sell for the bottler, incentivizing the bottler to increase the price of product 2 to divert demand toward product 1. Similarly, the effect at the retailer level is caused by the changes in the wholesale prices faced by

[30] We use values of λ that are similar to the ones used in Miller and Weinberg (2017).

the retailer (i.e., the bottler sells product 1 for less after vertical integration). These increases in the price of product 2 arise despite a decrease in the concentrate price of product 2.

B Contracts between bottlers and concentrate producers

Contracts between bottlers and upstream firms are proprietary data. However, some of these contracts are stored in online repositories. In addition, the financial information of publicly traded bottlers and concentrate producers is publicly available. In this section, we provide links to documents we have had access to during the preparation of this paper. These documents allow us to argue that:

1. Upstream firms have the right to change the price of concentrate at their sole discretion.[31] An example of this is provided by historical events. In the 1990s, Coca-Cola bottlers protested against increases in the price of concentrate, as the price-cost margin of bottlers was decreasing.[32]

2. Bottlers have the right to choose the price at which they sell to their customers, with two exceptions: i) in some cases, upstream firms have the right to establish a price ceiling, and ii) upstream firms may suggest prices to the bottlers.[33]

3. Our review of these documents suggests that concentrate prices had a linear component at least until the end of our sample period. The only evidence of lump-sum transfers between bottlers and upstream firms is from a contract from 2018 that covers a sub-bottling agreement in a sub-territory.[34] Two additional

[31] See https://caselaw.findlaw.com/us-10th-circuit/1206491.html (2005, paragraph 4), https://www.lawinsider.com/contracts/2IyU2LWKs28SWYZuccejEZ/coca-cola-bottling-co-consolidated/317540/2010-11-12 (1990, paragraph 14), https://www.sec.gov/Archives/edgar/data/317540/000095014408001899/g12161ke10vk.htm (2008, page 2) https://www.lawinsider.com/contracts/4WlNJy9FdLu4pAtimh4GXe/coca-cola-bottling-co-consolidated/317540/2014-08-08 (2014, paragraph 23), https://www.lawinsider.com/contracts/1FrM3nPpXoZ2U2inKtRJCy/coca-cola-bottling-co-consolidated/317540/2017-05-11 (2017, paragraph 16.5), and https://www.sec.gov/Archives/edgar/data/1418135/000095012308001483/y42891a2exv10w9.htm (see point 4. Note, however, that this is a blank aggreement). In parenthesis we present the year of the document (when available) and the paragraph in which the document refers to pricing by the concentrate producer. All links were accessed on September 14th, 2018.

[32] See "Pepsi to Lift Price of Soda Concentrate, Following Coca-Cola's Strategic Shift," *The Wall Street Journal*, November 22, 1999, and "Coca-Cola seeks to supersize its bottlers," *Financial Times*, March 23, 2013.

[33] See https://caselaw.findlaw.com/us-10th-circuit/1206491.html (2005, paragraph 7), and https://www.sec.gov/Archives/edgar/data/317540/000095014408001899/g12161ke10vk.htm (2008, page 3). Also, contracts with other beverage companies have a similar structure. See the previous link, page 5.

[34] https://www.lawinsider.com/contracts/3M2VLnui7IKkkY0NgoibXd/coca-cola-bottling-co-consolidated/317540/2018-02-28 (2018, paragraph 8).

pieces of evidence are consistent with our reading of the documents. First, our results are a test for the existence of double marginalization, and these results suggest the existence of double margins. Second, industry publications report concentrate prices as prices per 288 oz case, suggesting a linear component to prices as well.[35]

From our examination of these documents, we conclude that while the original prices charged by the upstream firms were linear prices (Muris et al., 1993), there has been a recent movement toward incorporating nonlinearities in the terms of the contracts. However, our examination of the documents does not allow us to rule out the existence of a linear component in the price paid by the bottlers, at least until 2018.[36]

[35]See, for example, *Beverage Digest* Volume 54, No. 11 (May 15, 2009).

[36]See, for example Coca-Cola's 2010 and 2013 10Ks, pp. 7 and 6, respectively: https://www.coca-colacompany.com/content/dam/journey/us/en/private/fileassets/pdf/2012/12/form_10K_2008.pdf and https://www.coca-colacompany.com/annual-review/2013/img/2013-annual-report-on-form-10-k.pdf.

C FTC complaints and decision orders

The FTC reviewed the transactions in 2010 and cleared them in October and November of that year subject to some behavioral remedies. The FTC's main concerns were related to Coca-Cola and PepsiCo having access to confidential information provided by Dr Pepper SG to vertically integrated bottlers. In particular, the FTC argued that the agreements between Coca-Cola/PepsiCo and Dr Pepper SG could lessen competition because, first, they could eliminate competition between Coca-Cola/PepsiCo and Dr Pepper SG; second, they could increase the likelihood of unilateral exercise of market power by Coca-Cola and PepsiCo; and third, they could facilitate coordinated interaction. That is, the concerns raised by the FTC were based on potential violations of Section 5 of the FTC Act and Section 7 of the Clayton Act. The FTC did not raise arguments related to the Edgeworth-Salinger effect in its complaints.

The remedies imposed by the FTC included, among others, that Coca-Cola/PepsiCo employees who would have access to confidential information had to be "firewalled," could only participate in the bottling process, and could not receive bonuses or benefits incentivizing them to increase the sales of own brands relative to Dr Pepper SG brands.

The material related to the FTC's investigations can be accessed at

- https://www.ftc.gov/enforcement/cases-proceedings/091-0133/pepsico-inc-matter, and
- https://www.ftc.gov/enforcement/cases-proceedings/101-0107/coca-cola-company-matter.

D Additional summary statistics

In this Appendix, we provide additional summary statistics and information regarding the extent of vertical integration in the U.S. carbonated beverage industry.

D.1 Summary statistics

TABLE D.1: Summary statistics: Price (part I)

