# THE COMPETITIVE IMPLICATIONS OF PRIVATE LABEL MERGERS

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## INTRODUCTION

In 2019, private label products generated an estimated $180 billion in U.S. retail sales, accounting for nearly one in every four retail products sold.[1] Private labels are generally the cheapest option available, which is particularly appealing to price-sensitive shoppers seeking a lower-priced alternative to major national brands.[2] In recent years, there have been several proposed and consummated mergers between private label manufacturers that raise questions about the proper antitrust evaluation of such mergers. In December 2019, for instance, the Federal Trade Commission filed an administrative complaint challenging the acquisition of TreeHouse Foods' private label ready-to-eat cereal business by Post Holdings, claiming that the acquisition would "eliminate the vigorous competition between them to serve grocers across the country."[3]

The antitrust analysis of private label mergers is complicated by the fact that private label products compete to make sales at two distinct but interrelated stages. In the first stage, private label manufacturers compete to become a grocery retailer's private label product supplier (e.g., via an RFP process). In the second stage, the private label product chosen by the retailer competes against other items on the retail shelf, in particular against the branded products that private labels often seek to emulate. When initially

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[1] https://www.plma.com/storeBrands/facts2020.html

[2] *See, e.g.*, Karsten Hansen, Vishal Singh & Pradeep Chintagunta, *Understanding Store-Brand Purchase Behavior Across Categories*, 25 MARKETING SCIENCE 75 (2006).

[3] https://www.ftc.gov/news-events/press-releases/2019/12/ftc-alleges-post-holdings-incs-proposed-acquisition-treehouse. The parties abandoned the transaction in January 2020.

negotiating wholesale prices with retailers, private label manufacturers must consider both stages of competition. In the first stage, quoting a higher wholesale price may lead the retailer to choose a different private label supplier. In the second stage, because wholesale prices are an input cost to retailers—and therefore generally affect retail prices—higher wholesale prices may lead to higher retail prices and thus fewer private label sales in competition with other items on the retail shelf. The constraint imposed on private label wholesale prices by this second stage of competition—the need for the private label product to be priced competitively on the retail shelf—is not directly affected by a merger between private label manufacturers. Therefore, the antitrust evaluation of such mergers must assess the relative importance of (i) the competitive constraint imposed by upstream competition between private label manufacturers to become a retailer's private label supplier; and (ii) the competitive constraint imposed by downstream competition on the retail shelf.

In this article, we show how existing methods for assessing the likely competitive effects of horizontal mergers can be extended to the private label merger context. Our central result is that incorporating both stages of competition at which private label products compete can have a large impact on the antitrust evaluation of private label mergers. Specifically, our upward pricing pressure and merger simulation analyses demonstrate that smaller marginal cost efficiencies are typically needed to generate net downward pricing pressure post-merger compared to the prototypical case where firms sell directly to end consumers. Therefore, the task of quantifying merger-specific cost efficiencies and weighing them against the loss of competition from the merger arguably takes on a heightened importance when assessing private label mergers. Depending on the strength of downstream competition, even mergers that consolidate a significant proportion of private label industry sales can be procompetitive with only modest cost efficiencies.

## I. CASE HISTORY

Antitrust matters involving branded consumer products often have acknowledged the influence of competition between branded and private label products, generally from the perspective of the competitive constraint that private label products impose on their branded counterparts. In several cases, private label products have been included in the relevant market for the purposes of analyzing the competitive effects of a branded merger. For example:

- In its evaluation of the Kraft/Nabisco Cereals merger, the State of New York determined that "Private label RTE [ready-to-eat] cereal manufacturers position their cereals to compete directly against branded RTE cereal products," concluding that "the relevant product market is all RTE cereals."[4]

- In its review of the General Mills/Ralcorp transaction, the FTC Complaint defined the relevant line of commerce to include the sale of both branded and private label RTE cereals.[5]
- The FTC did not issue a Second Request regarding Energizer's acquisition of Spectrum Holdings (the owner of Rayovac), which Energizer's lead antitrust counsel attributed to compelling evidence of competition from private label producers.[6]

In other cases, however, private labels have been excluded from the relevant market. For example:

- In Coca-Cola's proposed acquisition of Dr. Pepper, the court held that the relevant product market was "carbonated soft drinks," including smaller brands like RC Cola but excluding private labels.[7]
- In the proposed merger of Nestlé and Dreyer's, the alleged product market in the FTC Complaint was "super-premium ice cream products," which excluded private label products.[8]
- In its evaluation of the proposed acquisition of Unilever's Lawry's and Adolph's spice blends by McCormick, the FTC excluded private label seasoned salts from the relevant market.[9]

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[4] *State of N.Y. v. Kraft General Foods, Inc*., 926 F. Supp. 347, 333. A more contentious point in this case was whether the relevant product market could be limited to "adult" cereals.

[5] https://www.ftc.gov/sites/default/files/documents/cases/1997/05/c3742cmp.pdf

[6]https://mlexmarketinsight.com/contact-us/ftcwatch/selected-2017-articles/mixed-signals-dissecting-ftcs-decision-to-clear-energizer-spectrum-deal ("In retail transactions, parties often argue that private label is a significant constraint on pricing but rarely are able to provide compelling evidence to back up that argument… Here, however, the parties were able to demonstrate that private label competition is significant through econometric analysis, documentary evidence and customer testimony.")

[7] *FTC v. The Coca-Cola Co.*, 641 F. Supp. 1128 (D.D.C. 1986). A more contentious point in this case was whether the relevant product market should also include other beverages such as fruit juice, coffee, and water.

[8] https://www.ftc.gov/sites/default/files/documents/cases/2003/06/dreyercomplaint.htm

[9]https://www.ftc.gov/sites/default/files/documents/cases/2008/07/080730mccormickcmp.pdf ("The relevant line of commerce in which to analyze the effects of the acquisition is the manufacture and sale of branded seasoned salt products. Branded seasoned salt products

- In the proposed acquisition of Conagra's Wesson cooking oil brand by Smucker (the owner of Crisco), the FTC Complaint alleged that branded canola and vegetable oils was a relevant product market, and that "competition from private label [canola and vegetable] oils would not replace the competition eliminated by the [a]cquisition."[10]

As illustrated by the above examples, the focus of analyses of competition between brands and private labels has been the competitive constraint that private label products do or do not impose on their branded counterparts. This article, on the other hand, focuses on the reverse perspective—the constraint that competition with branded products downstream imposes on pricing by private label manufacturers upstream. This is the perspective required to accurately assess the competitive implications of mergers between private label manufacturers.

Because retailers may not be able to easily substitute to a branded manufacturer when seeking a private label supplier (except via reallocation of shelf space), it may be tempting to think that the evaluation of upstream competition between private label manufacturers can be evaluated separately from the analysis of downstream competition between private labels and other products on the retail shelf.[11] To the contrary, we show that competition between branded and private label products is a two-way street—strong competition from national brands downstream can significantly limit the potential for upstream mergers between private label manufacturers to cause anticompetitive harm. Therefore, just as the extent to which private labels constrain brands is an empirical question, so too is the extent to which brands constrain private labels.[12]

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include any dry branded product or product formulation (not including private or store label) sold at retail, usually in glass or plastic bottles, that consist primarily of salt, contain at least two other different herbs, spices, and/or other seasonings, and are labeled or otherwise described on the container as seasoned salt.")

