THE COMPETITIVE IMPLICATIONS OF PRIVATE LABEL MERGERS

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In 2019, private label products generated an estimated $180 billion in U.S. retail sales.[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, several proposed and consummated mergers between private label manufacturers have raised questions about the proper antitrust evaluation of such mergers. In December 2019, for instance, the Federal Trade Commission filed a 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 distinct, yet interrelated, stages at which private label products compete to make sales. First, private label manufacturers compete to become a retailer's private label product supplier (e.g., via an RFP process). Second, the private label product chosen by the retailer competes against other items on the retail shelf,

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[1] *The Store Brands Story*, Priv. Label Mfrs. Ass'n, www.plma.com/storeBrands/facts2020.html (last visited Jan. 22, 2021).

[2] Karsten Hansen, Vishal Singh & Pradeep Chintagunta, *Understanding Store-Brand Purchase Behavior Across Categories*, 25 Mktg. Sci. 75, 76 (2006).

[3] Press Release, Fed. Trade Comm'n, FTC Alleges Post Holdings, Inc.'s Proposed Acquisition of TreeHouse Foods, Inc.'s Private Label Ready-to-Eat Cereal Business Will Harm Competition (Dec. 19, 2019), 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.

in particular, against branded products that private labels often seek to emulate. When negotiating wholesale prices with retailers, private label manufacturers must consider both stages of competition: A higher wholesale price may lead the retailer to choose a different private label supplier in the first stage. Because wholesale prices are an input cost to retailers—and therefore generally affect retail prices—a higher wholesale price may also lead to a higher retail price and thus fewer private label sales in the second stage. 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 the competitive constraints imposed by both (1) upstream competition between private label manufacturers to become a retailer's private label supplier, and (2) 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. The central result of our analysis is that considering both stages 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 in which 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

Courts and antitrust enforcers assessing mergers involving branded consumer products have often acknowledged competition between branded and private label products; generally, they have done so when evaluating the competitive constraint that private label products impose on their branded counterparts. In several cases, courts and enforcers have included private label products in the relevant market for purposes of analyzing the competitive effects of a branded merger. For example:

- In evaluating the Kraft/Nabisco Cereals merger, the court determined that "[p]rivate 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 the entire RTE industry."[4]

- In challenging the General Mills/Ralcorp transaction, the FTC alleged that the relevant line of commerce included 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, courts and enforcers have excluded private labels from relevant markets for branded products. For example:

- In evaluating 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 challenging the proposed merger of Nestlé and Dreyer's, the FTC alleged that the relevant product market was "superpremium ice cream products," which excluded private label products.[8]
- In its evaluation of McCormick's proposed acquisition of Unilever's Lawry's and Adolph's spice blends, the FTC excluded private label seasoned salts from the relevant market.[9]
- In challenging the proposed acquisition of Conagra's Wesson cooking oil brand by J.M. Smucker (the owner of Crisco), the FTC alleged that branded canola and vegetable oils was a relevant product market and

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[4] New York v. Kraft Gen. Foods, Inc., 926 F. Supp. 321, 347, 360 (S.D.N.Y. 1995). A more contentious point in this case was whether the relevant product market could be limited to "adult" cereals.

[5] Complaint, Gen. Mills, Inc., 123 F.T.C. 1323, 1325 (1997).

[6] Kirk Victor, *Mixed Signals? Dissecting FTC's Decision To Clear Energizer-Spectrum Deal*, FTCWATCH (Apr. 24, 2018) ("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.") (internal quotation marks omitted).

[7] FTC v. Coca-Cola Co., 641 F. Supp. 1128, 1133–34 (D.D.C. 1986), *vacated*, 829 F.2d 191 (D.C. Cir. 1987). 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] Complaint, Nestlé Holdings, Inc., 136 F.T.C. 791, 794 (2003).

[9] Complaint, McCormick & Co., 146 F.T.C. 199, 202 (2008) ("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 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.").

> that "competition from private label [canola and vegetable] oils would not replace the competition eliminated by the [a]cquisition."[10]

As the above examples illustrate, analyses of competition between brands and private labels have focused on 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 constraint—the constraint that competition with branded products downstream imposes on pricing by private label manufacturers upstream. This is the perspective required to assess the competitive implications of mergers between private label manufacturers.

