Vertical Integration with Multiproduct Firms: When Eliminating Double Marginalization May Hurt Consumers*

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Abstract

How do vertical mergers impact consumers? While the elimination of double marginalization caused by vertical integration is often viewed as procompetitive, theory predicts that it may cause price changes that hurt consumers in multiproduct industries. We measure the causal effects of vertical integration on prices by exploiting variation in vertical structure caused by vertical mergers in the carbonated-beverage industry. We find that vertical integration caused a decrease in the prices of products with eliminated double margins and an increase in prices of other products bottled by integrated firms, raising the question of whether consumers necessarily benefit from vertical mergers.

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

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1 Introduction

How vertical integration affects consumer welfare and market efficiency is a long-standing question in competition policy. While the elimination of double marginalization caused by vertical integration is often viewed as procompetitive, theory predicts that the elimination of double marginalization may cause price changes that hurt consumers in multiproduct industries (Edgeworth, 1925, Salinger, 1991). These price increases, absent in the case of vertical integration of single-product firms, raise the question of whether consumers necessarily benefit from vertical mergers in multiproduct industries.

Vertical integration impacts pricing incentives in two ways when double margins are eliminated for some of the products sold by a firm. 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 second effect the *Edgeworth-Salinger effect*. The Edgeworth-Salinger effect counteracts the efficiency effect of vertical integration, and it may lead to price increases (Hotelling, 1932, Salinger, 1991).[1]

In this paper, we measure the efficiency and Edgeworth-Salinger effects of vertical integration and discuss implications for competition policy. To the best of our knowledge, we are the first to provide causal evidence of the magnitude of the Edgeworth-Salinger effect. We perform our analysis in the context of the carbonated-beverage industry in the United States, and identify the price effects of vertical mergers by exploiting a

[1] A partial elimination of double marginalization (and thus the Edgeworth-Salinger effect) is relevant for a broad set of vertical transactions in multiproduct industries. These transactions include, for example, mergers in the media industry (e.g., AT&T's proposed acquisition of Time Warner and Disney's proposed acquisition of 21st Century Fox, both in 2018); health insurance companies buying 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.

recent wave of vertical integration in this industry.

The carbonated-beverage industry is composed of upstream firms that produce concentrate (e.g., The Coca-Cola Company or PepsiCo), and downstream bottlers that purchase concentrate from the upstream firms, mix it with carbonated water, and produce the beverages that are sold to retailers. Importantly, bottlers may purchase concentrate from one or more upstream firms. For example, The Coca-Cola Company's main bottler has bottled both The Coca-Cola Company brands and Dr Pepper Snapple Group brands in many locations across the United States.

At least two reasons make this industry ideal for the purposes of our study. First, 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 independent bottlers, vertical integration took place in only some parts of the country. This geographical variation in vertical integration generates rich longitudinal and cross-sectional variation in vertical structure that is key for our identification strategy.

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

To measure the effects of vertical integration on prices, we use a unique combination of data sources. First, 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). Second, we use an industry publication and Federal Trade Commission documents to identify how each store in the scanner data was impacted by vertical integration: unaffected by vertical integration, exposed to a partial elimination of double marginalization, or exposed to a full elimination of double marginalization.

The richness of our data motivates two complementary research designs to identify the causal effect of vertical integration on prices. First, we exploit within-product price changes across locations differentially exposed to vertical integration to implement a differences-in-differences research design. This approach allows us to measure the impact of vertical integration on prices at the product level. Second, we leverage variation in vertical structure within a store and across products to measure the impact of vertical integration on relative prices. That is, we compare the price changes of products sold by integrated bottlers with the price changes of products sold by nonintegrated bottlers within a store, before and after the vertical transactions. Throughout our analysis, we identify the efficiency and Edgeworth-Salinger effects of vertical integration by distinguishing between own and Dr Pepper Snapple Group brands bottled by a vertically integrated bottler.

We find that vertical integration caused price increases of 1.2 to 1.6 percent for Dr Pepper Snapple Group products bottled by vertically integrated bottlers. Vertical integration also caused a decrease in the prices of Coca-Cola and PepsiCo products bottled by integrated bottlers of 0.8 to 1.2 percent, though some of these estimates are noisy. Dynamic-effect estimates also show that the price increases in Dr Pepper Snapple Group products bottled by a vertically integrated bottler only started after the vertical transactions took place, and the price increases persisted in time. These results are consistent with a manifestation of the efficiency and Edgeworth-Salinger effects of vertical integration, and show that the Edgeworth-Salinger effect is at least as large as the efficiency effect—but of the opposite sign.

Our findings also suggest that vertical integration caused an increase in the price of most Dr Pepper Snapple Group products bottled by vertically integrated bottlers, and the Edgeworth-Salinger effect was larger in stores belonging to small and local chains. We also use price indexes to study the effects of vertical integration on the average price paid by consumers. We find an insignificant average effect, though this result hides heterogeneous effects across upstream firms that resemble the findings described above. Lastly, we perform a number of robustness checks including blocking regressions based on propensity score matching, subsample analyses on neighboring counties differentially impacted by vertical integration, and analyses in which we aggregate the data to different geographic and temporal levels to consider potential spatial spillovers and serial correlation of prices. Throughout these exercises we find that vertical integration caused a price increase for Dr Pepper Snapple Group products bottled by vertically integrated bottlers.

Our research relates to the literature that examines whether vertical mergers are proor anticompetitive.[2] This question has been studied both theoretically (see, for example, Salinger, 1988, Perry, 1989, Ordover et al., 1990, Hart et al., 1990, Bolton and Whinston, 1991, Reiffen, 1992, Riordan, 1998, Choi and Yi, 2000, Chen, 2001, Levy et al., 2018, Salop, 2018) and empirically. With respect to empirical evidence, 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. Crawford et al. (2018) provide an empirical framework to study the welfare gains of vertical integration in the U.S. pay-television industry and find that the sign of the welfare effect of vertical integration depends on whether the nonintegrated firms have access to integrated content.[3] We contribute to this literature by being the first to provide causal estimates of the price effects of vertical integration that are unique to multiproduct firms (i.e., the Edgeworth-Salinger effect).

We also contribute to the 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 using a structural framework as well as non-nested tests. 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 rest of 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. Industry background and a description of the data are presented in Section 3 and Section 4, respectively. Section 5 presents our empirical framework. Our results showing that vertical integration led to an increase (decrease) in the prices of the goods for which the double margins were not (were) eliminated after vertical integration are discussed in Section 6. Lastly, in Section 7, we conclude.

[2] See Lafontaine and Slade (2007) for an extensive literature review.

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

2 Multiproduct Pricing and Vertical Integration

To see how vertical integration impacts the pricing incentives of a multiproduct firm, consider the example presented in Figure 1. Before vertical integration (Figure 1a), a downstream monopolist (henceforth, "the bottler") sells two substitute products, product 1 and product 2, at prices p_1 and p_2. In the example, 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 (see Figure 1b). Vertical integration eliminates the double margin for product 1, causing 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 below). Then, at 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 and the products are substitutes.[4] These inequalities suggest 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

[4] If products are complements, both inequalities would be negative when evaluated at premerger prices. The efficiency effect of vertical integration incentivizes a decrease in the price of product 1, and the eliminated double margin on product 1 incentivizes a decrease in the price of product 2 to boost the sales of product 1.

of product 2 to induce consumers to substitute to product 1. As discussed above, we call this the *Edgeworth-Salinger effect*.[5] This change in incentives due to the merger may result in an increase in the price of product 2, and even in an increase in the price of both goods because of strategic complementarities (see Salinger 1991 for examples). In Section 6, we discuss how strategic complementarities (or equilibrium feedback effects) affect our empirical analysis.

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 same economic effects of vertical integration arise in this extended framework, with the Edgeworth-Salinger effect of vertical integration causing price increases for products for which double marginalization is not eliminated. This is not surprising for two reasons. First, because the retailer purchases final goods from the bottlers and resells them to consumers, the retailer faces a similar change in pricing incentives after vertical integration. This change in incentives is caused by how vertical integration impacts the wholesale prices paid by the retailer: The bottler sets lower and higher wholesale prices for the products with and without eliminated double margins, respectively. Second, strategic responses by upstream firms are of second order relative to the effect of an eliminated double margin.

3 The Carbonated-beverage Industry

3.1 Industry

The U.S. carbonated-beverage industry was born when Coca-Cola was created in 1886.[6] 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 produce and sell concentrate, which is the key ingredient in carbonated beverages. Local bottlers purchase the concentrate, mix it with carbonated water, and produce, market, and distribute canned and bottled carbonated beverages. Transport costs and the logis-

[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. In this sense, evidence in favor of price changes consistent with the efficiency and Edgeworth-Salinger effects of vertical integration would suggest a linear component in the prices of input products.

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

tical difficulties of transporting carbonated beverages have motivated this industrial organization throughout the industry's existence.

The Coca-Cola Company (henceforth, Coca-Cola) and PepsiCo are examples of upstream firms. These firms have relied on a network of local franchised bottlers to produce and deliver their products to local customers. The original bottling operations were atomized, with hundreds of small local bottlers operating across the United States (Stanford, 2010a,b). Over time, bottler consolidation has taken place because of decreasing transportation costs and economies of scale. If by 1950 there were more than six thousand bottling plants, less than a thousand existed by 1990 due to bottler consolidation (Saltzman et al., 1999).

In the early days of the industry, concentrate producers had difficulties to monitor local market conditions and bottler behavior. These difficulties led concentrate producers and local bottlers to sign contracts that regulated different dimensions of their relationship. Since then, contracts between concentrate manufacturers and local bottlers establish that bottlers are responsible for manufacturing the final product as well as for local advertising and promotion. Bottlers also enjoy discretion in choosing the prices at which they sell canned and bottled carbonated beverages to retailers and other establishments. Because bottling operations require dedicated investments, bottlers have been granted perpetual rights to manufacture and distribute their products in exclusive territories (Katz, 1978).