		20 oz			67.6 oz			144 oz		
Brand	Firm	N	Mean	S.D.	N	Mean	S.D.	N	Mean	S.D.
7 Up	Dr Pepper	315798	1.4	0.24	420559	1.39	0.33	432133	4.06	0.91
A & W	Dr Pepper	332805	1.39	0.29	495688	1.38	0.31	454634	4.11	0.87
Barqs	Coke	40720	1.47	0.21	258862	1.41	0.28	347614	4.06	0.98
Caffeine Free Coke Classic	Coke	37	0.25	0.23	260251	1.43	0.28	383256	4.1	0.94
Caffeine Free Diet Coke	Coke	159921	1.51	0.17	468478	1.47	0.29	465918	4.08	0.9
Caffeine Free Diet Dr Pepper	Dr Pepper	386	1.27	0.15	78752	1.27	0.26	287195	4.04	0.93
Caffeine Free Diet Pepsi	Pepsi	130193	1.48	0.15	441642	1.38	0.3	432654	3.85	0.9
Caffeine Free Pepsi	Pepsi	9697	1.43	0.14	386572	1.38	0.29	381796	3.92	0.95
Canada Dry	Dr Pepper	160770	1.48	0.36	498073	1.42	0.31	454557	4.18	0.86
Cherry 7 Up	Dr Pepper	33089	1.32	0.34	310752	1.32	0.29	189856	3.89	0.95
Cherry Coke	Coke	206548	1.52	0.16	374474	1.46	0.28	408951	4.06	0.96
Coca Cola	Coke	535042	1.51	0.21	529313	1.49	0.29	526899	4.13	0.9
Coke Cherry Zero	Coke	109190	1.51	0.19	208736	1.44	0.28	368158	4.08	0.93
Coke Zero	Coke	488084	1.51	0.16	471515	1.47	0.29	468872	4.09	0.91
Crush	Dr Pepper	190937	1.48	0.23	307422	1.4	0.31	278953	4.1	0.92
Diet 7 Up	Dr Pepper	249729	1.4	0.28	481428	1.36	0.31	416338	4.08	0.89
Diet Barqs	Coke	1630	1.45	0.14	29669	1.35	0.27	273348	4.07	0.98
Diet Cherry 7 Up	Dr Pepper	226	3.19	0.54	242214	1.31	0.29	153544	3.81	0.92
Diet Cherry Coke	Coke	734	1.3	0.09	1282	1.26	0.22	222507	3.99	0.93
Diet Cherry Vanilla Dr Pepper	Dr Pepper	23728	1.34	0.15	67015	1.29	0.27	149419	3.8	0.87
Diet Coke	Coke	533073	1.51	0.15	521944	1.48	0.29	518848	4.12	0.89
Diet Coke With Lime	Coke	68041	1.49	0.17	153463	1.41	0.27	363190	4.06	0.94
Diet Coke With Splenda	Coke	1176	1.31	0.08	10902	1.29	0.22	256848	4.02	0.89
Diet Dr Pepper	Dr Pepper	404050	1.5	0.18	467563	1.42	0.3	457437	4	0.89
Diet Mountain Dew	Pepsi	411141	1.5	0.15	443204	1.39	0.3	428846	3.89	0.91
Diet Mountain Dew Caffeine Fr	Pepsi	1486	1.35	0.28	75774	1.38	0.28	77189	3.86	0.81
Diet Mug	Pepsi	9	1.29	0	114301	1.39	0.3	197862	4.03	1.01
Diet Pepsi	Pepsi	527909	1.5	0.15	516303	1.4	0.3	505935	3.87	0.85
Diet Pepsi Jazz	Pepsi	21378	1.34	0.17	79244	1.29	0.26	80978	3.68	0.83
Diet Pepsi With Lime	Pepsi	6670	1.38	0.19	102956	1.35	0.28	204097	3.92	1.01
Diet Rite	Dr Pepper	14149	3.46	2.12	276901	1.3	0.28	175716	3.89	0.79
Diet Schweppes	Dr Pepper	84	1.52	0.16	160331	1.36	0.3	102541	4.23	0.99
Diet Sierra Mist	Pepsi	2346	1.66	0.2	318569	1.37	0.3	301042	4.05	1.03
Diet Sierra Mist Cranberry Sp	Pepsi	30677	1.36	0.26	75288	1.35	0.31	49875	4.08	0.93
Diet Squirt	Dr Pepper	9231	1.43	0.21	114671	1.33	0.29	167313	3.98	0.88
Diet Sun Drop	Dr Pepper	25797	1.56	0.8	86704	1.25	0.3	58665	4.02	0.91
Diet Sunkist	Dr Pepper	151871	2.91	2.66	382738	1.34	0.31	385239	4.05	0.93

Notes: An observation is a brand–size–store–week combination.

Table D.1: Summary statistics: Price (part II)

		20 oz			67.6 oz			144 oz		
Brand	Firm	N	Mean	S.D.	N	Mean	S.D.	N	Mean	S.D.
Diet Vernors	Dr Pepper	12228	1.55	0.87	77604	1.55	0.4	52919	4.02	0.97
Diet Wild Cherry Pepsi	Pepsi	109859	1.51	0.17	371608	1.37	0.29	367639	3.91	0.98
Dr Pepper	Dr Pepper	476714	1.49	0.18	496559	1.43	0.3	479838	4.02	0.89
Fanta	Coke	178632	1.51	0.18	390753	1.4	0.3	368379	4.06	0.96
Fresca	Coke	14547	1.6	0.22	325198	1.45	0.28	382544	4.16	0.89
Manzanita Sol	Pepsi	14185	1.39	0.21	61639	1.32	0.27	57111	3.7	0.87
Mello Yello	Coke	50343	6.5	3.59	24353	1.26	0.27	136670	4.02	0.92
Mountain Dew	Pepsi	519875	1.5	0.17	506505	1.41	0.3	489342	3.89	0.9
Mountain Dew Code Red	Pepsi	92306	1.48	0.34	236518	1.37	0.28	278790	3.9	0.97
Mountain Dew Throwback	Pepsi	66743	1.41	0.28	12838	1.44	0.3	112274	4.08	1.02
Mountain Dew Voltage	Pepsi	94610	1.45	0.24	160664	1.4	0.29	181766	4.06	1.01
Mug	Pepsi	41320	1.54	0.38	357551	1.38	0.29	354697	3.99	0.99
Pepsi	Pepsi	531774	1.5	0.17	528315	1.41	0.3	518629	3.9	0.87
Pepsi Max	Pepsi	311016	1.49	0.21	342304	1.39	0.31	327517	3.93	0.99
Pepsi Next	Pepsi	38781	1.5	0.27	53334	1.29	0.34	47463	3.85	1.03
Pepsi One	Pepsi	2564	1.35	0.12	208701	1.35	0.29	314400	3.92	0.99
Pepsi Throwback	Pepsi	83036	1.43	0.27	23590	1.47	0.29	141714	4.09	1
Pibb Xtra	Coke	25866	1.43	0.18	48456	1.34	0.27	125295	3.96	0.89
R C	Dr Pepper	43099	1.2	0.38	244893	1.26	0.28	202901	3.84	0.83
Schweppes	Dr Pepper	53970	1.54	0.19	339935	1.4	0.31	272106	4.08	0.95
Seagrams	Coke	19573	4.46	3.63	265112	1.44	0.31	216035	4.19	1
Sierra Mist	Pepsi	255442	1.42	0.16	295841	1.34	0.29	275171	3.74	0.9
Sierra Mist Cranberry Splash	Pepsi	55905	1.39	0.26	102603	1.36	0.31	74311	4.02	0.95
Sierra Mist Free	Pepsi	73193	1.42	0.16	67950	1.25	0.25	103503	3.58	0.8
Sierra Mist Natural	Pepsi	140485	1.52	0.24	173222	1.41	0.33	153299	4.05	1.02
Sprite	Coke	525923	1.51	0.15	432152	1.5	0.3	498676	4.09	0.93
Sprite Zero	Coke	189673	1.5	0.16	440937	1.45	0.29	435877	4.1	0.95
Squirt	Dr Pepper	137354	1.42	0.27	273682	1.37	0.3	235008	3.98	0.91
Sun Drop	Dr Pepper	53992	1.4	0.28	118015	1.27	0.31	95340	4.05	0.96
Sunkist	Dr Pepper	352410	1.46	0.35	476905	1.36	0.32	425571	4.01	0.94
Vanilla Coke	Coke	54182	1.42	0.18	17827	1.3	0.25	240326	4.1	0.97
Vault	Coke	98225	1.34	0.21	66704	1.28	0.26	148527	3.87	0.86
Vernors	Dr Pepper	19129	1.43	0.28	93776	1.55	0.4	64943	4.08	0.97
Welchs	Dr Pepper	54194	1.31	0.34	158751	1.28	0.29	157569	3.8	0.84
Wild Cherry Pepsi	Pepsi	176707	1.51	0.17	410239	1.39	0.3	378463	3.91	1.01

Notes: An observation is a brand–size–store–week combination.