Because retailers seeking a private label supplier may not be able to substitute to a branded manufacturer (except via reallocation of shelf space), it may be tempting to evaluate upstream competition between private label manufacturers separately from downstream competition between private labels and other products on the retail shelf.[11] We show, however, that competition between branded and private label products is a two-way street—strong competition from national brands downstream can significantly limit the anticompetitive potential of upstream mergers between private label manufacturers. 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]

II. ECONOMIC ANALYSIS

A. UPWARD PRICING PRESSURE

On one hand, mergers between competitors 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 quantify the net effect of these countervailing forces on the pricing

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[10] Complaint, J.M. Smucker Co., 165 F.T.C. 376, 401 (2018).

[11] In *FTC v. H.J. Heinz Co.*, for example, the FTC claimed that wholesale competition between Heinz and Beech-Nut should be analyzed independently of retail competition, but the court rejected that argument, stating that "the wholesale market cannot be separated out for analysis without regard to the merger's effect on other levels of competition." 246 F.3d 708, 719 n.17 (D.C. Cir. 2001).

[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 of a private label on a retailer's "buyer power" vis à vis branded manufacturers. For additional discussion, see, e.g., Chris Doyle & Richard Murgatroyd, *The Role of Private Labels in Antitrust*, 7 J. COMPETITION L. & ECON. 631 (2011); Hila Nevo & Roger Van den Bergh, *Private Labels: Challenges for Competition Law and Economics*, 40 WORLD COMPETITION 271 (2017).

incentives of the merged firm. For example, Joseph Farrell and Carl Shapiro show that, 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:

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

where θ is the post-merger marginal cost reduction, D is the diversion ratio between the merging firms' products, and M is the firms' pre-merger percentage margin.[14] For example, if the diversion ratio is 30 percent and margins are 20 percent, cost efficiencies must exceed 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 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 that the retailer charges will generally depend on the wholesale prices that manufacturers set. When choosing a wholesale price, a private label manufacturer must therefore think about both (i) the likelihood that it will be 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 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]

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[13] For ease of exposition, we focus on the case of symmetric firms. Similar results apply to the asymmetric case; we provide that analysis in the Appendix.

[14] Joseph Farrell & Carl Shapiro, *Antitrust Evaluation of Horizontal Mergers: An Economic Alternative to Market Definition*, B.E. J. THEORETICAL ECON.: POLICIES & PERSP., Vol. 10, No. 1, Art. 9, 12 (2010), faculty.haas.berkeley.edu/shapiro/alternative.pdf.

[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).

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

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

- ε_u is the "upstream elasticity": the (absolute value of the) percent change in the likelihood that the retailer selects the manufacturer given a 1 percent increase in the manufacturer's proposed wholesale price;
- ε_d is the "downstream elasticity": the (absolute value of the) percent change in the quantity sold at retail given a 1 percent increase in the retail price of the private label product; and
- ε_t is the "pass-through elasticity": the percent change in the retail price of the private label product given a 1 percent increase in the wholesale price.

Note that the right-hand-side of condition (2) is the same as in condition (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 of 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 ε_u is 1 (in absolute value), the downstream elasticity ε_d is 4 (in absolute value), and the pass-through elasticity ε_d is 1. If the diversion ratio is 30 percent and margins are 20 percent as in the prior numerical example, cost efficiencies must exceed 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 against other competing products once on the retail shelf. A merger between private label manufacturers reduces competi-

[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.

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

tion 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 ε_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.

The competitive dynamics described above are most salient when either pass-through, the downstream elasticity, or both are large relative to the upstream elasticity. For example, the above modeling considerations likely would be particularly important in industries where sellers provide end consumers access to many products (but not both merging firms' products), allowing those products to compete for consumers' business directly. By contrast, they might not be as relevant in industries where there is intense upstream competition for limited or exclusive access to customers downstream.

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. Without further modeling, however, 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 con-

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[18] A higher wholesale price set by 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 the quantity that the other merging manufacturer will sell at retail if chosen by the retailer.