Contracts between upstream firms and bottlers have evolved over time (see Section B in the Online Appendix). Though 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.[7] Further, during the last decade, upstream firms have started to consider different aspects of their relationship with their bottlers when setting the prices of concentrate. In addition to the cost of concentrate, variables such as channel and packaging mix have started to impact the price at which the upstream firms sell concentrate to their bottlers. Under these modern agreements, upstream firms face no obligation to participate with bottlers in the bottlers' marketing expenditures, though bottlers still benefit from the upstream firms' national marketing campaigns.[8]

[7] 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.

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

Something that has been a constant throughout the history of the industry is that bottlers often transact with more than one upstream firm (e.g., the bottler Pepsi Bottling Group transacted with both PepsiCo and Dr Pepper Snapple Group prior to 2009). This practice is known as cross-franchising and is allowed by upstream firms subject to two restrictions (Saltzman et al., 1999). First, a given bottler cannot bottle two beverages of the same flavor from two separate upstream firms (e.g., a bottler producing PepsiCo's Pepsi products cannot also produce cola-flavored products from other upstream firms).[9] 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 industry involving upstream firms and bottlers. The Federal Trade Commission (henceforth, FTC) reviewed the transactions and cleared them in October and November of 2010 subject to some behavioral remedies related to information management and compensation (Federal Trade Commission, 2010a,b).[10] First, PepsiCo Inc merged with Pepsi Bottling Group Inc (PBG) and Pepsi Americas Inc (PAS) in August of 2009. Second, The Coca-Cola Company merged with Coca-Cola Enterprises Inc (henceforth, CCE), its main bottler, in February of 2010. Lastly, PepsiCo acquired Pepsi-Cola Bottling Co of Yuba City Inc (PYC) in April of 2010. Before these vertical mergers, Coca-Cola, PepsiCo, and Dr Pepper Snapple Group (henceforth, Dr Pepper SG) relied heavily on these and other independent bottlers to produce and distribute bottled and canned carbonated beverages. According to the FTC, CCE accounted for about 75 and 14 percent of Coca-Cola's and Dr Pepper SG's sales of bottled and canned soft drinks in 2009, respectively, while PBG and PAS accounted for about 75 and 20 percent of PepsiCo's and Dr Pepper SG's sales of bottled and canned soft drinks in 2009, respectively.

Group, Inc. (2009).

[9]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.

[10]We provide a summary of the FTC's complaints and decision orders of these transactions in Section C in the Online Appendix. The complaints can be accessed at https://www.ftc.gov/sites/default/files/documents/cases/2010/11/101105cocacolacmpt.pdf and https://www.ftc.gov/sites/default/files/documents/cases/2010/09/100928pepscocmpt.pdf. These websites, as well as all other websites referenced in this paper, were last accessed on October 18, 2018.

After the firms entered into their respective merger agreements, both Coca-Cola and PepsiCo acquired new exclusive licenses to continue to sell and distribute Dr Pepper SG's brands in some territories. The licenses granted Coca-Cola exclusive rights to continue selling Dr Pepper and Canada Dry in former CCE territories, and it granted PepsiCo exclusive rights to continue selling Dr Pepper, 7UP, A&W, Canada Dry, Crush, Sunkist, Squirt, Schweppes, and Vernors in former PBG and PAS territories.[11] These new licenses were acquired because the change in ownership of the bottlers triggered the termination of the original licenses.

The vertical mergers eliminated the incentive of Coca-Cola and PepsiCo to sell concentrate to their integrated bottlers at a price greater than marginal cost (i.e., double marginalization). Double marginalization, however, was not eliminated for Dr Pepper SG brands bottled by PepsiCo and Coca-Cola, because Dr Pepper SG remained independent in selling inputs to bottlers. As a consequence, the vertical mergers and the agreements with Dr Pepper SG had an impact on vertical structure along two dimensions. First, because not all territories were served by CCE in the case of Coca-Cola, and PBG, PAS, and PYC in the case of PepsiCo, the vertical mergers only exposed some territories to vertical integration. Second, neither PepsiCo nor Coca-Cola bottled Dr Pepper SG brands in all of the territories served by a vertically integrated bottler. This resulted in a partial elimination of double marginalization in some of the areas impacted by vertical integration.

With respect to market foreclosure, two observations are in order. First, the acquisition of the licenses to continue selling Dr Pepper SG brands suggests that it was in the best interest of Coca-Cola and PepsiCo to continue selling Dr Pepper SG brands. The vertically integrated bottlers could have chosen to drop these Dr Pepper SG brands to potentially increase Dr Pepper SG's cost of selling these products, but this did not happen. Second, the bottlers had control over the prices of own and Dr Pepper SG brands both before and after the mergers, and Dr Pepper SG remained independent in providing inputs to bottlers throughout. The pricing problem therefore did not change for the vertically integrated bottlers after the vertical mergers other than through the elimination of the double margins for own brands, suggesting no incentive to increase the prices of the Dr Pepper SG brands after vertical integration other than through the Edgeworth-Salinger effect (see the discussion in Section 2). Although the Edgeworth-Salinger effect can be viewed as a form of consumer foreclosure, we find no evidence

[11]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).

suggesting that the vertical mergers had other foreclosure effects.[12]

Lastly, industry observers argue that Coca-Cola and PepsiCo were seeking to reduce costs and gain control over retail prices with the mergers.[13] 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 lowering costs and gaining control over downstream prices, Coca-Cola and PepsiCo could market their products at lower prices, giving the firms greater flexibility to counter a decline in the consumption of carbonated soft drinks partly driven by substitution to noncarbonated soft drinks.

4 Data

Our data come from three sources: territory maps of the U.S. bottling system in The Coke System and The Pepsi System books by Beverage Digest (Stanford, 2010a,b), public documents produced by the FTC's investigation of the PepsiCo and Coca-Cola vertical mergers,[14] and the IRI Marketing Data Set (see Bronnenberg et al. 2008 for details).

We use the Beverage Digest territory maps to identify the bottling territories of PBG, PAS, and PYC in the case of PepsiCo, and CCE in the case of Coca-Cola. This information is crucial for determining the areas of the country impacted by vertical integration. Table 1 presents information about the territories that were affected by the vertical integration of both Coca-Cola and PepsiCo.[15] Panel A shows that of the 443 counties in our data, 357 were served by CCE (in the case of Coca-Cola) and 397

[12] Foreclosure incentives are classified into two categories, input foreclosure and consumer foreclosure. Input foreclosure refers to the incentives of a vertically integrated firm to reduce or eliminate sales of an input to a downstream rival who previously purchased the input from the upstream division of the vertically integrated firm. This case does not apply to our setting. Consumer foreclosure refers to the incentives of the vertically integrated firm to reduce or eliminate input purchases from an upstream rival, from whom the downstream division of the integrated firm purchased inputs before vertical integration. Because the Edgeworth-Salinger effect reduces the quantity of Dr Pepper SG products bottled by an integrated bottler (and thus the inputs needed for those products), it can be viewed as a form of consumer foreclosure.

[13] See https://www.wsj.com/articles/SB10001424052748704240004575085871950146304 and https://www.wsj.com/articles/SB10001424052748704131404575117902451065876 for media coverage of the mergers.

[14] See 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.

[15] In this table, we restrict attention to the counties available in the IRI Marketing Data Set.

by PBG, PAS, or PYC (in the case of PepsiCo). That is, a majority of the counties in our sample were somehow affected by vertical integration in 2010. Three hundred and thirty-four counties were served by both CCE in the case of Coca-Cola and by PBG, PAS, or PYC in the case of PepsiCo. Eighty-six counties were served by at most one bottler that merged, while 23 counties were served by bottlers that did not integrate.

From the FTC documents, we identify the counties in which Dr Pepper SG brands were bottled by a bottler that integrated. That is, we use the FTC documents to identify the counties in which 7 UP, A&W, Canada Dry, Crush, Dr Pepper, Schweppes, Squirt, Sunkist, and Vernors were bottled by either PBG, PAS, or PYC (in the case of PepsiCo) or by CCE (in the case of Coca-Cola). Panel B of Table 1 shows that in about 29 percent of counties 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.[16]

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 only includes carbonated drinks such as carbonated soda or seltzer water (non-carbonated substitutes, such as iced tea or energy drinks, are excluded). We define a product as a brand–size combination (e.g., Diet Pepsi 20 oz bottle), and prices are defined as the average price paid by consumers for each product in a store–week combination. In our analysis, we only include carbonated-beverage brands with at least 0.1 percent of the market and restrict attention to three product sizes: 20 and 67.6 oz bottles and the 144 oz box of cans.[17] These sample restrictions leave us with about 49 million store–week–product 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).[18] Table D.1 in the Online Appendix presents a list of the products included in our sample, as well as product-level summary statistics.

Lastly, we note that we only have access to price information at the retail level. While

[16] The Dr Pepper SG products were bottled by a bottler other than PBG, PAS, or PYC (in the case of PepsiCo) or CCE (in the case of Coca-Cola) in ninety-six counties.

[17] Brands with less than 0.1 percent of the market are often local or regional brands that are sparsely available. We drop these because our ability to perform within-product price comparisons across areas differentially impacted by vertical integration is limited for these brands.

[18] 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 67.6 oz motivated us to lead with this format (44.6% of all transactions involved a 67.6 product).

the vertical mergers had a direct impact on the pricing incentives of bottlers, we argue in Section 2 that vertical integration also had an impact on the pricing incentives of retailers through changes in the prices set by bottlers. While we cannot directly measure the impact of vertical integration on bottler prices, the model in Section A in the Online Appendix suggests that the analysis of retail prices is informative about the impacts of vertical integration. This is because the retailer faces a change in wholesale prices that resembles the changes in input prices faced by the bottlers (i.e., a decrease in the wholesale prices of integrated products and an increase in the wholesale prices of Dr Pepper SG products bottled by an integrated bottler). These changes in wholesale prices incentivize retailers to change their prices in a manner that is consistent with the efficiency and Edgeworth-Salinger effects of vertical integration.[19] That is, our model leads us to hypothesize that vertical integration caused an upward (downward) pressure on the retail prices of integrated-bottler products without (with) eliminated double margins.