[10] https://www.ftc.gov/system/files/documents/cases/d09381_smucker_conagra_part_3_administrative_complaint_redacted_public_version.pdf

[11] In *FTC v. Heinz*, for example, the FTC argued that wholesale competition between Heinz and Beech-Nut should be analyzed independently of retail competition, but the court held that "the wholesale market cannot be separated out for analysis without regard to the merger's effect on other levels of competition." https://www.ftc.gov/sites/default/files/documents/cases/2001/04/010427heinz-milnot-appellatecourtppinion.pdf

[12] Besides the impact of competition with national brands on the antitrust evaluation of private label mergers, there are a variety of other antitrust questions related to private labels, such as the effect that having a private label has on a retailer's "buyer power" vis-à-vis

## II. Economic Analysis

### *A. Upward Pricing Pressure*

On one hand, mergers create incentives to increase prices because business that would have been lost to the merging partner via a price increase is "recaptured" through the merger. On the other hand, mergers create incentives to decrease prices if they involve cost efficiencies, which make price cuts more profitable. Upward pricing pressure analysis provides a way to quantity the net effect of these countervailing forces on the pricing incentives of the merged firm. For example, in the case of symmetric firms,[13] the merger of two firms creates net downward pricing pressure if the percent reduction in marginal cost due to the merger satisfies the following inequality (Farrell and Shapiro (2010)):[14]

$$\theta > D \cdot \frac{M}{1 - M}, \tag{1}$$

where $\theta$ is the post-merger marginal cost reduction, $D$ is the diversion ratio between the merging firms, and $M$ is their pre-merger percentage margin. For example, if the diversion ratio is 30 percent and margins are 20 percent, cost efficiencies need to be at least 0.3 * 0.2 / (1 – 0.2) = 7.5 percent for the merger to generate downward pricing pressure.

Condition (1) above applies to the case where firms set prices directly to end consumers. When private label manufacturers bid to serve retailers and those retailers then sell the product on to end consumers, adjustments to condition (1) are required. Suppose for example that private label manufacturers submit binding wholesale price proposals to retailers (i.e., the price per unit that the retailer will pay to the private label manufacturer for each unit sold), the retailer chooses one of the manufacturers as its private label supplier, and the retailer then sets the retail price of the private label product. Both the manufacturer that the retailer chooses and the retail price

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branded manufacturers. For additional discussion, *see, e.g.*, Chris Doyle & Richard Murgatroyd, *The Role of Private Labels in Antitrust*, 7 J. COMP. L. & ECON. 631 (2011); Hila Nevo & Roger Van den Bergh, *Private Labels: Challenges for Competition Law and Economics*, 40 WORLD COMPETITION 271 (2017).

[13] For ease of exposition, we focus on the case of symmetric firms. Similar results, which appear in the appendix, apply to the asymmetric case.

[14] Joseph Farrell & Carl Shapiro, *Antitrust Evaluation of Horizontal Mergers: An Economic Alternative to Market Definition*, 10 BE JOURNAL OF THEORETICAL ECONOMICS 9 (2010).

that the retailer charges generally will depend on the wholesale prices that the manufacturers set. When choosing a wholesale price, private label manufacturers must therefore think about both (i) the likelihood that they are selected by the retailer and (ii) the pass-through of the chosen wholesale price to the retail price. The retail price determines the competitiveness of the private label product on the retail shelf, which affects the quantity that will be sold.

Extending the analysis of Farrell and Shapiro (2010) to operationalize this logic results in the following adjusted inequality for the cost efficiencies needed to create downward pricing pressure after the merger of two symmetric firms:[15]

$$\theta > D \cdot \frac{M}{1 - M} \cdot \frac{\varepsilon_u}{\varepsilon_u + \varepsilon_d \cdot \varepsilon_t}, \qquad (2)$$

where $\theta$, $D$, and $M$ are as defined above (the post-merger percent cost reduction, the diversion ratio, and the margin, respectively).[16] The $\varepsilon$ terms are elasticities.

- $\varepsilon_u$ is the "upstream elasticity": the (absolute value of the) percent change in the likelihood that the retailer selects the manufacturer given a one percent increase in the manufacturer's proposed wholesale price;
- $\varepsilon_d$ is the "downstream elasticity": the (absolute value of the) percent change in the quantity sold at retail given a one percent increase in the retail price of the private label product; and
- $\varepsilon_t$ is the "pass-through elasticity": the percent change in the retail price of the private label product given a one percent increase in the wholesale price.

Note that the right-hand-side of condition (2) is the same as in condition

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[15] Condition (1) is derived from the first order condition of the profit maximization problem $\max_p Q(p) \cdot (p - c)$, where p is price, c is marginal cost, and $Q(p)$ is quantity sold (a function of the price). Condition (2) is derived by extending the profit maximization problem to incorporate the two stages of competition at which private label manufacturers compete: $\max_w \Pr(w) \cdot Q(p(w)) \cdot (w - c)$, where w is the wholesale price, c is marginal cost, $\Pr(w)$ is the probability that the manufacturer is selected by the retailer (a function of the wholesale price), and $Q(p(w))$ is quantity sold conditional on being selected by the retailer (a function of the retail price which itself is a function of the wholesale price). See the appendix for the full derivation of condition (2).

[16] The diversion ratio in condition (2) is defined as the fraction of the probability of being selected by the retailer lost by one firm after a wholesale price increase that is captured by the other firm.

(1) but multiplied by the additional term $\frac{\varepsilon_u}{\varepsilon_u+\varepsilon_d\cdot\varepsilon_t}$. Under the standard assumptions that demand slopes downward (both in terms of the retailer's choice of private label manufacturer and end consumers' demand at retail) and pass-through is positive, this additional term is strictly less than one. Therefore, the cost efficiencies required to generate downward pricing pressure are strictly less than in the case where firms sell directly to end consumers.[17] The quantitative effect of this change can be important. For illustration, suppose that the upstream elasticity $\varepsilon_u$ is 1 (in absolute value), the downstream elasticity $\varepsilon_d$ is 4 (in absolute value), and the pass-through elasticity $\varepsilon_t$ is 1. If the diversion ratio is 30 percent and margins are 20 percent as in the prior numerical example, cost efficiencies need to be at least 0.3 * (0.2 / (1 – 0.2)) * (1 / (1 + 4*1)) = 1.5 percent for the merger to generate downward pricing pressure. This value is one-fifth of the 7.5 percent cost efficiency required in the case where the merging firms sell directly to end consumers.

The intuition for this result follows from the fundamental point that private label manufacturers must compete at two stages: first between each other to get on the retail shelf, and then second against other competing products once on the retail shelf. A merger between private label manufacturers reduces competition in the first stage but not the second stage.[18] The additional term quantifies the relative importance of these two stages of competition. The upstream elasticity $\varepsilon_u$ reflects the sensitivity of the retailer to changes in wholesale prices (the first stage) and the downstream elasticity multiplied by the pass-through elasticity $\varepsilon_d \cdot \varepsilon_t$ reflects the sensitivity of end consumers to changes in wholesale prices (the second stage).[19] When the first stage of competition dominates, such that $\frac{\varepsilon_u}{\varepsilon_u+\varepsilon_d\cdot\varepsilon_t}$ approaches one, the cost efficiencies necessary to generate downward pricing pressure are unaffected. When the second stage of competition dominates, such that $\frac{\varepsilon_u}{\varepsilon_u+\varepsilon_d\cdot\varepsilon_t}$ approaches zero, the cost efficiencies necessary to generate downward pricing pressure tend toward zero.