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

[20] *See, e.g.*, Carl Shapiro, *The 2010 Horizontal Merger Guidelines: From Hedgehog to Fox in Forty Years*, 77 ANTITRUST L.J. 49, 77–78 (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.").

crete, the specific application is to canned soup, although the methods we employ are much more general. The specific inputs to the model—which include branded and private label retail shares, consumer demand elasticities, and private label manufacturer concentration—will vary from industry to industry, as will the model's predictions. Given 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 chose 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. 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 state that its products compete with 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 come from the now-defunct grocery chain Dominick's. The Dominick's dataset, which is publicly available through the Uni-

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[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—in the sense that higher retail prices will still decrease quantity sold—but the extent of direct competition with other same-category products is more limited.

[22] Campbell Soup Co., Annual Report (Form 10-K) 5 (Sept. 26, 2019), investor.campbellsoup company.com/static-files/13276cc4-0d6a-466a-8da2-82ac2dab7008 ("We operate in a highly competitive industry and experience competition in all of our categories. This competition arises from numerous competitors . . . [including] producers of private label products . . ."); *id.* at 6 ("[A] continued shift towards private label offerings, could result in us reducing prices . . . .").

[23] The economics literature has also begun to explore how the existence of multiple levels of competition within a supply chain affects market outcomes. For example, Kate Ho and Robin Lee 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). Gloria Sheu and Charles Taragin 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 the retailer chooses a single private label supplier, whereas in Sheu and Taragin's model the retailer contracts with all suppliers. Gloria Sheu & Charles Taragin, *Simulating Mergers in a Vertical Supply Chain with Bargaining*, (Oct. 2020) (working paper), www.researchgate.net/publication/330564874_Simu lating_Mergers_in_a_Vertical_Supply_Chain_with_Bargaining.

versity of Chicago,[24] is retail scanner data that track sales by universal product code (UPC) over time at Dominick's stores in the Chicago area. Similar data with national coverage are often available in merger investigations. The data we use date from 1996 and may not reflect current competitive conditions, but they help make our analysis concrete. Table 1 summarizes average canned soup retail prices, wholesale prices, and quantity shares by manufacturer.[25] Nearly 90 percent of soup sold by Dominick's in 1996 was Campbell's brand soup. The lowest-priced products were 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" aggregates multiple smaller brands for analytical convenience.

The Dominick's data provide 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

[24] *Dominick's Dataset*, UNIV. OF CHI. BOOTH SCH. OF BUS., www.chicagobooth.edu/research/kilts/datasets/dominicks (last visited Jan. 22, 2021). We impose a variety of sample restrictions to arrive at the final sample of products included in 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.

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

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.[26] 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 bargaining between retailers and manufacturers. We discuss this and other extensions later in Part III.B. 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 α_j is a constant that can be roughly interpreted as the average consumer's valuation of product j, p_j is the retail price of product j, β captures consumers' price sensitivity, and ϵ_{ij} captures consumer i's idiosyncratic preference for product j. The distribution of the ϵ_{ij} terms in the population determines purchase shares and the nature of substitution between products. We adopt perhaps the simplest model, sometimes referred to as the "simple logit"

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[26] Given that positive wholesale and retail margins on private label products create distortions away from jointly optimal pricing—i.e., double-marginalization—one might expect retailers and manufacturers to negotiate nonlinear prices—e.g., a contract that lowers wholesale margins in exchange for lump-sum payments from the retailer to the manufacturer. However, we are not aware of such contract structures being common in grocery retail. This may indicate that retailers depend on manufacturer effort to increase sales at the margin, e.g., through marketing effort or timely and reliable delivery of product.