D.2 Price variance decomposition

To examine the sources of price variation in our data, we perform a decomposition of the variance of price for the subsample of 67.6 oz products, where an observation is a store–week–product combination. Table D.2 presents a decomposition into three week-level components: a chain component (capturing the average price level at the store's chain level), a within-chain store–level component (capturing store–level deviations from the average price of its chain), and a within-store component (capturing differences across products within a store). The table shows that the two most significant factors explaining overall price variation are the within-store and the chain components (61.2% and 32.3% of the overall price variation when the analysis considers both sale and non-sale prices). The analysis suggests that consumers face significant price variation when comparing prices in a given store–week, and stores of the same chain tend to set similar prices (see DellaVigna and Gentzkow 2019 for related findings).[37] The latter finding will lead us to study the robustness of our results to various levels of data aggregation (e.g., MSA–chain–year–product).

TABLE D.2: Price variance decomposition (67 oz products)

	Sample	
	All	Nonsale
Chain–week component	0.323	0.538
Store–week (within chain–week) component	0.065	0.105
Within store–week component	0.612	0.357

Notes: The variance of price is decomposed using the identity $p_{jst} = p_{ct} + (p_{st} - p_{ct}) + (p_{jst} - p_{st})$, where p_{jst} is the price of product j at store–week (s, t), p_{ct} is the average price at chain–week (c, t), and p_{st} is the average price at store–week (s, t). The variance of p_{jst} is the sum of $var(p_{ct})$ (chain–week variation), $var(p_{st} - p_{ct})$ (store-level variation within chain–week), and $var(p_{jst} - p_{st})$ (within store–week variation). The table reports each of these components relative to total variance (i.e., $var(p_{ct})/var(p_{jst})$, $var(p_{st} - p_{ct})/var(p_{jst})$, and $var(p_{jst} - p_{st})/var(p_{jst})$, respectively).

D.3 Within-store price dispersion

In this section, we provide evidence on the extent of within-store price dispersion. We do this in two steps. First, Table D.3 presents examples of prices that consumers

[37] Table D.3 presents examples of non-sale prices at different stores for the same week, and shows that even when restricting to the most popular products, consumers face significant within store–week price variation. We generalize this in Figure D.1, where we plot the distribution of the within-store–week standard deviation of price. The figure shows that within-store price variation is significant even within products of the same size.

faced when visiting different stores for one week in our sample. The table restricts the analysis to "round number" prices (e.g., 1.15 as opposed to 1.13414) of products that were not flagged as being on sale. Because our measure of prices is the average price paid by consumers for a product in a given store–week combination, non-rounded prices may arise when some consumers use coupons or when the store changed the price of a product in the middle of a week. The table shows that even when considering the most popular products, price dispersion across brands is not trivial.

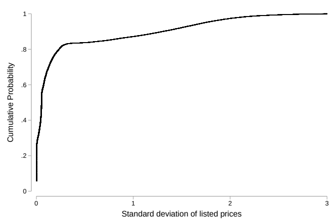
Second, Figure D.1 reports the within-store price dispersion for products of different sizes, using the full sample of regular prices as well as the subsample of round number regular prices. The figure shows that prices vary significantly across products of the same size, even when restricting attention to products that were not on sale.

TABLE D.3: Price variation within store–week: Examples of pricing patterns

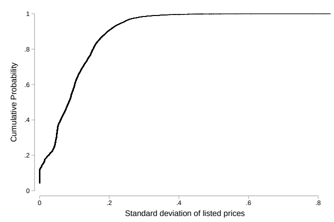
	Store				
Product	1	2	3	4	5
Coca Cola (67 oz)	1.49	1.59	1.49	1.49	1.69
Diet Coke (67 oz)	1.49	1.59	1.49	1.49	1.69
Pepsi (67 oz)	1.39	1.49	1.39	1.39	1.59
Diet Pepsi (67 oz)	1.39	1.49	1.39	1.39	1.59
Dr Pepper (67 oz)	1.29	1.59	1.39	1.29	1.59
Diet Dr Pepper (67 oz)	1.29	1.59	1.39	1.29	1.59

Notes: All of these examples correspond to IRI week 1429 (January 15-21, 2007). Each column corresponds to a different store. None of the prices in the table were flagged as a sale price in the data.

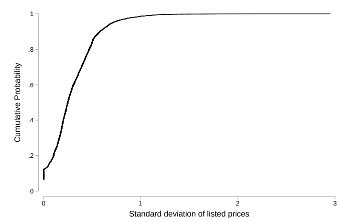
All products and prices



(a) 20 oz

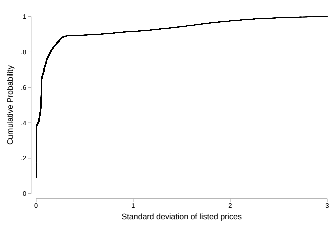


(b) 67 oz

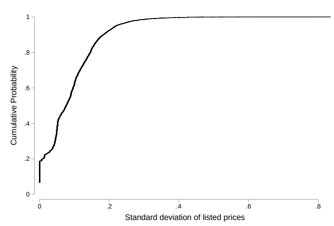


(c) 144 oz

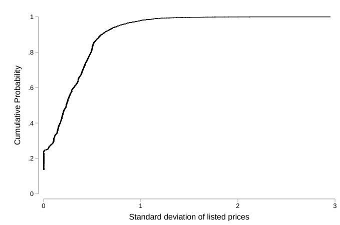
All products, round number prices



(d) 20 oz



(e) 67 oz



(f) 144 oz

FIGURE D.1: Within store–week standard deviation of prices: Cumulative distribution function

Notes: The upper panel presents the within-store standard deviation of price across products of the same size, considering prices that are not flagged as a sale price. The lower panel repeats the analysis restricting the sample to round number prices.

D.4 Covariate balance before and after vertical integration

Table D.4 and Table D.5 explore differences in demographics, retail configuration, and consumption of substitute products (i.e., beer and milk) both before and after the vertical mergers between areas differentially impacted by vertical integration. Table D.4 shows differences between areas impacted and not impacted by vertical integration (e.g., the treated areas are on average wealthier, more populated, and have a larger number of retail stores than the untreated areas), and also shows that there were no differential changes in these variables across areas affected and unaffected by vertical integration.

Table D.5 reports averages of the number of liters of beer and milk (in logs) sold in a store–week combination. The table shows similar levels of consumption of beer, both before and after vertical integration, in areas impacted and not impacted by vertical integration. The table also suggests that a greater amount of milk was consumed in areas impacted by vertical integration throughout the sample period. Statistical tests cannot reject the hypothesis of no differential changes in the consumption of these goods in areas impacted by vertical integration (the p-values are 0.64 and 0.85 for beer and milk, respectively).