[17] In the asymmetric case, this result is not guaranteed to apply to both merging firms, although our quantitative simulations indicate that that the necessary cost efficiencies generally decrease for both firms even under asymmetry. See the appendix for more details.

[18] To see this more precisely, note that a higher wholesale price from one of the merging manufacturers will make the retailer more likely to choose the other merging manufacturer, but does not have a first-order effect on what the other merging manufacturer will sell at retail if chosen by the retailer.

[19] End consumers can be insensitive to wholesale prices either if they are insensitive to retail prices (i.e., if $\varepsilon_d$ is small) or if wholesale price increases are not passed through to retail prices (i.e., if $\varepsilon_t$ is small).

This analysis demonstrates the importance of explicitly considering the two stages at which private label products compete when assessing the likely competitive effects of a merger between private label manufacturers. However, without further modeling, upward pricing pressure analysis alone is not enough to predict post-merger price effects.[20] For example, the analysis above does not consider the price responses of the merging parties' rivals, whereas a full merger simulation can.

### *B. Merger Simulation*

To illustrate how standard merger simulation methods can be extended to the case of mergers between private label manufacturers, we develop such a model and apply it to a hypothetical merger. To make the analysis more concrete, the specific application is to canned soup, although the methods we employ are much more general. The specific inputs of the model—branded and private label retail shares, consumer demand elasticities, private label manufacturer concentration, etc.— will vary from industry to industry, as will the model's predictions. Given the certitude of industry-specific idiosyncrasies, our goal is not to make universal claims about the competitive impact of private label mergers. Rather, our goal is to elucidate the overall modeling approach and show by proof-of-concept that considering both stages at which private label products compete can make a significant difference in the assessment of competitive effects.

We choose canned soup because of the existence of publicly available data for the industry and because the industry is dominated by a branded manufacturer, the Campbell Soup Company ("Campbell's"). The key question evaluated by the model is the extent to which downstream competition—primarily with Campbell's—constrains the ability of a private label manufacturer to increase wholesale prices after merging with a rival manufacturer.[21] Public filings by Campbell's are very clear that there is

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[20] *See, e.g.*, Carl Shapiro, *The 2010 Horizontal Merger Guidelines: From Hedgehog to Fox in Forty Years*, 77 ANTITRUST LAW JOURNAL 49 (2010). ("Further information about demand is needed, and additional analysis is required, to translate these incentives into predictions of post-merger price increases. To accomplish this, DOJ economists and economists working for merging parties often undertake merger simulation exercises.")

[21] Some grocery retailers, like Aldi and Trader Joe's, do not sell branded products in all product categories. For these retailers, it remains the case that private labels must compete once on the retail shelf, but the extent of direct competition with other same-category products is more limited.

strategic interaction between their products and private labels,[22] and the merger simulation model explicitly weighs the relative importance of this competitive interaction on the retail shelf versus the competitive interaction between rival private label manufacturers upstream.[23]

1. Data

Our data for canned soup comes from the now defunct grocery chain Dominick's. The Dominick's dataset, which is publicly available through the University of Chicago,[24] is retail scanner data that tracks sales by UPC over time at Dominick's stores in the Chicago area. Similar data with national coverage often is available in merger investigations. Although we use data from 1996, and therefore the analysis may not reflect current competitive conditions, the data are useful for our goal of making the analysis concrete. Table 1 summarizes average canned soup retail prices, wholesale prices, and quantity shares by manufacturer.[25,26] Nearly 90 percent of soup sold by Dominick's in 1996 was Campbell's brand soup. The lowest-priced products

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[22] Campbell Soup Company Form 10-K, Fiscal Year 2019. ("We operate in a highly competitive industry… This competition arises from numerous competitors [including] producers of private label products… a continued shift towards private label offerings, could result in us reducing prices.")

[23] The economics literature has also begun to explore how multiple levels of competition within a supply chain affects market outcomes. For example, Ho and Lee (2017) develop a model to quantify the effect of competition between healthcare insurers—who act as intermediaries between healthcare providers and patients—on a variety of outcomes, such as the negotiated prices paid to hospitals and the premiums charged to enrollees. Kate Ho & Robin S. Lee, *Insurer Competition in Health Care Markets*, 85 ECONOMETRICA 379 (2017). Sheu and Taragin (2020) model a two-level supply chain and show how the vertical structure of the market affects the impact of both horizontal and vertical mergers. One subtle but important difference between our model and Sheu and Taragin's is that in our model only a single private label supplier is chosen by the retailer, whereas in Sheu and Taragin's model the retailer contracts with all suppliers. Gloria Sheu and Charles Taragin, *Simulating Mergers in a Vertical Supply Chain with Bargaining,* Working Paper (2020).

[24] https://www.chicagobooth.edu/research/kilts/datasets/dominicks

[25] We make a variety of sample restrictions to arrive at the final sample of products entering the analysis. First, we drop observations flagged by the data provider as suspect. Second, we limit the data to products between 7.5 and 26.2 ounces to eliminate products like bouillon cubes. Third, we drop all stocks and broths, which are generally priced lower than other canned soup products.

[26] In principle the analysis can be conducted separately by product—e.g., if competitive conditions for tomato soup are significantly different than chicken noodle soup—but for parsimony we conduct the analysis at the manufacturer level, with each manufacturer offering a single "composite" product.

are Dominick's private label soups, with an average retail price during the year of 68 cents per 10.75 ounce can.

TABLE 1: RETAIL PRICES, WHOLESALE PRICES, AND SHARES

| Manufacturer | Retail Price ($/10.75 oz) | Wholesale Price ($/10.75 oz) | Quantity Share |
|---|---|---|---|
| Campbell's | $0.76 | $0.63 | 89.3% |
| Progresso | $0.91 | $0.66 | 2.9% |
| Healthy Choice | $1.05 | $0.63 | 1.5% |
| Other Branded | $1.04 | $0.78 | 1.1% |
| Private Label | $0.68 | $0.57 | 5.1% |

Notes: 10.75 oz is the most common size, accounting for 54 percent of revenue. Other branded combines multiple smaller brands which are aggregated together for analytical convenience.

The Dominick's data provides a snapshot of competition at the retail level to attract grocery shoppers. Unfortunately, we do not have similar data on competition at the wholesale level—i.e., competition between private label manufacturers to become Dominick's private label canned soup supplier. The Dominick's data contain information on wholesale prices (as shown in Table 1), but we could not locate any data on private label manufacturer market structure. Private label manufacturer shares and margins are necessary inputs to the merger simulation model. For illustration, we assume that there are three private label manufacturers each with a one-third share of private label sales, such that a merger would reduce the number of manufacturers from three to two and consolidate two-thirds of private label sales under one company. We further assume that private label manufacturers earn 20 percent margins. The assumption of 20 percent margins is consistent with the gross margins earned by publicly traded private label companies.[27]

## 2. Model Overview

Below we provide an overview of the merger simulation model. The goal is to extend standard models of competition involving consumer products just enough to integrate the two stages of competition at which private label manufacturers compete. Much of the modeling can (and should) be further extended to incorporate various real-world complexities that may be important in assessing the effects of a given private label merger, such as

[27] For example, between 2001 and 2005, Ralcorp Holdings' gross margin ranged between 19.2 percent and 20.6 percent. Ralcorp Holdings, Inc. Form 10-K, Fiscal Year 2005.