4.1 Summary Statistics

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 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 2017 for related findings).[20] The latter finding will lead us to study the robustness of our results to various levels of data aggregation

[19]Importantly, we find that retailers do not magnify the efficiency and Edgeworth-Salinger effects of vertical integration.

[20]Table D.2 in the Online Appendix 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 in the Online Appendix, 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.

(e.g., MSA–chain–year–product).

In Table 3, we report the average prices of a number of 67.6 oz products, before and after vertical integration, for treated and untreated counties. This exercise is our first approximation to measuring how prices were impacted by vertical integration. 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. While the price changes reported in Table 3 are consistent with manifestations of the efficiency and Edgeworth-Salinger effects of vertical integration, the tables do not account for potential confounders. We explicitly consider potential confounders in the next sections.

Table 3 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, Table D.3 and Table D.4 in the Online Appendix 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. While we find differences between areas impacted and not impacted by vertical integration, we do not find that areas impacted by vertical integration experienced differential changes in these variables after the vertical mergers (i.e., these variables evolved similarly across all areas during our sample period). We discuss these tables and findings, and how they impact our empirical strategy, in the next section.

5 Empirical Framework and Identification

How does vertical integration impact the prices of multiproduct firms? Is the Edgeworth-Salinger effect economically significant? To answer these questions, we exploit two sources of variation caused by the vertical mergers, which motivate two *complementary* empirical analyses. First, we use the geographical variation in vertical structure caused by the transactions to compare within-product price changes in places that were affected by the vertical mergers with within-product price changes in places unaffected by the vertical mergers. More formally, we use a differences-in-differences research design that allows us to examine how vertical integration affected the prices of the products sold by vertically integrated bottlers relative to the prices of the same products sold by nonintegrated bottlers.

Second, we exploit within-store variation in vertical structure caused by the transactions to examine how vertical integration affected relative prices within a store. That is, we leverage that some products sold in a store were produced by an integrated bottler while others were produced by nonintegrated bottlers. In this case, we compare the price changes of products sold by integrated bottlers relative to the price changes of products sold by nonintegrated bottlers, before and after the vertical transactions. This analysis therefore examines how vertical integration impacted the full vector of equilibrium prices in a store–week combination.

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. Relatedly, the identification assumption in the within-store 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.[21]

With respect to potential threats to identification, a first concern is the existence of time-varying factors that are specific to products that started being bottled by vertically integrated bottlers after the mergers. While we address this possibility formally when presenting estimates for a model that allows for time-varying effects (i.e., dynamic differences-in-differences), we also use summary statistics to examine the existence of differential trends before the vertical mergers. Figure 2 shows the evolution of the average price both before and after the vertical mergers for all Coca-Cola, PepsiCo, and Dr

[21] We note that if a subset of products in a store–week combination are directly impacted by vertical integration, all equilibrium prices are going to respond as a consequence of strategic complementarities. All of these price changes impact relative prices. Our identification assumption is that relative prices would have remained stable absent vertical integration.

Pepper SG 67.6 oz products.[22] The graphs distinguish between products that started being bottled by a vertically integrated bottler after the mergers from those that were never bottled by a vertically integrated bottler. The figure shows no differential trends before the first vertical transaction (vertical red line). As mentioned previously, we reexamine this issue when presenting our estimates.

A second concern is the existence of time effects that were specific to PepsiCo, Coca-Cola, or Dr Pepper SG. For instance, some of these upstream firms may have changed their advertising intensity or rebate policy at the time of the vertical mergers, or they may have experienced differential input-cost shocks after the vertical mergers. We exploit the panel structure of the data to tackle these concerns by allowing for product-specific week fixed effects, $\phi_{j,w}$, where j denotes a product and w a week. As well, we control for the store–product level advertising intensity reported in the scanner data.[23]

A third concern is that our research design would be invalidated if vertical integration had happened in selected locations because of observable or unobservable characteristics that we cannot control for in our analysis. However, we note that were no changes in the territories of the integrated bottlers during our sample period that would suggest that Coca-Cola and PepsiCo were targeting specific locations.[24] Importantly, there were no divestitures during our sample period. Given the large footprint of the bottlers (i.e., a footprint that covered multiple states, rural and urban areas, wealthy and non-wealthy areas), the lack of divestitures after the vertical mergers is evidence against selection.

In addition, throughout our analysis we examine whether selection is empirically relevant in different ways. First, and as mentioned above, our dynamic differences-in-differences framework allows us to test for preexisting trends that were specific to the areas impacted by vertical integration. Second, we repeat our analysis on the subsample of neighboring counties that were differentially exposed to integration. This allows us to estimate the price effects of vertical integration on counties that are similar except for their exposure to vertical integration. Third, we implement a blocking regression approach based on propensity score matching. We find evidence suggest-

[22]We report the same plots for the other sizes in Figure D.2 in the Online Appendix.

[23]The advertising intensity information in the scanner data correspond to the ordinal variables feature and display. We include indicators for the different values that these variables can take.

[24]Aside from the vertical mergers that we study, the only other transactions during our sample period are the acquisitions of the territory of Coke Browning in Texas in 2008 by CCE and the acquisition of two small territories by PBG in 2008 (see Stanford 2010a,b).

ing that selection is not empirically relevant throughout. Lastly, we note that our within-store analysis leverages price differences within a store and does not rely on price comparisons across locations to identify the effects of vertical integration.

While we argue that selection is not a concern, this does not mean there are no differences between areas differentially affected by vertical integration. Table D.3 in the Online Appendix examines differences in demographics and retail configuration at the county–year level both before and after the vertical mergers. The table shows that the treated counties are on average wealthier, more populated, and have a larger number of retail stores than the untreated counties. The table also shows that there were no differential changes in demographics or retail configuration after the mergers in areas impacted by vertical integration.[25] Nonetheless, we control for these time-varying county-level characteristics in our analysis. Further, we use these pre-integration observables as the basis of our propensity score matching robustness check.

Lastly, one confounder that we cannot directly address in the estimation is the possibility of differential changes in rebate policies between areas affected and unaffected by vertical integration that took place at the time of the vertical transactions. These differential changes would not be captured by the set of fixed effects described above and would be a cause of concern. To our knowledge, changes in rebate policy of this type were not implemented.

To measure how vertical integration impacted prices in the carbonated-soda industry, we first use a differences-in-differences research design that exploits the geographical variation in vertical structure caused by the vertical transactions. Specifically, in our main specification, we separately estimate

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

for every $k \in$ {PepsiCo, Coca-Cola, Dr Pepper SG}.[26] 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, $x_{j,s,w}$ is a vector of product characteristics at the store–week

[25] We also examine differences in the consumption of substitute products (beer and milk) between areas differentially impacted by vertical integration. Table D.4 in the Online Appendix shows that there were no differential changes in the consumption of beer and milk, before and after vertical integration, between areas impacted and not impacted by vertical integration.

[26] In subsection 6.1, we estimate this specification separately for each product j to examine heterogeneity in the effect of vertical integration across products.

level (e.g., advertising intensity), and $\varepsilon_{j,s,w}$ is an error term clustered at the county level.[27] 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.

Our second approach leverages the within-store–week variation in vertical structure caused by the vertical transactions. We modify Equation 1 by pooling the products of all upstream firms and including store–week fixed effects. The inclusion of store–week fixed effects changes the analysis in two ways. First, we identify the impact of vertical integration on prices off of variation in vertical structure across products sold in a given store–week combination (as opposed to geographical variation in vertical structure at the product level). Second, the store–week fixed effects absorb changes in the level of prices at the store–week level. This implies that our estimates of the effects of vertical integration on prices must be interpreted as changes in relative prices within a store, rather than changes in price levels. Specifically, we estimate

$$\begin{aligned}\log(price_{j,s,w}) =& VI_{CocaCola,s,w} \cdot CocaCola\,Product_j \beta_1 \\ &+ VI_{PepsiCo,s,w} \cdot PepsiCo\,Product_j \beta_2 \\ &+ VI_{CocaCola,s,w} \cdot DrPepperSG\,Product\,Bottled\,By\,CocaCola_j \beta_3 \\ &+ VI_{PepsiCo,s,w} \cdot DrPepperSG\,Product\,Bottled\,By\,PepsiCo_j \beta_4 \\ &+ \eta_{j,s} + \phi_{j,w} + \gamma_{s,w} + x'_{j,s,w}\delta + \varepsilon_{j,s,w}, \end{aligned} \tag{2}$$

where $VI_{CocaCola,s,w}$ and $VI_{PepsiCo,s,w}$ are indicators for whether Coca-Cola and PepsiCo were integrated with their bottlers; $CocaCola\,Product_j$ and $PepsiCo\,Product_j$ are indicators for whether product j is a Coca-Cola or PepsiCo product, respectively; the indicators $DrPepperSG\,Product\,Bottled\,By\,CocaCola_j$ and $DrPepperSG\,Product\,Bottled\,By\,PepsiCo_j$ take the value one when product j was a Dr Pepper SG product bottled by a Coca-Cola or PepsiCo bottler (e.g., Dr Pepper or Crush in some counties); $\gamma_{s,w}$ are store-level time effects; and $\varepsilon_{j,s,w}$ is an error term clustered at the county level.

In the case of Equation 2, the coefficients of interest are β_1, β_2, β_3, and β_4. The coefficients β_1 and β_2 measure how vertical integration impacts the prices of products owned by an integrated bottler relative to the prices of products bottled by nonintegrated

[27] 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 only vary at the county–year (or county–month) level.

bottlers (i.e., efficiency effect). Similarly, β_3 and β_4 measure how vertical integration affects prices of Dr Pepper SG products bottled by an integrated bottler relative to the prices of products bottled by nonintegrated bottlers (i.e., the Edgeworth-Salinger effect). Again, these effects must be interpreted as changes in relative prices within a store rather than changes in price levels across locations.