Table D.4: Covariate balance before and after vertical integration

	(1)	(2)	(3)		(4)	(5)	(6)	(7)
		Before VI			After VI			
Variable	Untreated	Treated	(2)-(1)		Untreated	Treated	(5)-(4)	(6)-(3)
Mean income	56574.03	69909.15	13335.12		59010.22	70923.56	11913.34	-1421.78
	(12424.17)	(18879.13)	[0.000]		(11326.73)	(19037.87)	[0.000]	[0.501]
Population (in logs)	11.38	12.27	0.88		11.63	12.28	0.65	-0.23
	(0.8)	(1.12)	[0.000]		(0.85)	(1.12)	[0.000]	[0.110]
Convenience stores	8.25	39.09	30.84		10.4	39.14	28.74	-2.1
	(11.33)	(64.73)	[0.000]		(12.82)	(67.04)	[0.000]	[0.538]
Supermarkets	20.36	92.63	72.27		22.6	96.43	73.82	1.56
	(20.92)	(197.95)	[0.000]		(21.7)	(219.07)	[0.000]	[0.868]
Temperature	61.68	54.24	-7.44	64.2	55.54	-8.66	-1.21	
	(7.29)	(7.41)	[0]	(2.19)	(6.84)	[0]	[.158]	

Notes: An observation is a county–year combination. The table reports averages of county–level characteristics for treated and untreated counties. Standard deviations are in parentheses. *p*-values of two-sided tests for equality of means in brackets. Income and population data at the county–year level were obtained from the U.S. Census Bureau's American Community Survey (2007-2012). The number of convenience stores and supermarkets in each county–year were drawn from the US Census Bureau's County Business Patterns database. Temperature at the county–month level was retrieved from NOAA's National Climatic Data Center database (i.e., https://www.ncdc.noaa.gov/cag/county/time-series/).

Table D.5: Average number of liters (in logs) sold in a store–week combination

	Before VI	After VI
Untreated	7.276	7.252
Treated	7.283	7.143

A) Beer

	Before VI	After VI
Untreated	7.775	7.590
Treated	8.337	8.218

B) Milk

Notes: The table reports averages of the number of liters sold in every store–week combination based on the IRI Marketing Data Set.

D.5 Evolution of average prices

Here we present the evolution of the average prices of both 20 oz and 144 oz products, separating by whether the products were bottled by vertically integrated bottlers. Similar to what is reported in Figure 2, the figure shows that the prices of treated and untreated products tracked each other before vertical integration, suggesting that there were no differential preexisting trends in these sets of products.

We complement the figures with a formal test for the existence of differential trends. Table D.6 presents regression estimates of residualized prices on a week indicator, an indicator that identifies products that started being produced by an integrated bottler after the vertical mergers, and the interaction of the two indicators. In the first stage, prices are residualized with respect to the other covariates included in our analysis (e.g., indicators for feature and display and county-level covariates). The table shows no evidence of differential trends before the vertical mergers.

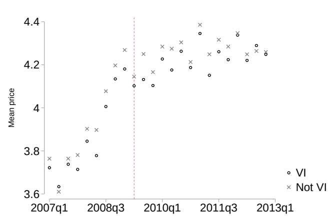
20 oz products

(a) Coca-Cola 20 oz

(b) PepsiCo 20 oz

(c) Dr Pepper SG 20 oz

144 oz products



(d) Coca-Cola 144 oz

(e) PepsiCo 144 oz

(f) Dr Pepper SG 144 oz

FIGURE D.2: The evolution of prices before and after the mergers by whether the products were ever sold by a VI firm (products of 20 and 144 oz)

Notes: An observation is a firm–VI status–week combination, where VI status takes the value of one if the product was ever bottled by a VI firm (e.g., Coke bottled by CCE or Dr Pepper bottled by CCE). The dotted vertical lines indicate the first transaction.

Table D.6: Testing divergence of price trends before vertical mergers: OLS regressions

	Dependent variable: residualized prices		
	Coca-Cola	Dr Pepper SG	Pepsi
	(1)	(2)	(3)
Ever integrated×Trend	0.0001	0.0000	-0.0001
	(0.0000)	(0.0000)	(0.0001)
Ever integrated	-0.0878	-0.0530	0.1184
	(0.0672)	(0.0571)	(0.0758)
Week	-0.0000	-0.0000	0.0001
	(0.0000)	(0.0000)	(0.0000)
Observations	7,417,588	7,058,387	7,714,048
R^2	0.0000	0.0001	0.0001

Notes: Standard errors clustered at the county level. All specifications regress residualized prices on a week indicator, an indicator that identifies products that started being produced by an integrated bottler after the vertical mergers, and the interaction of the two indicators. In the first stage, prices are residualized with respect to the other covariates included in our analysis (e.g., indicators for feature and display and county-level covariates).

E Comparing estimates across research designs

With respect to the connection between the differences-in-differences and within-store estimators, we note that both estimators would deliver the same point estimates if the prices of nonintegrated products evolved similarly across all markets. To see this, suppose we have a sample of two markets with two time observations per market (i.e., one observation before and one after vertical integration). In the first market (market A), a subset of the products became integrated. In the second market (market B), vertical integration does not take place. In this context, the differences-in-differences estimator for product j would be $(p_{j,A,1} - p_{j,B,1}) - (p_{j,A,0} - p_{j,B,0})$, while the within-store estimator would be $(p_{j,A,1} - p_{NoVI,A,1}) - (p_{j,A,0} - p_{NoVI,A,0})$, where $p_{NoVI,A,t}$ is the average price of nonintegrated products in market A at time t. From these expressions, it is clear that the estimates are equivalent when the changes in the prices of nonintegrated products is the same across markets: $p_{j,B,1} - p_{j,B,0} = p_{NoVI,A,1} - p_{NoVI,A,0}$.

The estimates would for example differ if vertical integration caused changes in the prices of nonintegrated products in markets where at least one firm became integrated (e.g., via equilibrium feedback effects). Because these effects of vertical integration on the prices of nonintegrated products cannot exist in markets where vertical integration did not take place, these price effects could have made the prices of nonintegrated products to diverge across areas differentially impacted by vertical integration.

To examine this connection between estimators, we re-compute the within-store estimator on the same subsample used in Table 4 (Panel B), which is designed to minimize the role of equilibrium feedback effects. We report the estimates in Table E.1. A comparison between Table 4 (Panel B) and Table E.1 reveals that the estimates are almost identical, which is to be expected in the absence of equilibrium feedback effects.[38] The similarity between the estimates is a strength of our paper, as both research designs rely on different sources of variation and identification assumptions.

[38]We note that these tables have different sample sizes because the within-store analysis pools the products of all upstream firms while the differences-in-differences analysis is at the upstream firm level.

Table E.1: The effect of vertical integration on prices (within-store estimates): Restricted treatment subsamples

	Dependent variable: log(price)		
	Coca-Cola	Coca-Cola/DPSG or PepsiCo/DPSG	PepsiCo
	(1)	(2)	(3)
Vertical integration	-0.009	-0.006	-0.006
× Coca-Cola/PepsiCo product	(0.003)	(0.003)	(0.003)
Vertical integration	-	0.012	-
× Dr Pepper SG product		(0.005)	
Observations	5,306,197	7,853,553	4,759,626
R^2	0.935	0.931	0.938

Notes: Standard errors clustered at the county level (Column 1: 197 clusters; Column 2: 217 clusters; Column 3: 201 clusters). All specifications include store–week, product–week, and product–store fixed effects, as well as controls for feature and display. Column 1 restricts the sample to counties that were either untreated or in which only Coca-Cola integrated (and the Coca-Cola bottler did not bottle Dr Pepper SG products); column 2 restricts the sample to counties that were untreated and counties in which either Coca-Cola or PepsiCo integrated while bottling Dr Pepper SG products; and column 3 restricts the sample to counties that were either untreated or in which only PepsiCo integrated (and the PepsiCo bottler did not bottle Dr Pepper SG products).

F Additional analyses

F.1 Price indexes with national weights

In this subsection, we first explain the computation of the price indexes used in estimation and then replicate our price index differences-in-differences analysis using national rather than store-level indexes. This analysis will help us shed light on whether vertical integration caused an increase or decrease in quantity-weighted prices.