[27] For example, between 2001 and 2005, Ralcorp Holdings' gross margin ranged between 19.2% and 20.6%. Ralcorp Holdings, Inc., Annual Report (Form 10-K) 16 (Dec. 14, 2005), www.sec.gov/Archives/edgar/data/1029506/000106880005000762/ral10k.htm (gross profit divided by net sales).

model,[28] which assumes that substitution between products is proportional to shares.[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 suppliers. 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 that retailer r receives from contracting with private label manufacturer m is given by $\gamma_m - \sigma \cdot w_m + e_{rm}$, where γ_m is a constant that can be roughly interpreted as the average retailer's valuation of contracting with manufacturer m, w_m is manufacturer m's wholesale price, σ captures retailers' price sensitivity, and e_{rm} captures 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 valuation of the manufacturer's proposal, capturing both the wholesale price and non-price components, such as 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 product of the probability that the retailer selects the manufacturer, the quantity the manufacturer sells conditional on its selection, and the dollar margin for each unit sold.[30] The quantity of the private label sold once it is on the retail shelf depends in part on the private label's retail price, which we assume is linked to

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[28] *See, e.g.*, KENNETH E. TRAIN, DISCRETE CHOICE METHODS WITH SIMULATION 45–50 (2d ed. 2009).

[29] Gregory J. Werden and Luke M. Froeb analyze the simple logit model in *The Effects of Mergers in Differentiated Products Industries: Logit Demand and Merger Policy*, 10 J.L. ECON. & ORG. 407 (1994). The simple logit model is also one of the main models available as part of the Antitrust R Package developed by DOJ economists Charles Taragin and Michael Sandfort, described in Luke M. Froeb et al., *Economics at the Antitrust Division: 2017–2018*, 53 REV. INDUS. ORG. 637, 639–42 (2018).

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

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

the wholesale price by the equation retail price = $\lambda_0 + \lambda_1 \cdot$ wholesale price, where λ_0 and λ_1 are parameters that describe how private label wholesale prices affect private label retail prices. For example, $\lambda_1 = 1$ corresponds to the case in which wholesale price changes are passed through to retail prices dollar-for-dollar. This linear specification of retail-price determination is intended to approximate retailers' profit-maximizing responses to wholesale price changes, without requiring an explicit model of retailer pricing (see Part III.B, below, for a discussion of alternative approaches).

In equilibrium, each manufacturer's wholesale price optimizes that manufacturer's expected profits, given the wholesale prices of its rivals. After the merger of two rival manufacturers, the merging manufacturers 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 factors determining the extent to which downstream competition constrains upstream prices: (1) the pass-through from wholesale to retail prices, and (2) the downstream demand elasticity. As illustrated by the upward pricing pressure analysis in Part II.A, these two factors determine 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.

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 unmodeled supplier. Downstream, the outside option represents substitution away from canned soup to other products.

[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 J. ECON. 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 γ_m, L marginal costs c_m, one upstream price sensitivity parameter σ, J product-specific constants α_j, one downstream price sensitivity parameter β, and 2 pass-through parameters λ_0 and λ_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 Werden & Froeb, *supra* note 29.

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, David Besanko, Jean-Pierre Dubé, and Sachin Gupta 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-through rates. For instance, for a retailer facing a linear demand curve, the pass-through rate from wholesale prices to retail prices is one-half; 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.

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

[34] *See, e.g.*, TIMOTHY VAN ZANDT, FIRMS, PRICES, AND MARKETS 135–36 (2012). For a comprehensive analysis of pass-through rates in economic modeling, see Michal Fabinger & E. Glen Weyl, Pass-Through and Demand Forms (Dec. 2012) (unpublished manuscript), www.aeaweb.org/conference/2013/retrieve.php?pdfid=473.

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

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, Aviv Nevo estimates own-price elasticities of around 3.3 in the RTE cereal industry.[37] Other studies have estimated own-price elasticities for a variety of consumer goods, generally finding elasticities in excess of 2.[38]

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; in other words, 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 standard approaches to deal with this issue: instrumenting for retail prices with wholesale prices (column (3)) or with average retail prices at sur-

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[36] The well-known Lerner condition indicates that the (absolute value of the) demand elasticity is equal to one divided by the margin. This condition applies, however, 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 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, 325 (2001).