Finally, we also estimate a version of Equation 1 that allows us to measure the dynamics of the impact of vertical integration on prices,

$$\begin{aligned}\log(price_{jsw}) = &\sum_{\tau=-L}^{-1} VI_{j,s} \times 1\{\tau \text{ quarters before time of VI}\}\beta_{\tau,k} \\ &+ \sum_{\tau=1}^{U} VI_{j,s} \times 1\{\tau \text{ quarters after time of VI}\}\beta_{\tau,k} \\ &+ \eta_{j,s} + \phi_{j,w} + x'_{j,s,w}\delta + \varepsilon_{j,s,w},\end{aligned} \tag{3}$$

where $VI_{j,s}$ is an indicator for whether product j at store s was eventually sold by a vertically integrated bottler, and $k \in$ {PepsiCo, Coca-Cola, Dr Pepper SG}. The coefficients $\{\beta_{\tau,k}\}$ measure the evolution of the prices of products that were eventually sold by a vertically integrated bottler relative to the prices of products that were never impacted by vertical integration, both before and after vertical integration. Estimates for this model will also allow us to statistically test for the existence of differential trends before the mergers between products that started being bottled by a vertically integrated bottler after the mergers and those that never were.

6 Measuring the Impact of Vertical Integration on Prices

To measure the impact of vertical integration on prices, we first present estimates that exploit the within-product variation in vertical structure across markets (i.e., differences-in-differences estimates). We then present dynamic differences-in-differences estimates, and finish by discussing estimates that leverage the within-store–week variation in vertical structure.

Table 4 presents our differences-in-differences estimates at the upstream firm level (i.e., Equation 1). The three panels reflect differences in how we define the treatment and control groups, but are otherwise identical. We start with the broadest possible definitions of the treatment and control groups, and we then refine these definitions to insulate our estimates from equilibrium feedback effects that result from multiple products being treated at the same time or products being indirectly treated. Refining the control and treatment groups is at the expense of sample size, but provides us with cleaner measures of the efficiency and Edgeworth-Salinger effects of vertical integration.

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 suggest 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.[28]

Two concerns may arise from our analysis in Table 4 (Panel A). First, indirectly treated observations in the control group (i.e., untreated products in a store–week combination with at least one treated product) are impacted by vertical integration indirectly via equilibrium feedback effects (i.e., prices are strategic complements). These equilibrium feedback effects, however small they may be, affect our comparison of within-product price differences across areas differentially impacted by vertical integration.[29] This leads us to exclude indirectly treated observations from our control group in Table 4 (Panel B), holding the treatment group fixed.

Second, there are many counties in which more than one firm vertically integrated, adding an extra layer of equilibrium feedback effects (i.e., the price effects for Coca-Cola products may be different if PepsiCo also integrated in that area). To further insulate our estimates from equilibrium feedback effects, we restrict the treatment group in Table 4 (Panel C) so as to remove price variation caused by the equilibrium feedback effects that result when more than one firm vertically integrated in a given county. In Column 1 of Panel C, we define the treatment group as treated observations in areas

[28]As argued in Section 2, the null effects for Coca-Cola and PepsiCo products are not inconsistent with the Edgeworth-Salinger effect. While a partial elimination of double marginalization creates an efficiency effect, the efficiency effect may not manifest in the equilibrium prices because of the Edgeworth-Salinger effect and the strategic complementarity of prices.

[29]Under the premise that vertical integration caused efficiency effects, indirectly treated products likely experienced small negative price changes 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. Our results show, however, that these biases are small.

in which *only* Coca-Cola vertically integrated and the Coca-Cola bottler did not bottle Dr Pepper SG products. 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 in Table 4 (Panel C) is the same as in Table 4 (Panel B).

The estimates in Table 4 (Panel B) suggest that vertical integration caused a 1.5 percent increase in the prices of Dr Pepper SG products bottled by vertically integrated bottlers, and a 0.7 percent decrease in the prices of PepsiCo products impacted by vertical integration. The coefficient for Coca-Cola products is negative though noisy. The estimates in Panel C suggest 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 suggest a 0.9 and 0.8 percent decrease in the prices of Coca-Cola and PepsiCo products caused by vertical integration, though their p-values are 0.133 and 0.104, respectively.

Combined, Panels B and C of Table 4 suggest that equilibrium feedback effects play a second-order role when measuring the impact of vertical integration on the prices of Dr Pepper SG products, though they appear to be more relevant when measuring the efficiency effects of vertical integration among Coca-Cola and PepsiCo products. We complement these findings with a treatment heterogeneity analysis for Dr Pepper SG products in Table E.1 in the Online Appendix, where we divide observations into three categories: directly treated, indirectly treated, and untreated.[30] The table suggests that vertical integration caused a 1.6 percent increase in the prices of Dr Pepper SG bottled by vertically integrated bottlers relative to the same products in untreated areas, and no (statistical) change in price differences between indirectly treated and untreated products. That is, the estimates suggest that the price increases experienced by Dr Pepper SG products were entirely concentrated in areas impacted by vertical integration in which Dr Pepper SG products were bottled by an integrated bottler.

We replicate our differences-in-differences analysis using store–week level price indexes to shed light on the impact of vertical integration on quantity-weighted prices. We construct a price index based on average quantities sold in the period before vertical integration, and compute the index on the full set of products and on the subsets

[30]Of the 443 counties in our sample, twenty-three and seventy-three counties are in the untreated and indirectly treated categories, respectively.

of products owned by Coca-Cola, Dr Pepper SG, and PepsiCo (see Section E.2 in the Online Appendix for details). Table E.3 (Column 1) in the Online Appendix shows that vertical integration did not have a significant effect on quantity-weighted prices when considering the full set of products, but it did cause heterogeneous effects by upstream firm. Much in line with Table 4, the table shows that vertical integration caused an increase in the quantity-weighted price of Dr Pepper SG products (4.8 percent), and a decrease in the quantity-weighted prices of Coca-Cola and PepsiCo (0.6 and 2.2 percent, respectively, though the effect is only significant for PepsiCo products).

To study both when the changes in the prices of products bottled by vertically integrated bottlers occurred and whether there were differential trends before the vertical mergers, we present estimates for Equation 3 in Figure 3, where we allow for time-varying effects. The coefficients in the figures must be interpreted as time-specific average price differences between prices of products that were eventually sold by a vertically integrated bottler (i.e., own or Dr Pepper SG brands) and prices of products that were never sold by an integrated bottler, both before and after vertical integration. The analysis includes all directly treated observations in the treated group, and both untreated and indirectly treated observations in the control group (see Figure E.1 in the Online Appendix for estimates that exclude indirectly treated observations from the control group).

Figure 3 (Panel A) presents estimates for both Coca-Cola and PepsiCo products, and suggests no statistical evidence of differential trends before the vertical mergers that were specific to products eventually sold by a vertically integrated bottler. Panel A also shows limited evidence of price decreases for Coca-Cola and PepsiCo products caused by vertical integration. Panel B reports estimates for Dr Pepper SG products and shows no evidence of differential trends before the vertical mergers as well as significant price increases for Dr Pepper SG products bottled by vertically integrated bottlers after the first transaction took place. In line with Table 4, the figure suggests price increases caused by vertical integration of about 1 to 2 percent on average, and price increases that were lasting.

We next study the impact of vertical integration on prices exploiting within-store–week variation in vertical structure caused by the vertical mergers (i.e., Equation 2). This analysis complements our differences-in-differences design by measuring how relative prices changed within a store as a consequence of vertical integration. Because we are interested in measuring the equilibrium effects of vertical integration on prices (i.e., what happens to the full vector of prices if a subset of products in a store was exposed to vertical integration), we define the treatment group as directly treated products and the control group as all observations that were not directly treated (i.e., indirectly treated and untreated).[31] We report the estimates of the within-store–week analysis in Table 5.

Column 1 of Table 5 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 measured to be 2.2 and 0.7 percent, respectively.[32]

Lastly, we study the sensitivity of our within-store–week estimates to instances of multiple treatments (i.e., counties in which more than one upstream vertically integrated). Similar to Table 4 (Panel C), we replicate the within-store–week analysis but restricting the sample to instances in which i) only Coca-Cola integrated (without producing Dr Pepper SG products) or ii) only PepsiCo integrated (without producing Dr Pepper SG products) or iii) either Coca-Cola or PepsiCo integrated while producing Dr Pepper SG products (but not both). Counties unaffected by vertical integration are included throughout. We report the results in Table E.2 in the Online Appendix. The results remain qualitatively identical though the point estimates decrease in magnitude.

In summary, we find that vertical integration in the carbonated-beverage industry caused price increases for Dr Pepper SG products and price decreases for both Coca-Cola and PepsiCo products bottled by vertically integrated bottlers (though some of our differences-in-differences estimates for Coca-Cola and PepsiCo products are noisy).

[31] We note, however, 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.

[32] 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 ($p = 0.01$).

Our results are consistent with manifestations of the efficiency and Edgeworth-Salinger effects of vertical integration and suggest that the Edgeworth-Salinger effect is large relative to the efficiency effect of vertical integration. Because the Edgeworth-Salinger effect works against efficiency gains, these results suggest that the Edgeworth-Salinger effect is relevant for the evaluation of vertical mergers. Lastly, these results also suggest the existence of a linear component in the pricing of concentrate—since otherwise vertical integration would not have caused price effects—which provides new evidence on the types of vertical arrangements that are used in practice.

6.1 Heterogeneity Analysis

To explore heterogeneity in the effects of vertical integration on prices, we perform two exercises. The first is a product-level analysis, in which we replicate our differences-in-differences analysis for each product that was impacted by vertical integration in at least one county. The second exercise replicates our differences-in-differences analysis but allows for the effects of vertical integration on prices to vary as a function of chain characteristics.

To examine how the effect of vertical integration on prices varied across products, we estimate

$$\log(price_{j,s,w}) = VI_{j,s,w}\beta^{j}_{VI} + \lambda_s + \phi_w + x'_{j,s,w}\delta + \varepsilon_{j,s,w} \quad (4)$$

for every product j that was somewhere impacted by vertical integration, where 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 λ_s and ϕ_w are store and 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.