We construct the store–week price indexes as follows. For each store, we compute the average weekly quantity of each product in the period before vertical integration. For each store–week combination, we weigh each price by its average quantity in the period before vertical integration. For each store–week combination, we sum the weighted prices (i.e., price multiplied by its pre-vertical integration average quantity) and normalize the price index by dividing by the sum of weights of the products available in that store–week combination. We compute price indexes considering the full set of products in a store–week combination as well as price indexes on the subsets of Coca-Cola, Dr Pepper SG, and PepsiCo products.

Finally, we also use national rather than store-level price indexes. The results, which we present in Table F.1 are similar to those presented in the main text as we do not find significant price changes on average or for Coca-Cola products, while the price of PepsiCo products bottled by integrated bottlers decreased by 1.6 percent and the price of Dr Pepper SG products increased by 5.3 percent.

Table F.1: The effect of vertical integration on national price indexes (differences-in-differences estimates)

	Dependent variable: log(price index)			
	All products	Coca-Cola	Dr Pepper SG	PepsiCo
	(1)	(2)	(3)	(4)
Vertical integration	0.006	0.005	0.053	-0.016
	(0.007)	(0.007)	(0.009)	(0.006)
Observations	542,668	542,282	540,319	538,465
R^2	0.664	0.429	0.651	0.359

Notes: Standard errors clustered at the county level (431 clusters). An observation is a store–week combination. Price indexes are computed based on pre-vertical integration average quantities at the product level, where the weight of each product in a given store–week combination is its average quantity across all store–week combinations in the pre-merger period. The price index in column 1 includes all products, whereas the price indexes in column 2 to 4 restrict the set of products to Coca-Cola, Dr Pepper SG, and PepsiCo products, respectively. All specifications include store and week fixed effects, as well as time-varying county-level controls.

F.2 Addressing potential selection

F.2.1 Blocking regression

In this section, we implement a blocking regression approach to ensure that control and treatment groups are comparable. To do this, we first estimate the likelihood of a county being exposed to treatment based on its demographics and market outcomes prior to the transactions. We do this by estimating the probability that a county is treated via maximum likelihood estimation of a logit model. The dependent variable is equal to one if a county is going to be exposed to vertical integration and zero otherwise. The independent variables are the same demographics included in the analyses presented above, in addition to the average shares, volume, and prices of the products of each firm (all measured using county-level averages over the pre-integration period).

We then use the estimated logit specification to predict the propensity score of each county of being exposed to treatment. We use this propensity score to assign both treated and untreated counties to bins, ensuring that both the propensity score and the explanatory variables included in the propensity score specification are balanced within each bin.

Once all counties, treated and untreated, have been assigned to propensity-score bins, we replicate Table 4 for each bin and estimate the effect of vertical integration on prices within each bin. Finally, we compute the overall price effect of vertical integration on the products of each upstream firm as the weighted average of the bin-specific price effects. Table F.2 reports the results and shows that our estimates do not change significantly relative to Table 4.

Table F.2: The effect of vertical integration on prices (differences-in-differences estimates): Propensity-score matching

	Dependent variable: log(price)		
	Coca-Cola	Dr Pepper SG	PepsiCo
	(1)	(2)	(3)
Vertical integration	0.002	0.012	-0.009
	(0.006)	(0.003)	(0.004)
Observations	15,751,752	15,810,500	15,292,417

Notes: Standard errors clustered at the store level. All specifications include product–week and product–store fixed effects, as well as time-varying county-level controls and controls for feature and display. Estimation is by blocking regressions. First, we compute the propensity score of each county of being exposed to vertical integration by Coca-Cola, PepsiCo, and Dr Pepper SG. We do this by estimating a logit model via maximum likelihood. We then group counties by propensity score, subject to the mean propensity score and covariates being balanced within each group. Then, we estimate Equation 1 for each firm and blocking group. Estimates reported in the table correspond to the weighted estimates according to the number of counties in each blocking group. Because under some specifications there are groups with fewer counties than parameters to be estimated, we cluster standard errors at the store rather than county level. Finally, we lose observations relative to Table 4, because estimation is performed on the subsample for which the common support assumption holds within each propensity-score group.

F.2.2 Neighboring counties

In Table F.3 and Table F.4 we repeat our differences-in-differences and within-store analyses (respectively), restricting the sample to neighbor counties that were differentially impacted by vertical integration. That is, two neighboring counties are included in the subsample if (i) they were both impacted by vertical integration but only one was exposed to the Edgeworth-Salinger effect, or (ii) only one was impacted by vertical integration. This restriction limits the sample to 132 counties (out of 443 counties in the baseline analysis). This subsample analysis allows us to compare price changes in counties that are very similar except for having been differentially impacted by vertical integration. The estimates remain largely unchanged, suggesting that our main results are not impacted by unobserved heterogeneity across counties that is not captured by the set of fixed effects included in our estimating equations.

Table F.3: The effect of vertical integration on prices (differences-in-differences estimates): Neighboring counties subsample

	Dependent variable: log(price)		
	Coca-Cola	Dr Pepper SG	PepsiCo
	(1)	(2)	(3)
Vertical integration	-0.000	0.013	0.005
	(0.008)	(0.005)	(0.006)
Observations	6,072,345	5,984,326	6,501,197
R^2	0.905	0.897	0.882

Notes: Standard errors clustered at the county level (130 clusters). All specifications include product–week and product–store fixed effects, as well as time-varying county-level controls and controls for feature and display. The neighboring-counties subsample restricts attention to bordering counties that were differentially impacted by vertical integration. For example, counties that did not experience vertical integration but had at least one neighboring county impacted by vertical integration would be included in the subsample.

Table F.4: The effect of vertical integration on prices (within-store estimates): Neighboring counties subsample

	Dependent variable: log(price)	
	(1)	(2)
Vertical integration × Coca-Cola/PepsiCo product	-0.009 (0.003)	
Vertical integration × Dr Pepper SG product	0.013 (0.004)	
Vertical integration (Coca-Cola) × Coca-Cola product		-0.014 (0.005)
Vertical integration (Coca-Cola) × Dr Pepper SG product		0.015 (0.005)
Vertical integration (PepsiCo) × PepsiCo product		-0.002 (0.005)
Vertical integration (PepsiCo) × Dr Pepper SG product		0.007 (0.005)
Observations	18,557,740	18,557,740
R^2	0.905	0.905

Notes: Standard errors clustered at the county level (132 clusters). All specifications include store–week, product–week, and product–store fixed effects, as well as controls for feature and display. The neighboring-counties subsample restricts attention to bordering counties that were differentially impacted by vertical integration. For example, counties that did not experience vertical integration but had at least one neighboring county impacted by vertical integration would be included in the subsample.

F.3 Aggregation

We explore the robustness of our results to different levels of aggregation in Table F.5 (differences-in-differences) and Table F.6 (within-store). Two reasons motivate this analysis. First, the serial correlation of prices may lead to inconsistent estimates of standard errors (see Bertrand et al. 2004).[39] Second, chains set similar prices across their stores (see Table D.2 and DellaVigna and Gentzkow 2019), suggesting that there may be spillover effects when two nearby counties are differentially exposed to vertical integration. These analyses suggest robustness to both serial correlation of prices and spatial spillovers.

[39]We emphasize that throughout our analysis, we cluster standard errors at the treatment-unit level (i.e., county), which is an alternative solution to the problem of serially correlated outcomes (see Bertrand et al. 2004 for details).