[38] *See, e.g.*, Tirtha Dhar, Jean-Paul Chavas & Brian W. Gould, *An Empirical Assessment of Endogeneity Issues in Demand Analysis for Differentiated Products*, 85 AM. J. AGRIC. ECON. 605, 615 (2003) (finding elasticities for soda ranging between 2.9 and 9.8); Pradeep K. Chintagunta & Jean-Pierre Dubé, *Estimating a Stockkeeping-Unit-Level Brand Choice Model That Combines Household Panel Data and Store Data*, 42 J. MKTG. RSCH. 368, 376 (2005) (finding elasticities for dryer sheets ranging between 2.9 and 8.5); 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 MGMT. SCI. 832, 844 (2005) (finding elasticities for margarine ranging between 2.0 and 8.0); Sofia Berto Villas-Boas, *Vertical Relationships Between Manufacturers and Retailers: Inference with Limited Data*, 74 REV. ECON. STUD. 625, 643 (2007) (finding elasticities for yogurt ranging between 5.5 and 6.7); Nathan H. Miller & Matthew C. Weinberg, *Understanding the Price Effects of the MillerCoors Joint Venture*, 85 ECONOMETRICA 1763, 1778 (2017) (finding elasticities for beer ranging between 3.5 and 5.9).

rounding stores (column (4)).[39] Of course, these 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 estimates from the economic literature.[40] 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. * $p < 0.01$.

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—sufficient to offset upward pricing pressure created by the merger. To illustrate the relevance of downstream competition, Figure 1 reports these cost efficiencies for various levels of (i) the pass-through rate from private label wholesale prices to retail prices and (ii) the private label retail own-price elasticity.

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[39] For a discussion of instrumental variables in demand estimation applications, see, e.g., Nevo, *supra* note 37.

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

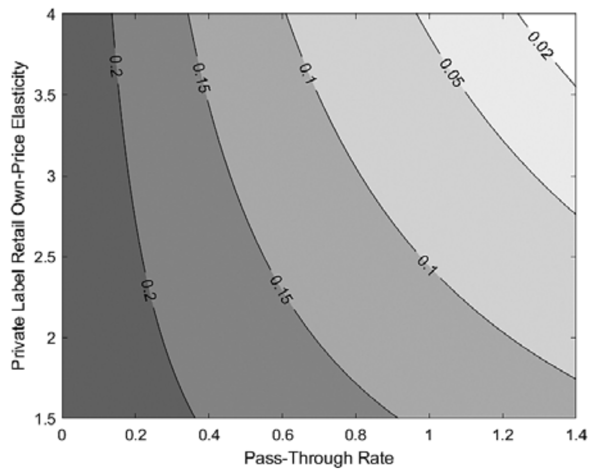

FIGURE 1:
COST EFFICIENCIES NECESSARY FOR ZERO PRICE EFFECTS

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, compensating marginal cost reduction calculations developed by Gregory Werden can be applied to estimate that efficiencies of 24.0 percent are needed for the merger to have no effect on prices.[41] 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 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, 85 percent less than in a model that ignores downstream competition.

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[41] Margins are 20%, and the diversion ratio between two manufacturers is 49% (not 50%) because of the outside option. Applying the formula developed by Werden yields $(0.2/(1-0.2)) \cdot (0.49/(1-0.49)) = 24.0\%$. Gregory J. Werden, *A Robust Test for Consumer Welfare Enhancing Mergers Among Sellers of Differentiated Products*, 44 J. INDUS. ECON. 409, 411 (1996).

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.[42] 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 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 compe-

[42] We chose 10% as a possible "default" efficiency credit following the discussion in Gregory J. Werden & Luke M. Froeb, *Choosing Among Tools for Assessing Unilateral Merger Effects*, 7 EUR. COMPETITION J. 155 (2011).

tition on upstream wholesale pricing can easily result in the erroneous conclusion that a procompetitive merger is anticompetitive.

III. DISCUSSION

A. Market Definition

The 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 small but significant and non-transitory increase in price (SSNIP) on retailers, or whether downstream competition at retail would defeat such an attempt.

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), in a private label-only market the merger would increase the Herfindahl-Hirschman Index (HHI) by 2,222 points (from 3,333 to 5,556), far surpassing the thresholds outlined in the Horizontal Merger Guidelines.[43] Yet, as shown in Table 4, the merger may generate only modest price increases even without any efficiencies.