bargaining between retailers and manufacturers. We discuss this and other extensions later in Part III.B. In an effort to be concise, we place many of the technical details in footnotes, often referring the reader to the existing merger simulation literature for further explanation.

a. Downstream Demand

The starting point is a model of downstream demand: i.e., a model of canned soup purchases by grocery shoppers. For simplicity and consistency with the economics literature, we adopt a logit model of demand in which the utility that consumer i receives from purchasing product j is given by $\alpha_j - \beta \cdot p_j + \epsilon_{ij}$, where $\alpha_j$ is a constant that can roughly be interpreted as the average consumer's evaluation of product j, $p_j$ is the retail price of product j, $\beta$ captures consumers' price sensitivity, and $\epsilon_{ij}$ captures consumer i's idiosyncratic preference for product j. The distribution of the $\epsilon_{ij}$ terms in the population determines purchase shares and the nature of substitution between products. We adopt perhaps the simplest assumption, sometimes referred to as the "simple logit" model,[28] in which substitution between products is proportional to shares. This is the model analyzed by Werden and Froeb (1994) (among many others) and is also one of the main models available as part of the Antitrust R Package developed by DOJ economists Charles Taragin and Michael Sandfort, further described in Froeb et al. (2018).[29]

b. Upstream Demand

We combine the model of downstream demand described above with a model of upstream demand: i.e., a model of how retailers choose their private label supplier. To keep the model as simple as possible, we assume that upstream demand has the same basic structure as downstream demand. Specifically, we assume that the utility retailer r receives from contracting with private label manufacturer m is given by $\gamma_m - \sigma \cdot w_m + e_{rm}$, where $\gamma_m$ is a constant that can roughly be interpreted as the average retailer's evaluation of contracting with manufacturer m, $w_m$ is manufacturer m's wholesale price, $\sigma$ captures retailers' price sensitivity, and $e_{rm}$ captures

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[28] *See, e.g.*, Kenneth E. Train, *Discrete Choice Methods with Simulation*, Cambridge University Press (2009).

[29] Gregory J. Werden & Luke M. Froeb, *The Effects of Mergers in Differentiated Products Industries: Logit Demand and Merger Policy*, 10 JL ECON. & ORG. 407 (1994). Luke M. Froeb, Russell W. Pittman, Charles S. Taragin, Steven Tschantz & Gregory J. Werden, *Economics at the Antitrust Division: 2017–2018*, 53 REVIEW OF INDUSTRIAL ORGANIZATION 637.

retailer r's idiosyncratic preference for contracting with manufacturer m. In this setup, the retailer's utility from each private label manufacturer can be interpreted as the retailer's total evaluation of the manufacturer's proposal, capturing both the wholesale price as well as other non-price components such as the packaging. As with downstream demand, we assume that retailers' idiosyncratic preferences are distributed such that upstream demand is simple logit with substitution between manufacturers that is proportional to shares.

c. Private Label Supply

We assume that private label manufacturers simultaneously choose binding wholesale prices to maximize their expected profits. A manufacturer's expected profit for a given wholesale price is equal to the probability that the retailer selects the manufacturer times the quantity sold conditional on being selected times the dollar margin for each unit sold.[30] The quantity sold by the private label once on the retail shelf depends in part on the private label's retail price, which we assume is linked to the wholesale price by the equation retail price $= \lambda_0 + \lambda_1 \cdot$ wholesale price, where $\lambda_0$ and $\lambda_1$ are parameters that govern how private label wholesale prices affect private label retail prices. For example, $\lambda_1 = 1$ corresponds to the case where wholesale price changes are passed through to retail prices dollar-for-dollar. This linear specification of retail price determination is intended to approximately reflect retailers' profit-maximizing responses to wholesale price changes, without requiring an explicit model of retailer pricing (see Part III.B for a discussion of alternative approaches).

In equilibrium, each manufacturer's wholesale price optimizes that manufacturer's expected profits, given the wholesale prices of their rivals. After the merger of two rival manufacturers, the merging manufacturers

[30] Given the simple logit demand assumptions, the expected profit of manufacturer m is given by:

$$\underbrace{\frac{\exp(\gamma_m - \sigma \cdot w_m)}{1 + \sum_\ell \exp(\gamma_\ell - \sigma \cdot w_\ell)}}_{\substack{\text{probability of being}\\ \text{chosen by the retailer}}} \cdot \underbrace{\frac{\exp(\alpha_{PL} - \beta \cdot p_{PL})}{1 + \sum_k \exp(\alpha_k - \beta \cdot p_k)}}_{\substack{\text{quantity sold at retail}\\ \text{conditional on being chosen}}} \cdot \underbrace{(w_m - c_m)}_{\substack{\text{dollar}\\ \text{margin}}} .$$

As explained in the text, the private label retail price $p_{PL}$ is a linear function of the wholesale price, $p_{PL} = \lambda_0 + \lambda_1 \cdot w_m$. As is standard, we include an "outside option" in both upstream and downstream demand. Upstream, the outside option represents the retailer's option to forgo a private label or contract with an un-modeled supplier. Downstream, the outside option represents substitution away from canned soup to other products.

internalize the effect of their wholesale prices on each other's profits.[31]

3. Model Calibration

The parameters of the model can be calibrated to match observed data on (or estimates of) upstream and downstream shares, prices, and a variety of elasticities and/or margins.[32] Below, we discuss and report quantitative estimates of two of the most important pieces in determining the extent to which upstream prices are constrained by downstream competition: (i) the pass-through from wholesale to retail prices and (ii) the downstream demand elasticity. As illustrated by the upward pricing pressure analysis in Part II.A, these two pieces govern the extent to which increases in wholesale prices upstream translate into quantity losses downstream. In both cases, our quantitative estimates are intended to reflect the types of estimates that can be quickly obtained during a merger investigation. The econometric methodology can be further refined as time permits.

a. Pass-Through from Wholesale to Retail Prices

If sufficiently detailed data are available, the pass-through from wholesale prices to retail prices can be estimated for the specific industry in question. Alternatively, estimates can be taken from the economics literature. In the empirical literature, for example, Besanko et al. (2005) estimate pass-through rates for grocery goods by category, finding average rates that generally exceed 0.6.[33] Economic theory also sheds light on plausible pass-

[31] For additional detail on implementing this internalization within the model, *see, e.g.*, Aviv Nevo, *Mergers with Differentiated Products: The Case of the Ready-to-Eat Cereal Industry*, 31 RAND JOURNAL OF ECONOMICS 395 (2000).

[32] Let L be the number of private label manufacturers and J be the number of retail products. There are 2L+J+4 parameters to calibrate: L manufacturer-specific constants $\gamma_m$, L marginal costs $c_m$, 1 upstream price sensitivity parameter $\sigma$, J product-specific constants $\alpha_j$, 1 downstream price sensitivity parameter $\beta$, and 2 pass-through parameters $\lambda_0$ and $\lambda_1$. The 2L+J+4 equations/data points we use to calibrate these parameters are L-1 upstream shares, the upstream aggregate elasticity, L manufacturer pricing first-order conditions, one upstream margin, J-1 downstream shares, the downstream aggregate elasticity, one downstream demand elasticity, an estimate of the pass-through rate, and one private label retail price/wholesale price pair. We assume that both aggregate elasticities, which determine the size of the upstream and downstream outside options, are equal to -0.1. For further information on calibrating similar models, *see, e.g.*, Gregory J. Werden & Luke M. Froeb, *The Effects of Mergers in Differentiated Products Industries: Logit Demand and Merger Policy*, 10 JL ECON. & ORG. 407 (1994).