We report the distribution of product-level differences-in-differences estimates in Figure 4, where we categorize the coefficients by the upstream firm to which each product belongs (e.g., Coca-Cola, PepsiCo, or Dr Pepper SG). In Figure 4 (Panel A), the definition of the treatment and control groups are analagous to those in Table 4 (Panel A). The figure shows that the Edgeworth-Salinger effect impacted most of the Dr Pepper SG brands bottled by a vertically integrated bottler (i.e., 70 percent of the products), with most of the mass concentrated between the values 0 and 0.03. Consistent with Table 4 (Panel A), the figure shows that most PepsiCo products bottled by a vertically integrated bottler experienced price decreases, whereas the findings are mixed for Coca-Cola products. In Figure 4 (Panel B) we repeat the exercise but now exclude the indirectly treated observations from the control group in a way that resembles Table 4 (Panel B). A notable difference relative to Panel A is that the efficiency effect of vertical integration manifests for a larger set of Coca-Cola products, which is in line with Table 4 (Panel B).

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 E.4 in the Online Appendix 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.

Lastly, we repeat the differences-in-differences analysis and drop convenience stores from the sample. Table E.5 in the Online Appendix presents the results, and shows that vertical integration caused a 2.4 percent increase in the prices of Dr Pepper SG products sold in grocery stores. The table suggests that the Edgeworth-Salinger effect of vertical integration was larger among grocery stores—i.e., Table 4 (Panel A) suggests a 1.5 percent increase in the prices of Dr Pepper SG products.

6.2 Regular- and Sale-price Analysis

Previous research has documented the prevalence of temporary price reductions in a number of categories of consumer packaged goods, with prices alternating between a "regular" and a "sale" price (see, for example, Raju 1992, Mulhern and Padgett 1995, Pesendorfer 2002, Hosken and Reiffen 2004, Hendel and Nevo 2006, 2013). This raises the question of whether the regular and sale price of each product in our sample were equally impacted by vertical integration. We address this question by using a variable in our dataset that indicates temporary reductions in the prices of products of at least 5 percent. This variable is defined at the product–store–week level, and we use it as our measure of “sale.” Table E.6 in the Online Appendix presents summary statistics for the sale indicator and shows that there were temporary price reductions in 42.2 percent of the product–store–week combinations in our data.

In Table 6 we present differences-in-differences estimates restricting the sample to the product–store–week combinations that were not on sale (“Regular” columns), and the product–store–week combinations that were on sale (“Sale” columns). The table suggests that the Edgeworth-Salinger effect of vertical integration impacted regular and sale prices equally, and the efficiency effect on PepsiCo products is stronger in the regular price subsample. Similarly, Table E.7 in the Online Appendix reports within-store estimates on the sale and regular prices subsamples, and shows that the efficiency and Edgeworth-Salinger effects of vertical integration manifest for both sale and regular prices, with generally larger point estimates in the sale prices subsample. Combined, these results lead us to conclude that the Edgeworth-Salinger effect of vertical integration impacted both sale and regular prices.

6.3 Additional Exercises

Table E.9 in the Online Appendix replicates our differences-in-differences analysis in Table 4, but use a blocking regression approach based on propensity score matching. This approach allows us to take into consideration selection on observables, which may be a concern given the differences in demographics between treated and untreated counties (see Table D.3 in the Online Appendix). To implement the blocking-regression approach, we follow Imbens (2015) and first estimate the likelihood of treatment at the county level based on county-level demographics and outcomes prior to the transactions. We then group treatment and control counties in bins based on their propensity score, making sure that both the propensity score and its determinants are balanced within each propensity-score bin. Lastly, we estimate the effect of vertical integration on prices within each bin using Equation 1, and we compute the overall price effect as the weighted average of the bin-specific estimated effects. We report the results in Table E.9, and find that our estimates remain almost identical to those reported in Table 4, suggesting that selection on observables is empirically irrelevant.

In Table E.10 and Table E.11 in the Online Appendix we repeat our differences-in-differences and within-store analyses (respectively) restricting the sample to neighboring 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.

We explore the robustness of our results to different levels of aggregation in Table E.10 (differences-in-differences) and Table E.11 (within-store) in the Online Appendix. Two reasons motivate this analysis. First, the serial correlation of prices may lead to inconsistent estimates of standard errors (see Bertrand et al. 2004).[33] Second, chains set similar prices across their stores (see Table 2 and DellaVigna and Gentzkow 2017), 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.

To examine whether our findings could have been caused by chance, we performed a number of placebo exercises (see Section E.9 in the Online Appendix for details). In the first set of placebo exercises, we repeat the differences-in-differences analysis in Table 4 (Panel A, Column 2) and the within-store analysis in Table 5 (Column 1), but assign treatment at random (i.e., randomizing which product–store combinations were exposed to vertical integration as well as the timing of vertical integration). We performed 1,000 placebo replications for each exercise, and report the estimates for each replication in Figure E.2 in the Online Appendix. Figure E.2 (Panel A) reports the distribution of estimated coefficients for the placebo differences-in-differences research design for Dr Pepper SG. The figure shows that our estimated coefficient in Table 4 (Panel A, Column 2) is in the upper tail of the distribution of placebo replication coefficients (i.e., p-value of 0.015). Similarly, Figure E.2 (Panel B) reports the estimated coefficients for the placebo within-store analysis, which shows that only 5.4 percent of the placebo replication coefficients were larger in magnitude than our estimates for the efficiency and Edgeworth-Salinger effects of vertical integration in Table 5 (Column 1)

[33]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).

(i.e., p-value of 0.054).

To complement our placebo analysis in Figure E.2, we perform a second set of placebo exercises using other beverage categories: beer and milk. In these exercises, we take the areas in which vertical integration occurred in the carbonated-beverage industry, and we randomize which products were exposed to the Edgeworth-Salinger effect of vertical integration within those areas. We performed 1,000 placebo replications for each product category, and report the estimates of a differences-in-differences research analysis for each replication in Figure E.3 in the Online Appendix. The analysis suggests that our estimates in Table 4 (Panel A, Column 2) are in the upper tail of the placebo replication coefficient distributions of the milk and beer categories, respectively (i.e., p-values of 0.006 and 0.044, respectively). These results combined suggest that our results are unlikely to have been caused by chance. Lastly, we discuss the clustering of standard errors in Section F in the Online Appendix.

6.4 Alternative Hypotheses

Though the results that we have presented in this paper are consistent with the efficiency and Edgeworth-Salinger effects of vertical integration, there might be alternative hypotheses that can explain these findings. In what follows we discuss three alternative hypotheses and argue why these cannot explain our results.

A first alternative hypothesis is that market foreclosure—in ways other than the Edgeworth-Salinger effect—caused the increase in the prices of Dr Pepper SG brands sold by a vertically integrated bottler. Two facts rule this out. First, the pricing incentives of the vertically integrated bottlers did not change other than through the elimination of double marginalization. That is, the ability and incentives of the integrated bottlers to limit Dr Pepper SG's access to consumers did not change with the vertical mergers (see Section 2). Second, the decision of Coca-Cola and PepsiCo to acquire licenses to continue selling Dr Pepper SG brands suggests that the vertically integrated bottlers had no incentives to limit Dr Pepper SG's access to consumers (see Section 3.2).

A second alternative hypothesis is that capacity constraints might have played a role. The efficiency effect of vertical integration—and the corresponding decrease in the prices of own brands—led to an increase in the demand for brands owned by a vertically integrated bottler. A capacity-constrained bottler may have chosen to reduce production of Dr Pepper SG products in order to free capacity to increase the production of own brands and meet the higher demand for own brands. One way of reducing the quantity of Dr Pepper SG products is by increasing the prices of these products. In principle, these changes in prices would be consistent with those that we have reported above. However, the demand for carbonated beverages is seasonal, leading us to expect that the bottlers would only be constrained in some months of the year. Figure 3 suggests that the price increases were not specific to a particular season, rendering the constrained capacity explanation unlikely.

A last alternative hypothesis is that our results are explained by a post-merger increase in the frequency of temporary price reductions specific to Dr Pepper SG products that *were not* bottled by a vertically integrated bottler. We address this possibility in Table E.8, where we measure the impact of vertical integration on the frequency of sales. The table shows that vertical integration did not cause a change in the frequency of temporary price reductions of Dr Pepper SG products that *were* bottled by vertically integrated bottlers, which rules out this alternative hypothesis.

7 Discussion

Measuring the impact of vertical integration on prices has attracted the attention of economists because of its implications for competition policy. While most empirical research has focused on the tension between the elimination of double marginalization and market foreclosure, we evaluate a third mechanism that only arises with multiproduct firms. When integrating with a supplier, vertical integration may eliminate double margins for only a subset of the products of the 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 by increasing the prices of the products for which double marginalization was not eliminated. We evaluate this mechanism by studying vertical mergers among Coca-Cola, PepsiCo, and their main bottlers, which only eliminated double margins for the brands owned by these companies (i.e., vertical integration did not eliminate double marginalization for Dr Pepper SG brands bottled by the integrated bottlers).

We find that the vertical integration of Coca-Cola and PepsiCo on average decreased the prices of Coca-Cola and PepsiCo products, and increased the prices of Dr Pepper

SG products bottled by the integrated firms. These results show that eliminating double marginalization may potentially hurt consumers in multiproduct industries—or at least mitigate potential benefits—and thus suggest caution when evaluating vertical mergers in these industries.