Table F.5: The effect of vertical integration on prices (differences-in-differences estimates): Aggregation results

	Dependent variable: log(price)		
	Coca-Cola	Dr Pepper SG	PepsiCo
	(1)	(2)	(3)
Panel A: Bertrand–Duflo–Mullainathan aggregation			
Integration	0.004	0.011	-0.006
	(0.005)	(0.003)	(0.004)
Observations	120002	128340	153568
R^2	0.992	0.989	0.990
Panel B: Chain–county–week aggregation			
Integration	0.005	0.012	-0.007
	(0.005)	(0.003)	(0.004)
Observations	9777190	9773005	10631305
R^2	0.902	0.902	0.884
Panel C: Chain–county–quarter aggregation			
Integration	0.003	0.009	-0.006
	(0.005)	(0.003)	(0.003)
Observations	847925	886362	980844
R^2	0.976	0.970	0.968
Panel D: Chain–county–year aggregation			
Integration	-0.000	0.007	-0.009
	(0.005)	(0.003)	(0.003)
Observations	219092	230853	268383
R^2	0.986	0.983	0.981
Panel E: Chain–MSA–week aggregation			
Integration	0.009	0.015	-0.004
	(0.011)	(0.006)	(0.008)
Observations	3301297	3458186	3641613
R^2	0.917	0.916	0.900
Panel F: Chain–MSA–quarter aggregation			
Integration	0.007	0.012	0.002
	(0.011)	(0.006)	(0.006)
Observations	280185	298901	325932
R^2	0.977	0.970	0.969
Panel G: Chain–MSA–year aggregation			
Integration	0.001	0.012	0.002
	(0.011)	(0.007)	(0.007)
Observations	71960	76483	87787
R^2	0.985	0.982	0.980

Notes: Standard errors clustered at the county level (panels A-D with 443 clusters) or MSA level (panels E-G with 50 clusters) in parentheses. All specifications include (aggregated) time-varying county-level controls. All specifications include product–time period and product–store/county/MSA fixed effects.

TABLE F.6: The effect of vertical integration on prices (within-store estimates): Aggregation results

	Dependent variable: log(price)						
	Aggregation level						
	Store Pre/Post Product	County Week Product	County Quarter Product	County Year Product	MSA Week Product	MSA Quarter Product	MSA Year Product
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Vertical integration	-0.011	-0.010	-0.010	-0.008	-0.010	-0.006	-0.007
× Coca-Cola/PepsiCo product	(0.003)	(0.002)	(0.002)	(0.002)	(0.004)	(0.004)	(0.003)
Vertical integration	0.011	0.010	0.007	0.006	0.010	0.008	0.007
× Dr Pepper SG product	(0.002)	(0.002)	(0.002)	(0.002)	(0.004)	(0.004)	(0.003)
Observations	401,908	30,181,251	2,715,122	718,325	10,400,894	905,010	236,227
R^2	0.992	0.907	0.976	0.986	0.921	0.976	0.985

Notes: Standard errors clustered at the county level (columns 1-4, 442 clusters) or MSA level (columns 5-7, 50 clusters). All specifications include store–time period, product–time period, and product–store fixed effects, as well as controls for feature and display.

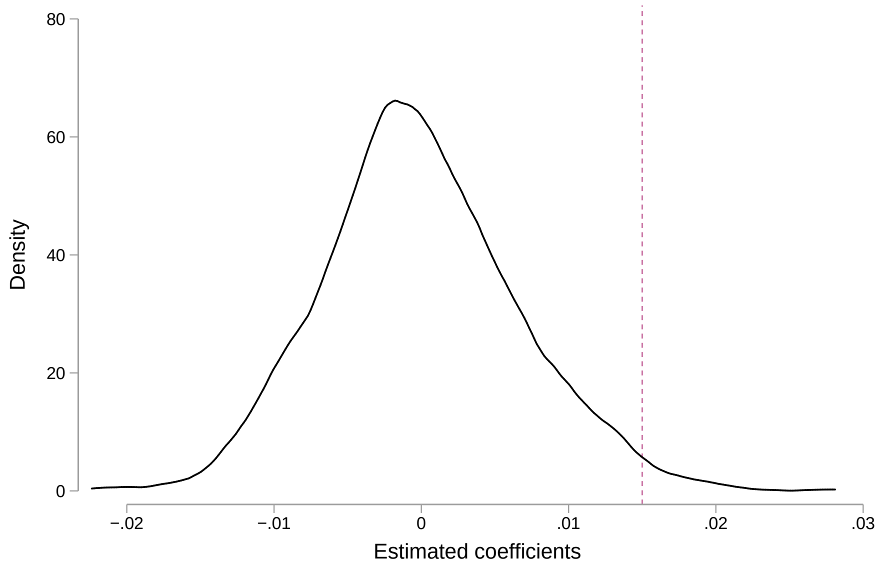
F.4 Placebos

To examine whether the estimated price effects of vertical integration on Dr Pepper SG products could be caused by chance, we perform four placebo exercises. Each of these exercises consists of 1,000 replications.

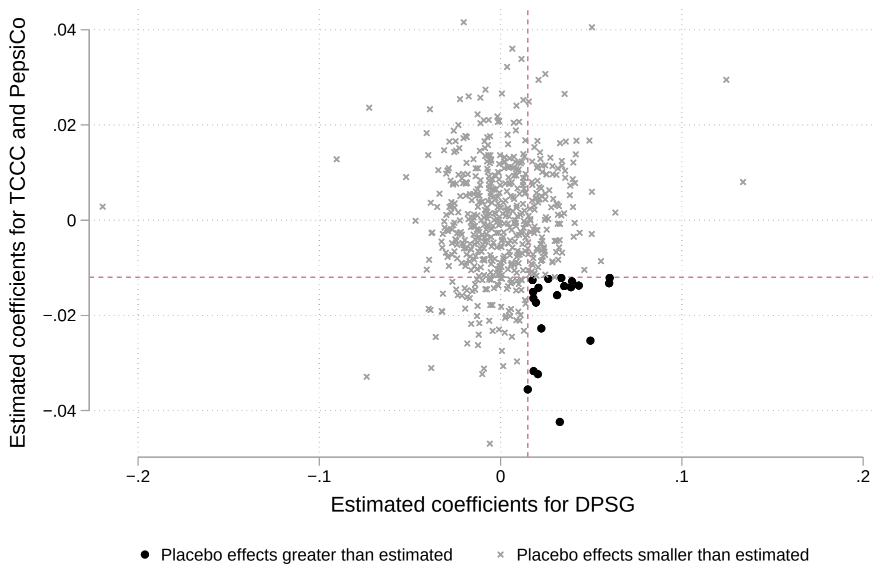
In the first exercise, we randomly draw the counties exposed to vertical integration, the moment at which vertical integration took place, and the subset of Dr Pepper SG products that were affected by vertical integration. Figure F.1a reports our findings and shows that the estimate effect reported in Table 4 (Panel A, Column 2) lies on the right tail of the distribution of placebo estimates, with an associated p-value of 0.015. This suggests that the estimated price increase of Dr Pepper SG products caused by vertical integration is unlikely to have occurred by chance.

In the second exercise, we repeat the analysis but now for Table 6. In this case, we estimate the impact of vertical integration on both own and Dr Pepper SG products that are sold within the same store. We report our findings in Figure F.1b. Though the figure omits some extreme values that would make it uninformative, the figure shows that few placebo estimates lie in the area in which they suggest that the relative price of own brands decreased more—and the relative price of Dr Pepper SG brands increased more—than the estimates we reported in the main text. In this case the p-value is 0.054, which also suggests that it is unlikely that the estimated price effects happened by chance.