[33] David Besanko, Jean-Pierre Dubé & Sachin Gupta, *Own-Brand and Cross-Brand Retail Pass-Through*, 24 MARKETING SCIENCE 123 (2005).

through rates. For instance, for a retailer facing a linear demand curve, the pass-through rate from wholesale prices to retail prices is 1/2; alternatively, if the demand curve has constant elasticity E, the pass-through rate is E/(E–1).[34]

Table 2 reports pass-through estimates for canned soup from the Dominick's data. The dependent variable in the regressions is the retail price and the independent variable is the wholesale price. The first column is a simple linear regression; the remaining columns of the table add a variety of fixed effects to control the variation used to estimate the pass-through rate. The pass-through estimates range from roughly 0.6 to 1.2.[35] We show how the predictions of the model depend on the assumed pass-through rate in Part II.B.4 below.

TABLE 2: PASS-THROUGH ESTIMATES

| | Dependent Variable: Retail Price | | | |
|---|---|---|---|---|
| | (1) | (2) | (3) | (4) |
| Wholesale Price | 1.172*** | 1.186*** | 1.185*** | 0.641*** |
| | (0.036) | (0.036) | (0.036) | (0.102) |
| Week Fixed Effects | No | Yes | Yes | Yes |
| Store Fixed Effects | No | No | Yes | Yes |
| UPC Fixed Effects | No | No | No | Yes |
| Observations | 417,300 | 417,300 | 417,300 | 417,300 |

Notes: Standard errors are clustered by UPC. *** p<0.01, ** p<0.05, * p<0.10.

b. Retail Demand Elasticities

As with pass-through, if sufficiently detailed data are available, the elasticity of retail demand can be estimated for the specific industry in question. Alternatively, estimates can be taken from the economics literature or calibrated based on retail margins.[36] For example, Nevo (2001) estimates

[34] *See, e.g.*, Timothy Van Zandt, *Firms, Prices and Markets*, 2012, p. 135-136. For a comprehensive analysis of pass-through rates in economic modeling, see Michal Fabinger and Glen Weyl, *Pass-Through and Demand Forms*, Working Paper (2012).

[35] Restricting the data only to private label products yields similar estimates ranging from 0.5 to 1.1.

[36] The well-known Lerner condition indicates that the (absolute value of the) demand elasticity is equal to one divided by the margin. However, this condition applies only to single-product firms, whereas retailers sell a multitude of products. For a multi-product firm selling N different products, the general formula that relates the own-price elasticity of a single product, product 1, to that product's margin is: $E_1 = \frac{-1}{M_1 - \sum_{i=2}^{N} D_{1i} \cdot M_i \cdot \frac{p_i}{p_1}}$, where $E_1$ is the

own-price elasticities of around 3.3 in the ready-to-eat cereal industry.[37] Butters et al. (2019) estimate canned soup elasticities between 2.2 and 2.9.[38] Other studies have estimated own-price elasticities for a variety of consumer goods, generally finding elasticities in excess of 2.[39]

Table 3 reports own-price elasticity estimates for canned soup from the Dominick's data. The dependent variable in the regressions is the (natural logarithm of the) quantity sold and the independent variable is the (natural logarithm of the) retail price. A well-known concern with demand regressions of this form is that prices are endogenous: i.e., prices are correlated with unobserved factors determining demand. For example, a retailer expecting weak demand (beyond what demand shifters represented in the data indicate) may decrease the price, and therefore the observed quantity response will conflate consumers' responses to the price change—the true object of interest—and the weakened overall demand. Columns (3) and (4) of the table adopt two typical approaches in the literature to deal with this issue: instrumenting for retail prices with wholesale prices (column (3)) or with average retail prices at surrounding stores (column (4)).[40] Of course, these

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own-price elasticity of product 1, $M_1$ is the margin of product 1, $D_{1i}$ is the diversion ratio from product 1 to another product i owned by the firm, $M_i$ is the margin of product i, and $\frac{p_i}{p_1}$ is the price ratio of product i to product 1. When the firm's products are substitutes ($D_{1i} > 0$), the unadjusted Lerner condition understates product 1's own-price elasticity.

[37] Aviv Nevo, *Measuring Market Power in the Ready-to-Eat Cereal Industry*, 69 ECONOMETRICA 307 (2001).

[38] Andrew Butters, Daniel Sacks & Boyoung Seo, *Why Don't Retail Prices Vary Seasonally with Demand?*, Working Paper (2019).

[39] For example, Dhar et al. (2003) find elasticities for soda ranging between 2.9 and 9.8; Chintagunta and Dube (2005) find elasticities for dryer sheets ranging between 2.9 and 8.5; Chintagunta et al. (2005) find elasticities for margarine ranging between 2.0 and 8.0; Villas-Boas finds elasticities for yogurt ranging between 5.5 and 6.7; Miller and Weinberg (2017) find elasticities for beer ranging between 3.5 and 5.9. Tirtha Dhar, Jean-Paul Chavas & Brian W. Gould, *An Empirical Assessment of Endogeneity Issues in Demand Analysis for Differentiated Products*, 85 AMER. J. AGR. ECON. 605 (2003); Pradeep K. Chintagunta & Jean-Pierre Dubé, *Estimating a Stockkeeping-Unit-Level Brand Choice Model That Combines Household Panel Data and Store Data*, 42 JOURNAL OF MARKETING RESEARCH 368 (2005); Pradeep Chintagunta, Jean-Pierre Dubé & Khim Yong Goh, *Beyond the Endogeneity Bias: The Effect of Unmeasured Brand Characteristics on Household-Level Brand Choice Models*, 51 MANAGEMENT SCIENCE 832 (2005); Sofia Berto Villas-Boas, *Vertical Relationships Between Manufacturers and Retailers: Inference with Limited Data*, 74 REVIEW OF ECONOMIC STUDIES 625 (2007); Nathan H. Miller & Matthew C. Weinberg, *Understanding the Price Effects of the MillerCoors Joint Venture*, 85 ECONOMETRICA 1763 (2017).

[40] For a discussion of instrumental variables in demand estimation applications, *see, e.g.*, Aviv Nevo, *Measuring Market Power in the Ready-to-Eat Cereal Industry*, 69

approaches themselves rely on assumptions; the goal here is merely to obtain a ballpark estimate of the retail own-price elasticity. The estimates range between roughly 2.5 and 3.6, which is broadly consistent with the estimates from the economic literature.[41] We show how the predictions of the model depend on the assumed retail own-price elasticity in Part II.B.4 below.

TABLE 3: RETAIL DEMAND ELASTICITY ESTIMATES

| | Dependent Variable: log(Quantity) | | | |
|---|---|---|---|---|
| | (1) | (2) | (3) | (4) |
| log(Retail Price) | -2.492*** | -2.971*** | -3.624*** | -3.220*** |
| | (0.108) | (0.107) | (0.157) | (0.118) |
| Week Fixed Effects | No | Yes | Yes | Yes |
| Store Fixed Effects | No | Yes | Yes | Yes |
| UPC Fixed Effects | Yes | Yes | Yes | Yes |
| Instruments | None | None | Wholesale Prices | Prices at Other Stores |
| Observations | 417,300 | 417,300 | 417,300 | 417,300 |

Notes: Quantity is measured in ounces sold and prices are per 10.75 ounces. Standard errors are clustered by UPC. *** p<0.01, ** p<0.05, * p<0.10.