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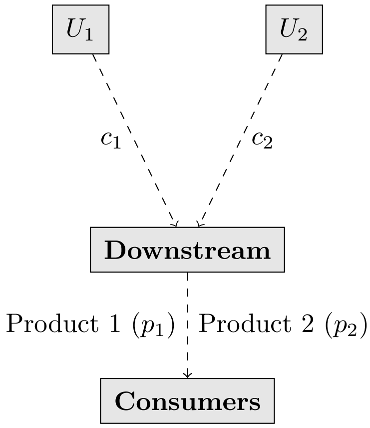
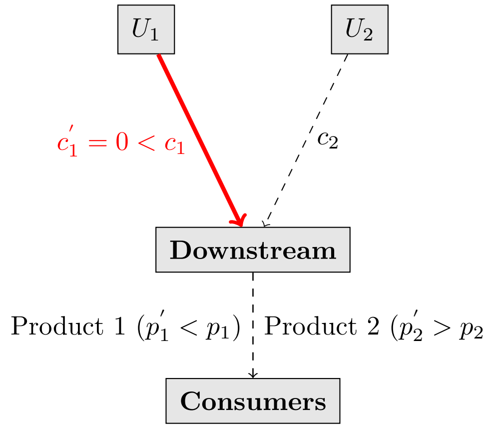
Tables and Figures



(a) Before vertical integration



(b) After vertical integration

Figure 1: Illustrating the Edgeworth-Salinger effect

Notes: The figure presents an example that illustrates the Edgeworth-Salinger effect. Figure 1a shows a downstream firm that produces Product 1 and Product 2 using inputs purchased from the upstream firms U_1 and U_2 at prices c_1 and c_2. Figure 1b illustrates what happens if the downstream firm integrates with the upstream firm U_1. Specifically, in the example, the input price c_1 decreases to zero, the assumed marginal cost for U_1. Because of this, Product 1 faces a downward pressure on its price. This is the efficiency gain associated with the elimination of double marginalization. At the same time, this makes Product 1 relatively more profitable to sell, inducing the downstream firm to increase the price of Product 2 to divert demand to Product 1. This is the *Edgeworth-Salinger effect*.

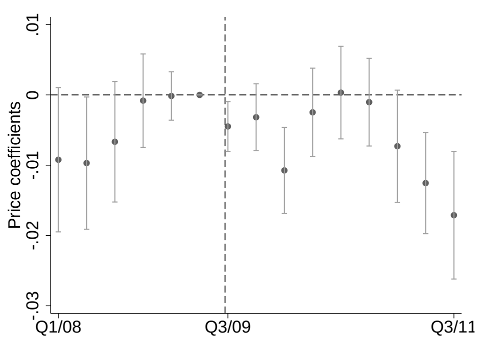
A) Coca-Cola

B) PepsiCo

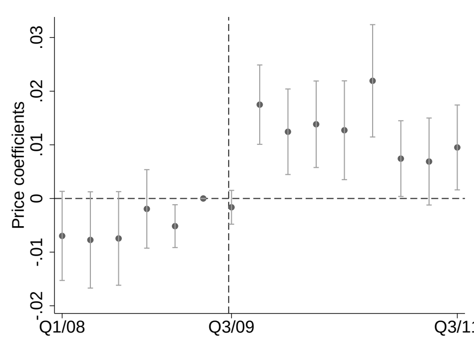
C) Dr Pepper SG

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

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 bottled by CCE or Dr Pepper bottled by CCE). The dotted vertical lines indicate the first transaction. Figures for other product sizes in Figure D.2 in the Online Appendix.



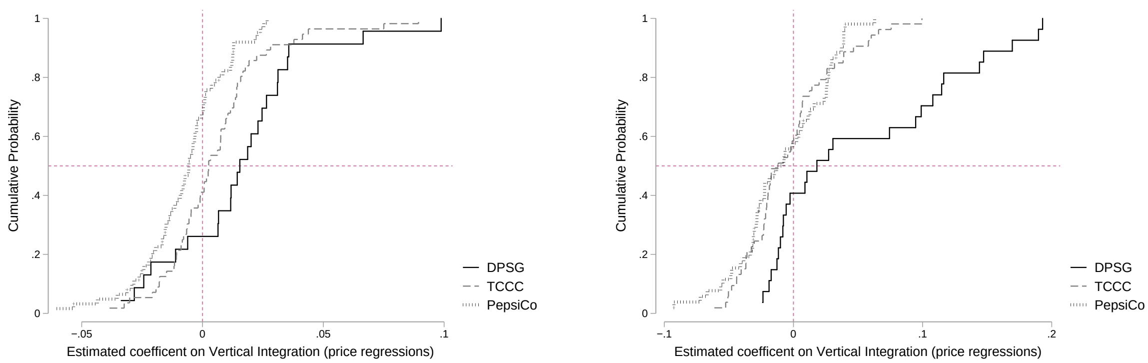
A) Coca-Cola and PepsiCo products



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 figure reports estimates for five quarters before the first transaction (i.e., Q3/2009) and five quarters after the last transaction (i.e., Q2/2010) as well as 95 percent confidence intervals. 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.



A) All observations

B) Excluding indirectly treated

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 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 in Panel A are defined as in Table 4 (Panel A), where the treatment and control groups in Panel B are defined as in Table 4 (Panel B).

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.

Table 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).

Table 3: 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.

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: Excluding indirectly treated observations			
Vertical integration	-0.002	0.015***	-0.007*
	(0.006)	(0.003)	(0.004)
Observations	14,181,874	14,776,605	16,003,752
R^2	0.908	0.902	0.890
Panel C: 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). * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. 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). Panel C (Column 1) 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); Panel C (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 Panel C (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).

Table 5: The effect of vertical integration on prices (within-store–week estimates)

	Dependent variable: log(price)	
	(1)	(2)
$VI \cdot$ Own product	-0.012***	
bottled by Coca-Cola or PepsiCo bottler	(0.003)	
$VI \cdot$ Dr Pepper SG product	0.015***	
bottled by Coca-Cola or PepsiCo bottler	(0.002)	
$VI_{CocaCola} \cdot$ Coca-Cola product		-0.011***
		(0.003)
$VI_{CocaCola} \cdot$ Dr Pepper SG product		0.022***
bottled by Coca-Cola bottler		(0.003)
$VI_{PepsiCo} \cdot$ PepsiCo product		-0.012**
		(0.005)
$VI_{PepsiCo} \cdot$ Dr Pepper SG product		0.007**
bottled by PepsiCo bottler		(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). * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. All specifications include store–week, product–week, and product–store fixed effects, as well as controls for feature and display.

Table 6: 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). * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. All specifications include product–week and product–store fixed effects, as well as time-varying county-level controls and controls for feature and display.

Online Appendix: Not For Publication

Vertical Integration with Multiproduct Firms: When Eliminating Double Marginalization May Hurt Consumers

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 reduced-form 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).

A.1 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 $\delta \in \mathbb{R}$.[34] 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

[34] 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 Syrup Producers

Contracts between bottlers and upstream firms are proprietary data. However, some of these contracts are stored in repositories that can be accessed with an Internet connection. 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.[35] 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.[36]

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.[37]

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

[35] 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.

[36] https://www.wsj.com/articles/SB943021201511406706 and https://www.ft.com/content/64e547a0-881b-11e2-8e3c-00144feabdc0

[37] 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.

2018 that covers a sub-bottling agreement in a sub-territory.[38] Two additional 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.[39]

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.[40]

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

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

[40]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.

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.

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)

Brand	Firm	20 oz N	20 oz Mean	20 oz S.D.	67.6 oz N	67.6 oz Mean	67.6 oz S.D.	144 oz N	144 oz Mean	144 oz 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 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.2 presents examples of prices that consumers faced when visiting different stores for 1 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.

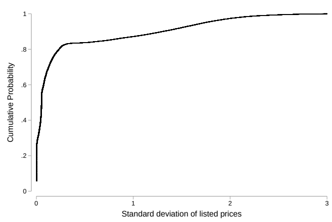
Second, Figure D.1 reports the within-store price dispersion for products of different sizes, using the full sample of regular prices as well as the subsample of round number regular prices. The figure shows that prices vary significantly across products of the same size, even when restricting attention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

TABLE D.2: Price variation within store–week: Examples of pricing patterns

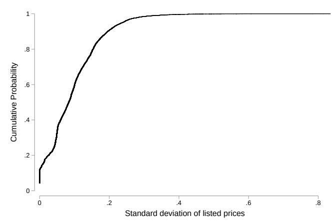
	Store				
Product	1	2	3	4	5
Coca Cola (67 oz)	1.49	1.59	1.49	1.49	1.69
Diet Coke (67 oz)	1.49	1.59	1.49	1.49	1.69
Pepsi (67 oz)	1.39	1.49	1.39	1.39	1.59
Diet Pepsi (67 oz)	1.39	1.49	1.39	1.39	1.59
Dr Pepper (67 oz)	1.29	1.59	1.39	1.29	1.59
Diet Dr Pepper (67 oz)	1.29	1.59	1.39	1.29	1.59

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 (see Section 6.2).

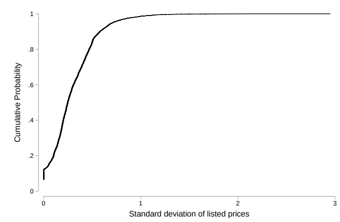
All products and prices



(a) 20 oz

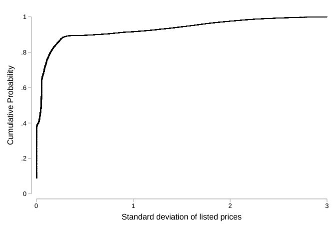


(b) 67 oz

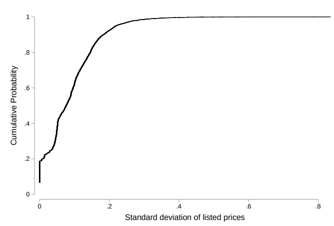


(c) 144 oz

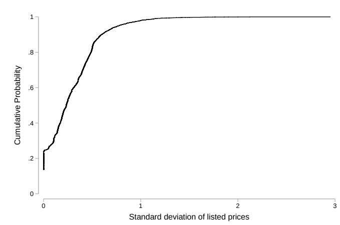
All products, round number prices



(d) 20 oz



(e) 67 oz



(f) 144 oz

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

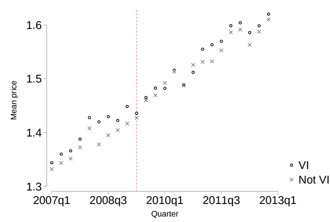
Notes: The upper panel presents the within-store standard deviation of price across products of the same size, considering prices that are not flagged as a sale price (see Section 6.2). The lower panel repeats the analysis restricting the sample to round number prices.