Similarly, if a private label-only market does not pass the hypothetical monopolist test, shares and concentration measures that include branded products may be misleading with respect to competitive effects. Table 1, above, shows that private label products account for only 5.1 percent of canned soup sales in the Dominick's data. For a market in which private label manufacturers' shares are measured as a percent of total canned soup sales, the most that a merger between private label manufacturers could possibly increase HHI is $5.1 \times 5.1 = 26$ points.[44] A merger between two private label manufacturers, each with a one-third share, would increase HHI by $2 \times 1.7 \times 1.7 = 6$ points. That is, the merger may result in a de minimis increase in HHI even though it may generate meaningful upward pricing pressure.

The Horizontal Merger Guidelines state, "The measurement of market shares and market concentration is not an end in itself, but is useful to the extent it illuminates the merger's likely competitive effects."[45] For the context analyzed in this article, in which private label manufacturers compete at two

[43] U.S. Dep't of Justice & Fed. Trade Comm'n, Horizontal Merger Guidelines § 5.3 (2010), ftc.gov/os/2010/08/100819hmg.pdf.

[44] Twenty-six 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% share.

[45] Horizontal Merger Guidelines, *supra* note 43, § 4.

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.[46] 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 involves multiple rounds of negotiation over not only price terms but also other aspects of the product, such as packaging and the shelf space that will be allocated to the product. Rather than assuming private label manufacturers set binding wholesale prices, we can instead assume that wholesale prices are the result of bargaining between retailers and manufacturers. An assumption of Nash bargaining,[47] for example, arguably better captures the back-and-forth that occurs in business-in-business negotiations,

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

[47] 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 L.J. 253 (2013); Soheil Ghili & Matt Schmitt, *A Framework for Estimating Damages in Reverse Payment Cases*, 81 ANTITRUST L.J. 873 (2017); David Dranove, Dov Rothman & David Toniatti, *Up or Down? The Price Effects of Mergers of Intermediaries*, 82 ANTITRUST L.J. 643 (2019); Mark A.

while retaining computational tractability.[48] One particularly appealing feature of the Nash bargaining formulation is that the bargaining power parameter can be thought of as capturing the retailer's unmodeled options to constrain a private label wholesale price increase, such as reallocating 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 set prices unilaterally.

3. *Private Label Manufacturers that Also Produce Branded Products*

Branded manufacturers sometimes also produce private label products. The effect that a manufacturer's production of both branded and private label products may have on its 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. This weakened constraint can be incorporated into the model 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.

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 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 such a merger does not directly affect the constraint that downstream competition imposes on private label manufacturers, and cost efficiencies give

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Israel, Thomas A. Stemwedel & Ka Hei Tse, *Are You Pushing Too Hard? Lower Negotiated Input Prices as a Merger Efficiency*, 82 ANTITRUST L.J. 623 (2019).

[48] *See, e.g.*, Nathan H. Miller, *Modeling the Effects of Mergers in Procurement*, 37 INT'L J. INDUS. ORG. 201 (2014).

the merged entity an 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 to evaluate mergers in which the parties sell directly to end consumers. The methods we develop, therefore, can be readily applied in investigations of private label mergers. Given its size—$180 billion in 2019 U.S. retail sales—the private label industry is itself worthy of study.[49] Moreover, variants of the model we present in this article can likely be applied more broadly to mergers between consumer product manufacturers, especially in cases where downstream retailers carry only a subset of upstream manufacturers' products.[50] Even more generally, as firms acquire an ownership interest in multiple levels of industry supply chains, adapting existing economic models to incorporate the multiple stages at which firms compete may become increasingly important.

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[49] *The Store Brands Story*, *supra* note 1.

[50] The model could also be extended to markets in which upstream manufacturers sell a product to intermediate producers, and the product accounts for a large fraction of the intermediate producers' costs. In that case, the upstream manufacturers may consider the impact of their pricing on the competitiveness of the intermediate producers in downstream markets.