### 4. Simulation Results

Recall that although we do not have data on private label canned soup market structure, for illustration we assume that there are three private label manufacturers each with a one-third share and 20 percent margins. The results below are for a merger of two of these manufacturers, reducing the number of private label manufacturers to two and consolidating two-thirds of private label sales under one company.

We begin by reporting the merger-specific marginal cost efficiencies—measured as a percentage of pre-merger marginal costs and applied to both merging firms—such that the merger has no effect on prices. To illustrate the relevance of downstream competition, Figure 1 reports these cost efficiencies varying (i) the pass-through rate from private label wholesale prices to retail prices and (ii) the private label retail own-price elasticity.

ECONOMETRICA 307 (2001).

[41] Restricting the data only to private label products yields similar estimates ranging from 2.6 to 3.4.

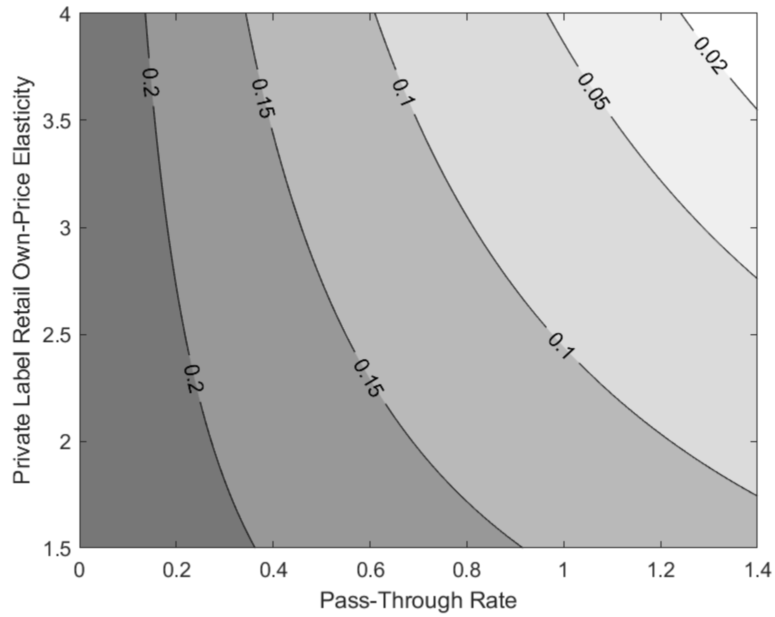


FIGURE 1: COST EFFICIENCIES NECESSARY FOR ZERO PRICE EFFECTS

Notes: The figure plots the marginal cost efficiencies necessary to yield a zero post-merger change in prices, depending on the pass-through rate and the private label retail own-price elasticity. Darker colors denote larger necessary cost efficiencies. The contour lines in the figure mark thresholds. The darkest color indicates that cost efficiencies larger than 20 percent are needed, the second darkest color indicates that cost efficiencies between 15 and 20 percent are needed, and so on.

For context, if downstream competition is ignored, Werden (1996)'s compensating marginal cost reduction calculations can be applied to estimate that efficiencies of 24.0 percent are needed for the merger to have no effect on prices.[42] In our model, this calculation is correct for the case where the pass-through rate is zero (or where retail demand is perfectly inelastic), because in that case changes in wholesale prices have no impact on private label retail sales downstream. Otherwise, if the pass-through rate is positive and retail demand is not perfectly inelastic, the cost efficiencies required are strictly less. For example, our smallest estimates of pass-through and the demand elasticity from Part II.B.3 above indicate a pass-through rate of about 0.6 and a retail own-price elasticity of about 2.5. For these values, the necessary cost efficiencies are 14.3 percent. Our largest estimates indicate a

[42] Margins are 20 percent and the diversion ratio between two manufacturers is 49 percent (not 50 percent because of the outside option). Applying equation (6) of Werden (1996) yields (0.2/0.8)*(0.49/0.51) = 24.0 percent. Gregory J. Werden, *A Robust Test for Consumer Welfare Enhancing Mergers Among Sellers of Differentiated Products*, 44 JOURNAL OF INDUSTRIAL ECONOMICS 409 (1996).

pass-through rate of about 1.2 and a retail own-price elasticity of about 3.6. For these values, the necessary cost efficiencies are only 3.7 percent: i.e., 85 percent less than in a model that ignores downstream competition.

TABLE 4: POST-MERGER (WHOLESALE) PRICE EFFECTS

***Panel A: Industry Price Effects without Cost Efficiencies***

| Retail Own-Price Elasticity | Pass-Through Rate 0 | 0.6 | 1.2 |
|---|---|---|---|
| 2 | 7.6% | 6.1% | 4.5% |
| 2.5 | 7.6% | 5.7% | 3.6% |
| 3 | 7.6% | 5.3% | 2.8% |
| 3.5 | 7.6% | 4.9% | 2.0% |
| 4 | 7.6% | 4.5% | 1.2% |

***Panel B: Industry Price Effects with 10% Cost Efficiencies***

| Retail Own-Price Elasticity | Pass-Through Rate 0 | 0.6 | 1.2 |
|---|---|---|---|
| 2 | 4.1% | 2.2% | 0.1% |
| 2.5 | 4.1% | 1.7% | -1.0% |
| 3 | 4.1% | 1.1% | -2.0% |
| 3.5 | 4.1% | 0.6% | -3.0% |
| 4 | 4.1% | 0.1% | -3.8% |

Notes: The industry price is defined as the average wholesale price across manufacturers.

Table 4 above reports post-merger price effects, again varying the pass-through rate from private label wholesale prices to retail prices and the private label retail own-price elasticity. Panel A presents price effects without any marginal cost efficiencies and Panel B presents price effects with 10 percent marginal cost efficiencies applied to both merging firms.[43] The results underscore the importance of modeling the effect of downstream competition on the ability of the merged firm to increase prices. For example, consider the case with a pass-through rate of 1.2 and a retail own-price elasticity of 3.5. Without efficiencies, the merger increases wholesale prices by only 2.0 percent. With efficiencies, the merger is procompetitive, yielding a 3.0 percent price *decrease*. Ignoring downstream competition, the model would

[43] We choose 10 percent as a possible "default" efficiency credit following the discussion in Werden and Froeb (2011). Gregory J. Werden & Luke M. Froeb, *Choosing Among Tools for Assessing Unilateral Merger Effects*, 7 EUROPEAN COMPETITION JOURNAL 155 (2011).

wrongly predict a 7.6 percent price increase without efficiencies and a 4.1 percent price increase with efficiencies. In short, failing to model the impact of downstream competition on upstream wholesale pricing can easily result in the erroneous conclusion that a procompetitive merger is anticompetitive.

## III. DISCUSSION

### *A. Market Definition*

The preceding analysis in Part II was focused entirely on competitive effects. The merger simulation model outlined above can also be used to inform market definition. Specifically, the model can be used to assess whether a hypothetical monopolist private label manufacturer would be able to impose a SSNIP on retailers, or whether downstream competition at retail would defeat such an attempt.