Finally, we also estimate Table 4 for two product categories different from carbonated soda: beer and milk. We do this to examine whether the price effects estimated for Dr Pepper SG products also took place in these categories that were not affected by vertical integration. In these cases, we performed 1,000 placebo replications, holding fixed the counties in which vertical integration took place, and when it occurred, and we randomize the firm and its subset of products that were affected by vertical integration. Figure F.2 shows that, as it was the case above, the estimated price change for Dr Pepper SG products bottled by a vertically integrated bottler lies on the right tail of the distributions of placebo estimates, suggesting it is unlikely that the estimated effect was caused by chance.



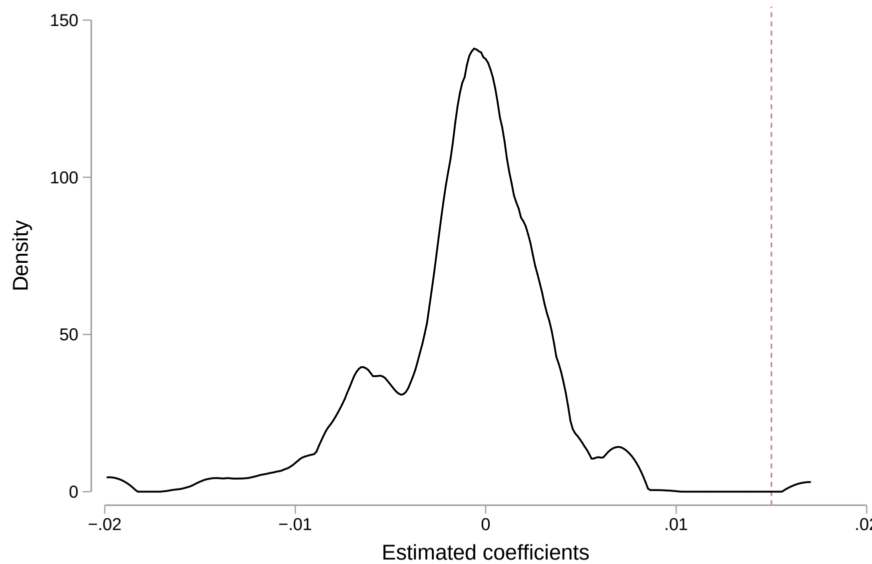
(a) Differences-in-Differences Dr Pepper SG



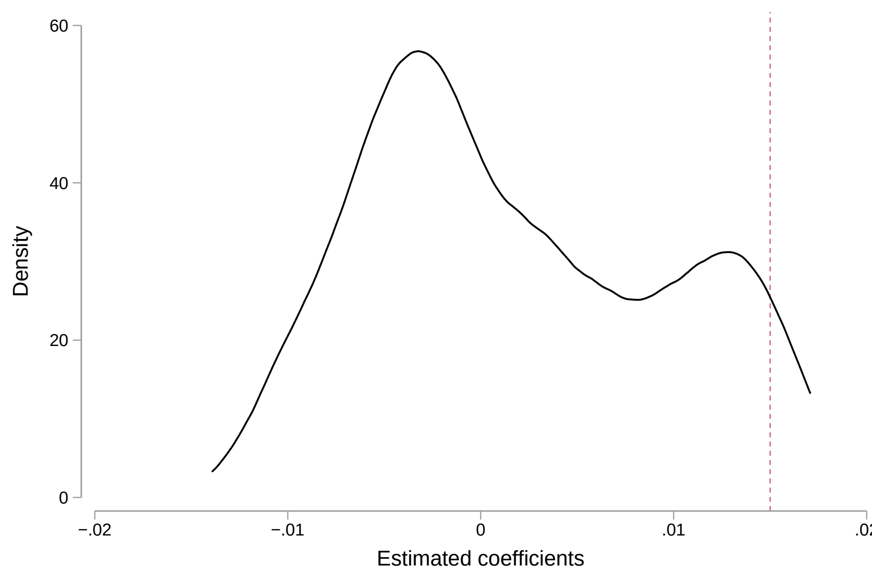
(b) Within-store analysis

FIGURE F.1: Placebo exercises

Notes: The upper panel presents the distribution of placebo estimates for the differences-in-differences analysis of Dr Pepper SG prices. The dashed vertical line corresponds to the estimated effect reported in Table 4 (Panel A, Column 2). The p-value for this estimate is 0.015. We implement the placebo exercises randomizing on three dimensions: when vertical integration took place, where it took place, and which products were affected. The lower panel repeats the analysis for the within-store analysis. In this case, the dashed vertical and horizontal lines report the estimated coefficients reported in Table 6 (Column 1). The black dots reported in the scatter plot correspond to placebo estimates that are larger than those reported in Table 6. The associated p-value is 0.054. The figure leaves out extreme values, but computation of the p-values considers the 1,000 placebo exercises.



(a) Differences-in-Differences (milk)



(b) Differences-in-Differences (beer)

Figure F.2: Placebo exercises

Notes: The upper panel presents the distribution of placebo estimates for the differences-in-differences analysis using milk products. The dashed vertical line corresponds to the estimated effect reported in Table 4 (Panel A, Column 2). The p-value for this estimate is 0.006. The lower panel repeats the analysis for beer products. In this case the p-value of the estimated effect is 0.044.

F.5 Clustering

In our main analysis we cluster errors at the county level. This choice is primarily driven by the fact that treatment is at the county level and not at the MSA level. That is, two neighboring counties may have been differentially impacted by vertical integration. While pricing incentives vary at the county level, one may be concerned about within-MSA residual price correlation due to shocks at the MSA level. As a robustness check, we replicate our main table with clustering at the MSA level in Table F.7 and Table F.8. The only notable difference is that we lose precision in Table F.8 (Column 2), where we decompose the impacts of vertical integration by upstream firm.

TABLE F.7: The effect of vertical integration on prices (differences-in-differences estimates): MSA clustering

	Dependent variable: log(price)		
	Coca-Cola	Dr Pepper SG	PepsiCo
	(1)	(2)	(3)
Vertical integration	0.003	0.015	-0.006
	(0.006)	(0.004)	(0.010)
Observations	15,756,886	15,935,207	17,051,189
R^2	0.910	0.903	0.891

Notes: Standard errors clustered at the MSA level (50 clusters). All specifications include product–week and product–store fixed effects, as well as time-varying county-level controls and controls for feature and display.

Table F.8: The effect of vertical integration on prices (within-store estimates): MSA clustering

	Dependent variable: log(price)	
	(1)	(2)
Vertical integration	-0.012	
× Coca-Cola/PepsiCo product	(0.005)	
Vertical integration	0.015	
× Dr Pepper SG product	(0.004)	
Vertical integration (Coca-Cola)		-0.011
× Coca-Cola product		(0.005)
Vertical integration (Coca-Cola)		0.022
× Dr Pepper SG product		(0.005)
Vertical integration (PepsiCo)		-0.012
× PepsiCo product		(0.010)
Vertical integration (PepsiCo)		0.007
× Dr Pepper SG product		(0.004)
Observations	48,743,206	48,743,206
R^2	0.905	0.905

Notes: Standard errors clustered at the county level (50 clusters). All specifications include store–week, product–week, and product–store fixed effects, as well as time-varying county-level controls and controls for feature and display.