D.3 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.

20 oz products

(a) Coca-Cola 20 oz



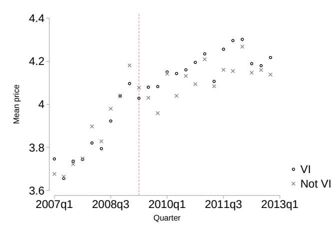
(b) PepsiCo 20 oz

(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.

D.4 Covariate balance before and after vertical integration

Table D.3: 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	61.81	54.24	-7.56	64.31	55.5	-8.8	-1.24
	(6.96)	(7.34)	[0.000]	(2.19)	(6.79)	[0.000]	[0.136]

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/).

D.5 Consumption of substitutes before and after vertical integration

Table D.4 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: 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.

E Additional analyses

In this section, we report additional analyses that are mentioned in the main text. These include heterogeneity analyses of the effects of vertical integration on prices of Dr Pepper SG products, estimates using price indexes, dynamic-effect estimates with a selected control group, estimates by type of chain, and further examination of the effects of vertical integration on both regular and sale prices.

In addition, we report the results of a series of robustness analyses including blocking regressions based on propensity-score matching, restricting the sample to neighboring counties differentially affected by vertical integration, aggregation exercises to take into account potential spillovers and autocorrelation in prices, and placebo exercises that consider both carbonated beverage products and products in other categories that were also sold in stores that were exposed to vertical integration.

E.1 Heterogeneity

The results presented in Table 4, Column 2, show that vertical integration increased the prices of Dr Pepper SG products bottled by a vertically integrated bottler. Table E.1 examines whether these estimates depend on how the sample and the control group are defined.

Table E.1, Column 1, replicates the analysis discussed in the main text but distinguishes between counties in which Dr Pepper SG products were bottled by a vertically integrated bottler; counties in which though Dr Pepper SG products were not bottled by a vertically integrated bottler, a rival firm did integrate; and counties in which there was no vertical integration (which is the excluded category). The results show that prices of Dr Pepper SG products increased—relative to prices in areas not exposed to vertical integration—only when Dr Pepper SG products were bottled by a vertically-integrated bottler. The same result holds when restricting the sample to neighboring counties differentially exposed to vertical integration.

Table E.2 examines how vertical integration impacted relative prices across products differentially exposed to integration, within the same store. The samples, however, are restricted using the following criteria. In Column 1 (3), we restrict the sample to consider untreated counties and counties in which only Coca-Cola (PepsiCo) integrated

Table E.1: The effect of vertical integration on prices (differences-in-differences estimates): Dr Pepper SG heterogeneity results

	Dependent variable: log(price)	
	(1)	(2)
	Subsample	
	All	Border
Vertical integration	0.016***	0.014**
	(0.003)	(0.006)
VI by rival firm not involving Dr Pepper SG products	0.003	0.004
	(0.005)	(0.007)
Observations	15,935,207	5,984,326
R^2	0.903	0.897

Notes: Standard errors clustered at the county level (Column 1: 443 clusters; Column 2: 131 clusters). * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. 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 excluded category includes counties unaffected by vertical integration.

and it did not bottle Dr Pepper SG products. Column 2 restricts the sample to untreated counties and counties in which *either* Coca-Cola *or* PepsiCo integrated *while* bottling Dr Pepper SG products. In these cases, we find that the relative price of own brands decreased between 0.6 and 0.9 percent when these were bottled by a vertically integrated bottler, while the price of Dr Pepper SG products increased by 1.2 percent.

Table E.2: The effect of vertical integration on prices (within-store–week estimates): Restricted treatment subsamples

	Dependent variable: log(price)		
	Coca-Cola	Coca-Cola/DPSG or PepsiCo/DPSG	PepsiCo
	(1)	(2)	(3)
VI · Own product bottled by Coca-Cola or PepsiCo bottler	-0.009***	-0.006**	-0.006*
	(0.003)	(0.003)	(0.003)
VI · Dr Pepper SG product bottled by Coca-Cola or PepsiCo bottler	-	0.012**	-
		(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). * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. 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).

E.2 Price indexes

In this subsection, we replicate our differences-in-differences analysis using a series of price indexes as our dependent variables. 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.

Table E.3 (Column 1) shows that vertical integration did not have a significant effect on quantity-weighted prices when considering the full set of products. Columns 2 to 4 show heterogeneous effects by upstream firm, which are in line with Table 4. Specifically, the table shows that vertical integration caused an increase in the quantity-weighted price of Dr Pepper SG products and a decrease in the quantity-weighted prices of Coca-Cola and PepsiCo (though the effect is only significant for PepsiCo products).

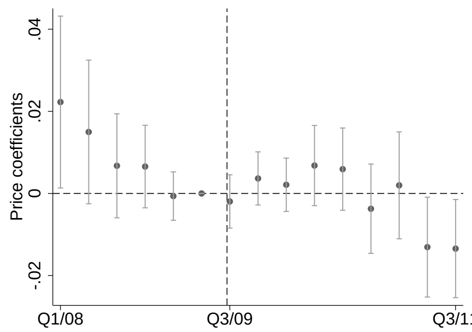
Table E.3: The effect of vertical integration on price indexes (differences-in-differences estimates)

	Dependent variable: Price index (in logs)			
	All products	Coca-Cola products	Dr Pepper SG products	PepsiCo products
	(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

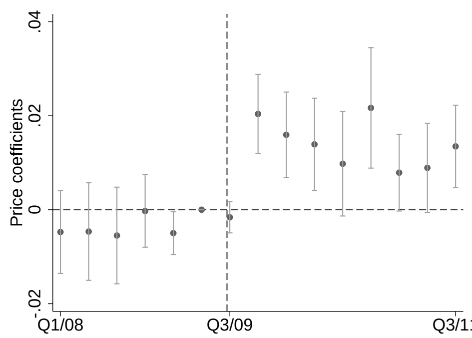
Notes: Standard errors clustered at the county level (431 clusters). * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. An observation is a store–week combination. Price indexes are computed based on pre-vertical integration average quantities at the store–product level, where the weight of each product in 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 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.

E.3 Dynamic differences-in-differences

Figure E.1 reports the estimated price effects of vertical integration on prices during the five quarters before the first transaction and the five quarters after the last one, restricting the control group to untreated counties only (rather than untreated and indirectly treated counties). Results are similar to those reported in the text in that there is no statistical evidence of differential preexisting trends in prices across areas differentially impacted by vertical integration, and that the impact of vertical integration on the prices of Dr Pepper SG products, when bottled by a vertically integrated bottler, were lasting.



A) Coca-Cola and PepsiCo products



B) Dr Pepper SG products

FIGURE E.1: Dynamics of the impact of vertical integration on prices (differences-in-differences estimates): Excluding indirectly treated observations

Notes: Standard errors clustered at the county level (443 clusters). The figure reports estimates for five quarters before the first transaction (i.e., Q3/2009) and five quarters after the last transaction (i.e., Q2/2010) as well as 95 percent confidence intervals. 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. The sample does not include 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).

E.4 Heterogeneity results by type of chain

Table E.4: 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). * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. 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 $Char \in \{Large, National, Large\&National\}$.

Table E.5: The effect of vertical integration on prices (differences-in-differences estimates): Grocery stores subsample

	Dependent variable: log(price)		
	Coca-Cola	Dr Pepper SG	PepsiCo
	(1)	(2)	(3)
Vertical integration	0.003	0.024***	-0.009
	(0.005)	(0.003)	(0.005)
Observations	13,393,903	13,698,982	14,667,062
R^2	0.910	0.905	0.891

Notes: Standard errors clustered at the county level (404 clusters). * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. 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). Drug/convenience stores are dropped from the sample.

E.5 Regular and sales prices

In this section, we first document the extent of temporary price reductions in the carbonated-beverage industry. Table E.6 shows that between 39 and 45 percent of the time, a product may be on sale. Table E.7 complements Table 6 by showing that the results of our analysis do not vary depending on whether a product is on sale or not. Further, Table E.8 examines whether vertical integration had any impact on the frequency with which vertically integrated bottlers implemented price promotions relative to unintegrated bottlers. We find no evidence of vertical integration causing a change in the frequency of promotions.

TABLE E.6: 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 E.7: The effect of vertical integration on prices (within-store–week estimates): Regular and sale prices

	Dependent variable: log(price)			
	(1)	(2)	(3)	(4)
	Subsample			
	Regular		Sale	
VI · Own product bottled by Coca-Cola or PepsiCo bottler	-0.010***		-0.016***	
	(0.003)		(0.003)	
VI · Dr Pepper SG product bottled by Coca-Cola or PepsiCo bottler	0.015***		0.019***	
	(0.002)		(0.003)	
$VI_{CocaCola}$ · Coca-Cola product		-0.011***		-0.018***
		(0.004)		(0.004)
$VI_{CocaCola}$ · Dr Pepper SG product bottled by Coca-Cola bottler		0.017***		0.031***
		(0.002)		(0.003)
$VI_{PepsiCo}$ · PepsiCo product		-0.008**		-0.012***
		(0.004)		(0.004)
$VI_{PepsiCo}$ · Dr Pepper SG product bottled by PepsiCo bottler		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). * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. All specifications include store–week, product–week, and product–store fixed effects, as well as controls for feature and display.

Table E.8: 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). * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. All specifications include product–week and product–store fixed effects, as well as time-varying county-level controls and controls for feature and display.

E.6 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 E.9: 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	0.003	0.014***	-0.008**
	(0.006)	(0.002)	(0.004)
Observations	15,727,691	14,909,921	16,909,793

Notes: Standard errors clustered at the store level. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. 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.