However, even if a private label-only market passes the hypothetical monopolist test, shares and concentration measures within that market may be misleading with respect to competitive effects. For the example analyzed in Part II (a merger from symmetric triopoly to duopoly), a private-label only market would increase HHI by 2,222 points (from 3,333 to 5,556), far surpassing the thresholds outlined in the Horizontal Merger Guidelines.[44] Yet, as shown in Table 4 above, the merger may generate only modest price increases even without any efficiencies. Similarly, even if a private label-only market does *not* pass the hypothetical monopolist test, shares and concentration measures including branded products may also be misleading with respect to competitive effects. Table 1 above shows that private label accounts for only 5.1 percent of canned soup sales in the Dominick's data. For a market measuring private label manufacturers' shares as a percent of total canned soup sales, the most that a merger between private label manufacturers could possibly increase HHI is 5.1*5.1 = 26 points.[45] A merger between two private label manufacturers each with a one-third share would increase HHI by 2*1.7*1.7 = 6 points. That is, a de minimis increase in HHI even though the merger may generate meaningful upward pricing pressure.

The Horizontal Merger Guidelines state that "The measurement of market shares and market concentration is not an end in itself, but is useful to the

[44] U.S. Department of Justice & The Federal Trade Commission, *Horizontal Merger Guidelines*, issued August 19, 2010, Section 5.3.

[45] 26 points is the change in HHI going from many private label manufacturers, each with an infinitesimal share, to a single private label manufacturer with a 5.1 percent share.

extent it illuminates the merger's likely competitive effects."[46] For the context analyzed in this article, in which private label manufacturers compete at two distinct but interrelated stages, share and HHI calculations may confuse the assessment of competitive effects rather than illuminating it.

### *B. Model Extensions*

The merger simulation model outlined above can be extended in a variety of ways to capture additional potentially relevant economic forces. We discuss several such extensions below.

#### 1. Endogenous Retailer Pricing

The merger simulation model in Part II.B adopts a "reduced form" specification of retailer pricing: the private label retail price is assumed to be a linear function of the private label wholesale price, and changes in the private label wholesale price are assumed to have no impact on the retail prices of other products. These assumptions can be relaxed by adopting an explicit model of retailer pricing. For example, the retailer can be assumed to set retail prices to maximize its profits from sales of all products in the category, including both private label and branded products.[47] This approach allows the retail price of all products in the category to respond to changes in private label wholesale prices. Although conceptually straightforward, this approach is computationally more complex because it requires solving for the retailer's profit-maximizing retail prices in conjunction with the private label manufacturers' profit-maximizing wholesale prices.

#### 2. Bargaining Between Retailers and Manufacturers

In reality, private label manufacturers generally do not set binding wholesale prices at which they are willing to supply retailers. Instead, more often the procurement process is characterized by multiple rounds of negotiation over not only price terms but also other aspects of the product such as the packaging and the shelf space that will be allocated to the product. Rather than assuming that private label manufacturers set binding wholesale prices, wholesale prices can instead be assumed to be the result of bargaining

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[46] U.S. Department of Justice & The Federal Trade Commission, *Horizontal Merger Guidelines*, issued August 19, 2010, Section 4.

[47] *See, e.g.*, David Besanko, Sachin Gupta & Dipak Jain, *Logit Demand Estimation Under Competitive Pricing Behavior: An Equilibrium Framework*, 44 MANAGEMENT SCIENCE 1533 (1998).

between retailers and manufacturers. An assumption of Nash bargaining,[48] for example, arguably better captures the back-and-forth that occurs in business-in-business negotiations, while retaining computational tractability.[49] One particularly appealing feature of the Nash bargaining formulation is that the bargaining power parameter can be thought of as capturing un-modeled options that the retailer has to constrain a private label wholesale price increase, such as re-allocating shelf space away from the private label. Given the prominence of large, powerful retailers such as Walmart, models with bargaining may paint a more complete and accurate picture of competitive realities than the simplified model presented above which assumes that manufacturers unilaterally set prices.

3. Private Label Manufacturers That Also Produce Branded Products

It is not uncommon for branded manufacturers to also produce private label products. The effect of this fact on economic incentives is most easily seen by considering private label versions of the manufacturer's most popular branded products. If the wholesale price of the private label version increases, leading to a subsequent increase in the retail price, some of the resulting substitution away from the private label will be recaptured by the manufacturer's branded product. This recapture weakens the constraint that downstream competition places on upstream wholesale pricing. Incorporating this weakened constraint into the modeling can be achieved by altering the private label manufacturer's profit function to include sales of co-owned branded products. In that case, downstream substitution away from the private label to the co-owned branded products will no longer constitute lost business for the manufacturer.

[48] Nash bargaining originates with John F. Nash Jr., *The Bargaining Problem*, 18 ECONOMETRICA 155 (1950). In recent years, Nash bargaining has found a variety of applications in antitrust analysis, including cross-market mergers, reverse payments in the pharmaceutical industry, and mergers of intermediaries such as health insurers. *See, e.g.*, Gregory S. Vistnes & Yianis Sarafidis, *Cross-Market Hospital Mergers: A Holistic Approach*, 79 ANTITRUST LAW JOURNAL 253 (2013); Soheil Ghili & Matt Schmitt, *A Framework for Estimating Damages in Reverse Payment Cases*, 81 ANTITRUST LAW JOURNAL 873 (2017); David Dranove, Dov Rothman & David Toniatti, *Up or Down? The Price Effects of Mergers of Intermediaries*, 82 ANTITRUST LAW JOURNAL 643 (2019); Mark A. Israel, Thomas A. Stemwedel & Ka Hei Tse, *Are You Pushing Too Hard? Lower Negotiated Input Prices as a Merger Efficiency*, 82 ANTITRUST LAW JOURNAL 623 (2019).

[49] *See, e.g.*, Nathan H. Miller, *Modeling the Effects of Mergers in Procurement*, 37 INTERNATIONAL JOURNAL OF INDUSTRIAL ORGANIZATION 201 (2014).

## IV. Conclusion

Antitrust analysis of private label mergers requires assessing the relative importance of the two stages at which private label manufacturers compete: first with each other to become a retailer's private label supplier, and then second with other products on the retail shelf. Our results in this article, which build on standard analytical techniques for evaluating the competitive effects of horizontal mergers, show that ignoring the two-stage nature of competition may result in erroneous inferences. If downstream competition at the retail level is sufficiently intense, our results indicate that even modest cost efficiencies may be enough to make a merger consolidating a large proportion of private label industry sales procompetitive. The core intuition for this result is that the constraint imposed on private label manufacturers by downstream competition is not directly affected by the merger, and cost efficiencies give the merged entity the incentive to compete aggressively downstream (by offering retailers attractive prices upstream).

Importantly, the methods we develop are only slightly more complex than the methods commonly used in cases where the merging firms sell directly to end consumers, and therefore readily can be applied in investigations of private label mergers. Given its size—one in every four retail products sold and $180 billion in 2019 U.S. retail sales—the private label industry is itself worthy of study.[50] Moreover, variants of the model we present in this article likely can be applied more broadly to mergers between consumer product manufacturers, especially in cases where downstream retailers only carry a subset of upstream manufacturers' products. Even more generally, as private equity firms acquire an ownership interest in multiple levels of industry supply chains,[51] adapting existing economic models to incorporate the multiple stages at which firms compete may become increasingly important.