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 second against non-private label products 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:

$$\sum_{m\in\mathcal{M}} \mathrm{Pr}_m(\mathbf{w}) \cdot \mathrm{Q}_m\big(\mathrm{p}(\mathrm{w}_m)\big) \cdot (\mathrm{w}_m - \mathrm{c}_m) \tag{3}$$

where $\mathcal{M}$ is the set of manufacturers under the same ownership, Pr_m is the probability that the retailer chooses manufacturer m (a function of the vector 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:

$$\left[\frac{\partial \mathrm{Pr}_1}{\partial \mathrm{w}_1} \cdot \mathrm{Q}_1 + \mathrm{Pr}_1 \cdot \frac{\partial \mathrm{Q}_1}{\partial \mathrm{p}} \cdot \frac{\partial \mathrm{p}}{\partial \mathrm{w}_1}\right] \cdot (\mathrm{w}_1 - \mathrm{c}_1) + \mathrm{Pr}_1 \cdot \mathrm{Q}_1 = 0 \tag{4}$$

The term in brackets reflects the quantity losses that occur with a wholesale price increase, some of which occurs upstream (captured by $\frac{\partial \mathrm{Pr}_1}{\partial \mathrm{w}_1} \cdot \mathrm{Q}_1$) and some of which occurs downstream (captured by $\mathrm{Pr}_1 \cdot \frac{\partial \mathrm{Q}_1}{\partial \mathrm{p}} \cdot \frac{\partial \mathrm{p}}{\partial \mathrm{w}_1}$). 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:

$$\left[\frac{\partial \mathrm{Pr}_1}{\partial \mathrm{w}_1} \mathrm{Q}_1 + \mathrm{Pr}_1 \frac{\partial \mathrm{Q}_1}{\partial \mathrm{p}} \frac{\partial \mathrm{p}}{\partial \mathrm{w}_1}\right] (\mathrm{w}_1 - (1-\theta)\mathrm{c}_1) + \mathrm{Pr}_1 \mathrm{Q}_1 + \frac{\partial \mathrm{Pr}_2}{\partial \mathrm{w}_1} \mathrm{Q}_2 (\mathrm{w}_2 - \mathrm{c}_2) = 0 \tag{5}$$

where all expressions 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:

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

where all expressions 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 $D_{12} \equiv \frac{\partial Pr_2/\partial w_1}{|\partial Pr_1/\partial w_1|}$ denote the upstream diversion ratio from manufacturer 1 to manufacturer 2 and simplifying, the merger generates downward pricing pressure if:

$$\theta > D_{12} \cdot \frac{M_2}{1-M_1} \cdot \frac{w_2}{w_1} \cdot \frac{Q_2}{Q_1} \cdot \frac{\varepsilon_{u1}}{\varepsilon_{u1}+\varepsilon_{d1}\cdot\varepsilon_{t1}} \quad (7)$$

where M denotes (pre-merger) margins and the ε terms are elasticities as defined in the main text of the article. ε_{u1} is the "upstream elasticity" $\left|\frac{\partial Pr_1}{\partial w_1} \cdot \frac{w_1}{Pr_1}\right|$, ε_{d1} is the "downstream elasticity" $\left|\frac{\partial Q_1}{\partial p} \cdot \frac{p}{Q_1}\right|$, and ε_{t1} is the "pass-through elasticity" $\frac{\partial p}{\partial w_1} \cdot \frac{w_1}{p}$. If downstream competition is not present, $\varepsilon_{d1} \cdot \varepsilon_{t1} = 0$ and $Q_1 = Q_2$, yielding $\theta > D_{12} \cdot \frac{M_2}{1-M_1} \cdot \frac{w_2}{w_1}$, which is the condition derived by Farrell and Shapiro.[51] In the symmetric case, the condition reduces to $\theta > D \cdot \frac{M}{1-M} \cdot \frac{\varepsilon_u}{\varepsilon_u+\varepsilon_d\cdot\varepsilon_t}$ 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 if 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., $\varepsilon_{d1} \cdot \varepsilon_{t1}$ is sufficiently large), the necessary cost efficiencies for both firms will be smaller than when downstream competition is not present.

[51] Farrell & Shapiro, *supra* note 14, at 12.