G Sub-sample analyses

G.1 Regular and sales prices

In this section, we first document the extent of temporary price reductions in the carbonated-beverage industry. Table G.1 shows that between 39 and 45 percent of the time, a product may be on sale. Table G.2 and Table G.3 show that the results of our differences-in-differences and within-store analyses, respectively, do not vary depending on whether a product is on sale or not. Further, Table G.4 examines whether vertical integration had any impact on the frequency with which vertically integrated bottlers implemented price promotions relative to nonintegrated bottlers. We find no evidence of vertical integration causing a change in the frequency of promotions.

TABLE G.1: Frequency of temporary price reductions by upstream firm

	Share of product–store–weeks with a temporary price reduction
Coca-Cola products	0.418
Dr Pepper SG products	0.393
PepsiCo products	0.451
Total	0.422

Notes: An observation is a product–store–week combination. An observation is classified as being on sale if the temporary price reduction is 5 percent or greater.

Table G.2: The effect of vertical integration on prices (differences-in-differences estimates): Regular and sale prices

	Dependent variable: log(price)					
	Coca-Cola		Dr Pepper SG		PepsiCo	
	(1)	(2)	(3)	(4)	(5)	(6)
	Subsample					
	Regular	Sale	Regular	Sale	Regular	Sale
Vertical integration	0.006	0.002	0.013	0.015	-0.009	-0.005
	(0.005)	(0.004)	(0.003)	(0.003)	(0.003)	(0.006)
Observations	9,165,010	6,587,902	9,653,494	6,278,308	9,348,662	7,697,017
R^2	0.954	0.924	0.950	0.928	0.933	0.923

Notes: Standard errors clustered at the county level (443 clusters). All specifications include product–week and product–store fixed effects, as well as time-varying county-level controls and controls for feature and display.

Table G.3: The effect of vertical integration on prices (within-store estimates): Regular and sale prices

	Dependent variable: log(price)			
	(1)	(2)	(3)	(4)
	Subsample			
	Regular		Sale	
Vertical integration × Coca-Cola/PepsiCo product	-0.010		-0.016	
	(0.003)		(0.003)	
Vertical integration × Dr Pepper SG product	0.015		0.019	
	(0.002)		(0.003)	
Vertical integration (Coca-Cola) × Coca-Cola product		-0.011		-0.018
		(0.004)		(0.004)
Vertical integration (Coca-Cola) × Dr Pepper SG product		0.017		0.031
		(0.002)		(0.003)
Vertical integration (PepsiCo) × PepsiCo product		-0.008		-0.012
		(0.004)		(0.004)
Vertical integration (PepsiCo) × Dr Pepper SG product		0.010		0.008
		(0.002)		(0.003)
Observations	28,166,818	28,166,818	20,560,389	20,560,389
R^2	0.952	0.952	0.942	0.942

Notes: Standard errors clustered at the county level (443 clusters). All specifications include store–week, product–week, and product–store fixed effects, as well as controls for feature and display.

Table G.4: The effect of vertical integration on the frequency of price promotions (differences-in-differences estimates)

	Dependent variable: Price promotion indicator		
	Coca-Cola	Dr Pepper SG	PepsiCo
	(1)	(2)	(3)
Vertical integration	0.007	-0.007	-0.009
	(0.011)	(0.005)	(0.011)
Observations	15,773,639	15,952,984	17,058,040
R^2	0.388	0.307	0.400

Notes: Standard errors clustered at the county level (443 clusters). All specifications include product–week and product–store fixed effects, as well as time-varying county-level controls and controls for feature and display.

G.2 Heterogeneity results by type of chain

To examine heterogeneity across different types of chains—for example, because of time-invariant heterogeneity in exposure to rebate policies—we repeat our differences-in-differences analysis allowing for the effects of vertical integration on prices to vary by type of chain. Specifically, we define two chain-level indicators, large (i.e., more than 20 stores) and national (i.e., presence in more than one census region), and interact these indicators with the vertical integration indicator in Equation 1. Table G.5 presents estimates for this heterogeneity analysis. The table shows that vertical integration caused a larger increase in the prices of Dr Pepper SG products in stores belonging to small and local chains, though the differences are not statistically significant. The table also shows that the decrease in prices of PepsiCo products caused by vertical integration was larger in stores belonging to small and local chains.

Table G.5: The effect of vertical integration on prices (differences-in-differences estimates): Heterogeneity results by type of chain

	Dependent variable: log(price)								
		Coca-Cola			Dr Pepper			PepsiCo	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
VI	-0.000	0.001	-0.000	0.018	0.018	0.017	-0.008	-0.010	-0.011
	(0.005)	(0.005)	(0.005)	(0.004)	(0.003)	(0.003)	(0.005)	(0.005)	(0.005)
VI × Large	0.005			-0.004			0.004		
	(0.005)			(0.005)			(0.005)		
VI × National		0.003			-0.005			0.008	
		(0.004)			(0.004)			(0.004)	
VI × (Large & National)			0.008			-0.004			0.011
			(0.004)			(0.004)			(0.004)
Observations	15,797,101	15,797,101	15,797,101	15,975,949	15,975,949	15,975,949	17,097,916	17,097,916	17,097,916
R^2	0.910	0.910	0.910	0.903	0.903	0.903	0.891	0.891	0.891
Prod-Week FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Prod-Store FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
p-value $VI + VI \times Char = 0$	0.299	0.308	0.115	0.000	0.001	0.000	0.380	0.764	0.937

Notes: Standard errors clustered at the county level (443 clusters). All specifications include product–week and product–store fixed effects, as well as time-varying county-level controls and controls for feature and display. The treatment and control group are the same as in Table 4 (Panel A). Large chains are chains with more than 20 stores. National chains are chain that are present in more than one census region. The last row of the table reports the p-value of an F-test for whether $VI + VI \times Char = 0$, with $Char \in \{Large, National, Large\&National\}$.

G.3 Differences-in-differences estimates excluding the 20 oz product category

In this section we replicate our differences-in-differences analysis excluding the 20 oz product category in light of the data presented in Section D.5, which suggests that integrated and nonintegrated products in this category may have followed different price trends before vertical integration. The results, presented in Table G.6, show that excluding the 20 oz product category does not have material impact on our findings.

TABLE G.6: The effect of vertical integration on prices (differences-in-differences estimates; 67 and 144 oz products only)

	Dependent variable: log(price)		
	Coca-Cola	Dr Pepper SG	PepsiCo
	(1)	(2)	(3)
Panel A: Baseline estimates			
Vertical integration	-0.000	0.017	-0.007
	(0.005)	(0.004)	(0.006)
Observations	12,456,338	12,819,915	13,302,545
R^2	0.895	0.902	0.882
Panel B: Restricted treatment subsample			
Vertical integration	-0.012	0.013	-0.006
	(0.007)	(0.005)	(0.006)
Observations	1,377,376	1,988,718	1,293,243
R^2	0.925	0.919	0.916

Notes: Standard errors clustered at the county level (443 clusters). All specifications include product–week and product–store fixed effects, as well as time-varying county-level controls and controls for feature and display. Panel A includes the full sample of 67 and 144 oz products. Panel B drops the observations that were indirectly treated (i.e., products bottled by nonintegrated bottlers in store–week combinations where at least one product was bottled by an integrated bottler) and restricts the sample to counties that were either untreated or where only Coca-Cola integrated and the Coca-Cola bottler did not bottle Dr Pepper SG products (column 1); counties in which either Coca-Cola or PepsiCo integrated while bottling Dr Pepper SG products (column 2); and counties where only PepsiCo integrated and the PepsiCo bottler did not bottle Dr Pepper SG products (column 3).