[50] https://www.plma.com/storeBrands/facts2020.html

[51] *See, e.g.*, https://www.supplychainquarterly.com/articles/1777-what-private-equity-investments-in-transportation-and-logistics-could-mean-for-you, noting that "Globally, PE firms were the acquirers in nearly 50 percent of the merger and acquisition (M&A) deals in transportation and logistics in 2017, up from 40 percent of such deals in 2015."

## V. APPENDIX

### *A. Derivation of the Adjusted Upward Pricing Pressure Condition*

This appendix derives the adjusted upward pricing pressure condition when private label manufacturers compete at two stages: first against each other to get on the retail shelf, and then second against non-private label products once on the shelf. The result is derived by analyzing the first-order conditions for profit maximization in this setting. Assume that manufacturers choose binding wholesale prices $w_m$ for each private label under their control to maximize:

$$\sum_{m \in \mathcal{M}} \mathrm{Pr}_m(\mathbf{w}) \cdot Q_m\big(p(w_m)\big) \cdot (w_m - c_m)\,, \tag{3}$$

where $\mathcal{M}$ is the set of manufacturers under the same ownership, $\mathrm{Pr}_m$ is the probability that the retailer chooses manufacturer m (a function of all wholesale prices $\mathbf{w}$), $Q_m$ is the expected quantity sold by manufacturer m at retail conditional on being chosen by the retailer (a function of the private label retail price $p(w_m)$ which is itself a function of the wholesale price), and $c_m$ is manufacturer m's marginal cost.

For an independent manufacturer, manufacturer 1, the profit maximizing wholesale price satisfies:

$$\left[\frac{\partial \mathrm{Pr}_1}{\partial w_1} \cdot Q_1 + \mathrm{Pr}_1 \cdot \frac{\partial Q_1}{\partial p} \cdot \frac{\partial p}{\partial w_1}\right] \cdot (w_1 - c_1) + \mathrm{Pr}_1 \cdot Q_1 = 0\,. \tag{4}$$

The term in brackets reflects the quantity losses that occur upon a wholesale price increase, some of which occurs upstream (captured by $\frac{\partial \mathrm{Pr}_1}{\partial w_1} \cdot Q_1$) and some of which occurs downstream (captured by $\mathrm{Pr}_1 \cdot \frac{\partial Q_1}{\partial p} \cdot \frac{\partial p}{\partial w_1}$). Besides this slight additional complexity, the first-order condition is identical to the standard case.

Following the merger of manufacturers 1 and 2, with the merger generating cost efficiencies of size θ (measured as a percentage of pre-merger marginal costs), the profit maximizing wholesale price of manufacturer 1 satisfies:

$$\left[\frac{\partial \mathrm{Pr}_1}{\partial w_1} Q_1 + \mathrm{Pr}_1 \frac{\partial Q_1}{\partial p} \frac{\partial p}{\partial w_1}\right](w_1 - (1-\theta)c_1) + \mathrm{Pr}_1 Q_1 + \frac{\partial \mathrm{Pr}_2}{\partial w_1} Q_2 (w_2 - c_2) = 0\,, \tag{5}$$

where all derivatives, etc. are evaluated at post-merger wholesale prices. There is upward pricing pressure arising from the merger if the pre-merger profit maximizing wholesale prices are not large enough to satisfy condition

(5) above. Subtracting (4) from (5), the merger generates upward pricing pressure if:

$$\left[\frac{\partial \mathrm{Pr}_1}{\partial \mathrm{w}_1} \cdot \mathrm{Q}_1 + \mathrm{Pr}_1 \cdot \frac{\partial \mathrm{Q}_1}{\partial \mathrm{p}} \cdot \frac{\partial \mathrm{p}}{\partial \mathrm{w}_1}\right] \cdot \theta \cdot \mathrm{c}_1 + \frac{\partial \mathrm{Pr}_2}{\partial \mathrm{w}_1} \cdot \mathrm{Q}_2 \cdot (\mathrm{w}_2 - \mathrm{c}_2) > 0\,, \qquad (6)$$

where all derivatives, etc. are evaluated at pre-merger wholesale prices. Or, analogously, the merger generates downward pricing pressure if the left-hand-side of condition (6) above is less than zero.

Letting $\mathrm{D}_{12} \equiv \frac{\partial \mathrm{Pr}_2/\partial \mathrm{w}_1}{|\partial \mathrm{Pr}_1/\partial \mathrm{w}_1|}$ denote the upstream diversion ratio from manufacturer 1 to manufacturer 2 and simplifying, the merger generates downward pricing pressure if:

$$\theta > \mathrm{D}_{12} \cdot \frac{\mathrm{M}_2}{1 - \mathrm{M}_1} \cdot \frac{\mathrm{w}_2}{\mathrm{w}_1} \cdot \frac{\mathrm{Q}_2}{\mathrm{Q}_1} \cdot \frac{\varepsilon_{\mathrm{u}1}}{\varepsilon_{\mathrm{u}1} + \varepsilon_{\mathrm{d}1} \cdot \varepsilon_{\mathrm{t}1}}\,, \qquad (7)$$

where $\mathrm{M}$ denotes (pre-merger) margins and the $\varepsilon$ terms are elasticities as defined in the main text of the article. $\varepsilon_{\mathrm{u}1}$ is the "upstream elasticity" $\left|\frac{\partial \mathrm{Pr}_1}{\partial \mathrm{w}_1} \cdot \frac{\mathrm{w}_1}{\mathrm{Pr}_1}\right|$, $\varepsilon_{\mathrm{d}1}$ is the "downstream elasticity" $\left|\frac{\partial \mathrm{Q}_1}{\partial \mathrm{p}} \cdot \frac{\mathrm{p}}{\mathrm{Q}_1}\right|$, and $\varepsilon_{\mathrm{t}1}$ is the "pass-through elasticity" $\frac{\partial \mathrm{p}}{\partial \mathrm{w}_1} \cdot \frac{\mathrm{w}_1}{\mathrm{p}}$. If downstream competition is not present, $\varepsilon_{\mathrm{d}1} \cdot \varepsilon_{\mathrm{t}1} = 0$ and $\mathrm{Q}_1 = \mathrm{Q}_2$, yielding $\theta > \mathrm{D}_{12} \cdot \frac{\mathrm{M}_2}{1-\mathrm{M}_1} \cdot \frac{\mathrm{w}_2}{\mathrm{w}_1}$, which is the condition derived in Farrell and Shapiro (2010).[52] In the symmetric case, the condition reduces to $\theta > \mathrm{D} \cdot \frac{\mathrm{M}}{1-\mathrm{M}} \cdot \frac{\varepsilon_{\mathrm{u}}}{\varepsilon_{\mathrm{u}} + \varepsilon_{\mathrm{d}} \cdot \varepsilon_{\mathrm{t}}}$ as stated in the main text. In the symmetric case, the necessary cost efficiency is guaranteed to be less than when downstream competition is not present as long as demand slopes downward and pass-through is positive. In the asymmetric case, the result also depends on the relative quantities that each merging manufacturer will sell downstream. If these quantities are not too dissimilar and downstream competition is relevant to upstream manufacturers (i.e., $\varepsilon_{\mathrm{d}1} \cdot \varepsilon_{\mathrm{t}1}$ is sufficiently large), the necessary cost efficiencies for both firms will be smaller than when downstream competition is not present.

[52] Joseph Farrell & Carl Shapiro, *Antitrust Evaluation of Horizontal Mergers: An Economic Alternative to Market Definition*, 10 BE JOURNAL OF THEORETICAL ECONOMICS 9 (2010).