E.7 Neighboring counties

In Table E.10 and Table E.11 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 E.10: 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). * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. 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 E.11: The effect of vertical integration on prices (within-store–week estimates): Neighboring counties subsample

	Dependent variable: log(price)	
	(1)	(2)
VI · Own product bottled by Coca-Cola or PepsiCo bottler	-0.009***	
	(0.003)	
VI · Dr Pepper SG product bottled by Coca-Cola or PepsiCo bottler	0.013***	
	(0.004)	
$VI_{CocaCola}$ · Coca-Cola product		-0.014***
		(0.005)
$VI_{CocaCola}$ · Dr Pepper SG product bottled by Coca-Cola bottler		0.015***
		(0.005)
$VI_{PepsiCo}$ · PepsiCo product		-0.002
		(0.005)
$VI_{PepsiCo}$ · Dr Pepper SG product bottled by PepsiCo bottler		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). * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. 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.

E.8 Aggregation

We explore the robustness of our results to different levels of aggregation in Table E.10 (differences-in-differences) and Table E.11 (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).[41] Second, chains set similar prices across their stores (see Table 2 and DellaVigna and Gentzkow 2017), 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.

[41] 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 E.12: 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. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. All specifications include (aggregated) time-varying county-level controls. All specifications include product–time period and product–store/county/MSA fixed effects.

Table E.13: The effect of vertical integration on prices (within-store–week 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)
VI · Own product	-0.011***	-0.010***	-0.010***	-0.008***	-0.010**	-0.006	-0.007**
bottled by Coca-Cola or PepsiCo bottler	(0.003)	(0.002)	(0.002)	(0.002)	(0.004)	(0.004)	(0.003)
VI · Dr Pepper SG product	0.011***	0.010***	0.007***	0.006***	0.010***	0.008**	0.007**
bottled by Coca-Cola or PepsiCo bottler	(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). * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. All specifications include store–time period, product–time period, and product–store fixed effects, as well as controls for feature and display.

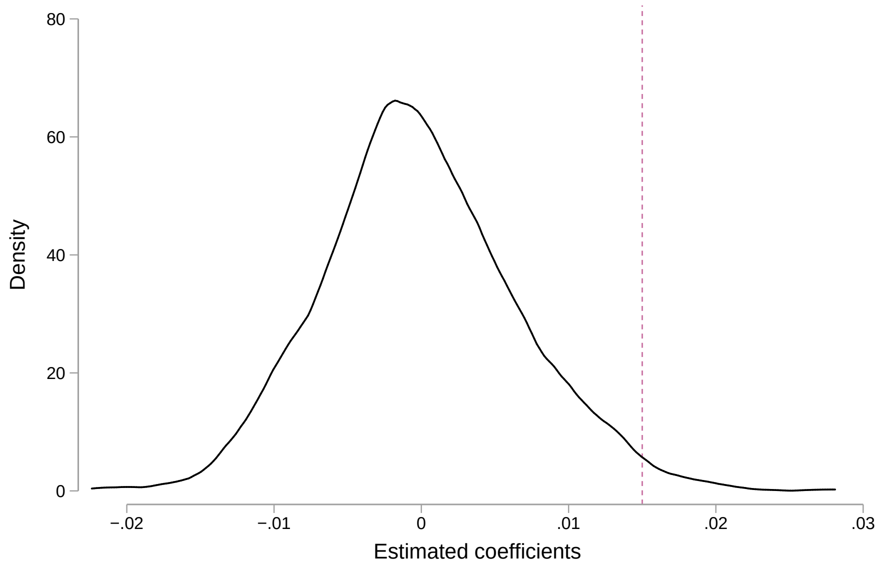
E.9 Placebos

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.

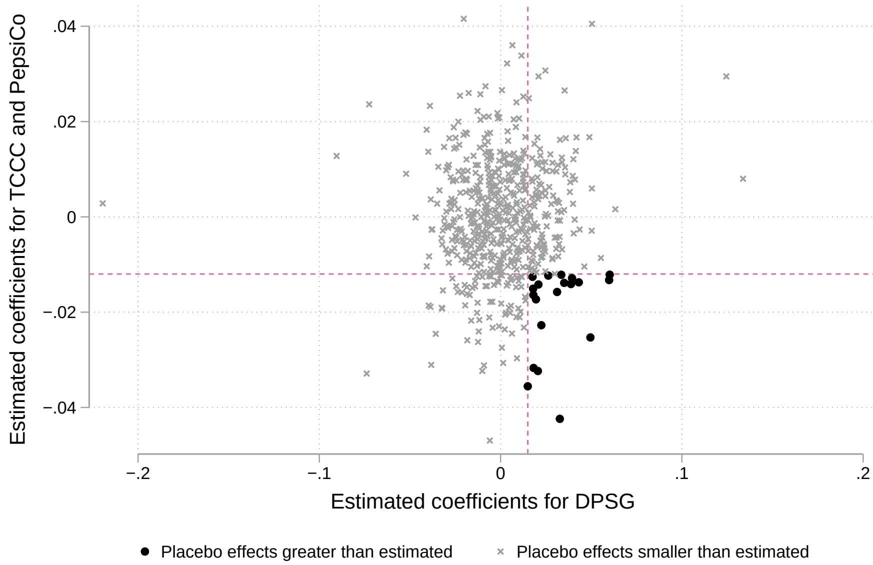
In the first exercise, we randomly draw the counties exposed to vertical integration, the moment at which vertical integration took place, and the subset of Dr Pepper SG products that were affected by vertical integration. Figure E.2a reports our findings and shows that the estimate effect reported in 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 5. 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 E.2b. 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 E.3 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.



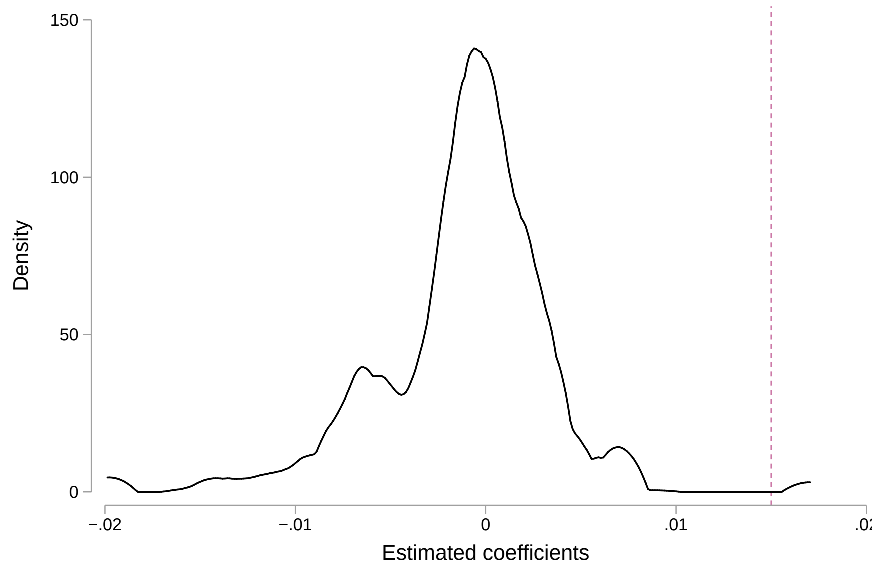
(a) Differences-in-Differences Dr Pepper SG



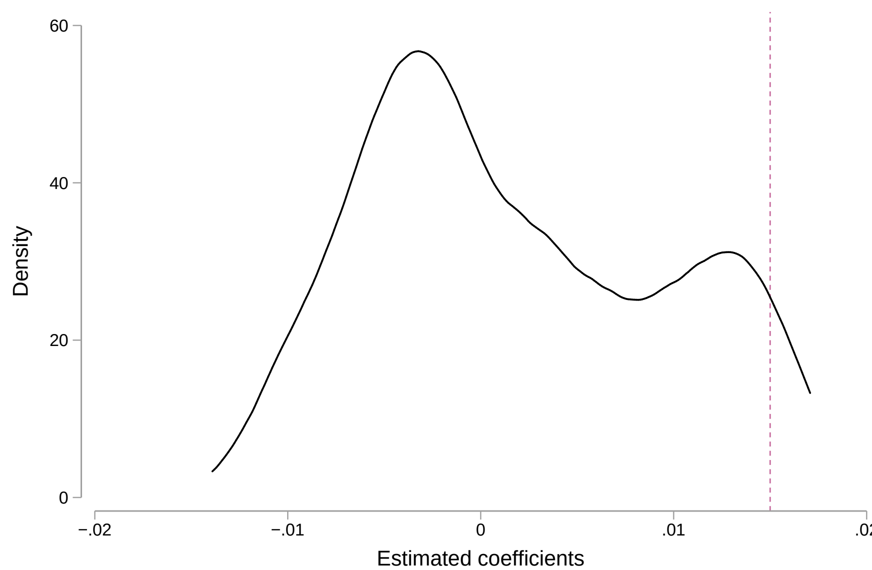
(b) Within-store analysis

FIGURE E.2: 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 5 (Column 1). The black dots reported in the scatter plot correspond to placebo estimates that are larger than those reported in Table 5. 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 E.3: 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 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.1 and Table F.2. The only notable difference is that we lose precision in Table F.2 (Column 2), where we decompose the impacts of vertical integration by upstream firm.

Table F.1: 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). * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. 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.2: The effect of vertical integration on prices (within-store–week estimates): MSA clustering

	Dependent variable: log(price)	
	(1)	(2)
VI · Own product bottled by Coca-Cola or PepsiCo bottler	-0.011**	
	(0.005)	
VI · Dr Pepper SG product bottled by Coca-Cola or PepsiCo bottler	0.014***	
	(0.004)	
$VI_{CocaCola}$ · Coca-Cola product		-0.011**
		(0.005)
$VI_{CocaCola}$ · Dr Pepper SG product bottled by Coca-Cola bottler		0.021***
		(0.005)
$VI_{PepsiCo}$ · PepsiCo product		-0.012
		(0.010)
$VI_{PepsiCo}$ · Dr Pepper SG product bottled by PepsiCo bottler		0.005
		(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). * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. 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.