Horizontal Integration Effects in Vertical Mergers

Yilun Li*

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Abstract

Recent mergers in health care and telecommunications have sparked debates about the anti-competitive effects of vertical mergers. In this paper we analyze a simulation of two upstream and two downstream firms to observe the effects that vertical integration has on consumer welfare and market competitiveness. We find that the horizontal integration effect dominates any efficiencies achieved by integration when the integrated firm almost has monopolist market power post-integration. In more flexible demand models, this phenomenon can also be observed when the integrated firm produces a highly substitutable good and the market share of a competitor is high. A dominating horizontal integration effect leads to increases in both consumer prices and rivals' costs, a situation that regulators are keen to avoid.

Keywords: Vertical Merger; Vertical Integration; Horizontal Merger; Merger Simulation.

*Undergraduate student in Economics. E-mail: *yilunli@sas.upenn.edu*. I am grateful to my independent study advisor, Aviv Nevo, for his advice and suggestions.

1 Introduction

Recent vertical mergers in healthcare (CVS-Aetna) and telecommunications (ATT-Time Warner) have brought the competitive effects of vertical integration into the spotlight for policy makers and regulators. Vertically integrating firms often claim to be able to achieve efficiencies that otherwise would be unfeasible if they were separate. Regulators worry about gains in market power and potential negative welfare effects resulting from vertical integration.

Whether or not efficiencies can be achieved without offsetting anticompetitive effects is a popular area of research. The Chicago School pioneered leading theories of antitrust and vertical merger theory in the 1970s, showing that many previously accepted theories of vertical mergers underestimated the gains in efficiencies. A new school of thought emerged in the late 80s that adopted oligopoly market structures to study effects of vertical integration. These papers such as Salinger (1988) and Ordover et al. (1990), directed their attention to market foreclosure, the market power gained by restricting supply (demand) to downstream (upstream) competitors.

Foreclosure and the closely related raising rivals cost theory remained the most intensely studied aspects of vertical mergers for the next decade. Following Ordover et al. (1990), the focus in this literature shifted towards equilibrium outcomes and foreclosing rivals to obtain monopoly power. Hart et al. (1990), O'Brien and Shaffer (1992), McAfee and Schwartz (1994) discover that a dominant supplier can exert monopoly power when competition is already lacking in the upstream market. Chen (2001) analyzed foreclosure in equilibrium outcomes while introducing tweaks in market structure.

More recently, the vertical integration literature has branched out into many areas of economics, antitrust, and regulatory interests. Nocke and White (2007) uses a repeated game to study the effect that vertical arrangements can have on sustaining collusion in an oligopoly market structure. Welfare effects of partial vertical integration, where upstream and downstream firms only share some of the joint profits, have also been studied more closely recently by Levy et al. (2018). Some have furthered the market foreclosure literature from the 90s and early 2000s; Nocke and Rey (2018) adopt secret contracting and interlocking relationships to study foreclosure. One commonality across all these recent results is that the products in the market are now assumed to be differentiated in both the upstream and downstream markets. Product differentiation comes in a variety of manners; some papers adopt Hotelling type models (Matsushima, 2009) while others use some parameter or function for substitutability (Zanchettin and Mukherjee, 2017). Furthermore, more authors have incorporated bargaining to divide upstream and downstream profits. Such innovations in methodology have enabled vertical integration models to demonstrate the subtle effects that vertically integrating firms have on pricing, market structure, and competition.

This paper simulates an equilibrium in a vertical market structure similar to the dual upstream-downstream oligopolies in Salinger (1988) and Hart et al. (1990). Unlike Ordover et al. (1990) or Chen (2001), equilibria are found numerically via simulation rather than solved with an analytical model. We enable product differentiation in both the upstream and downstream firms, and firms compete in prices in both the intermediate good and the final good market. For downstream consumers, we assume a logit or nested logit demand model; parameters across a range of values are chosen and the effects of vertical integration are analyzed. Our model can be thought of as a supermarket model, where each of the upstream firms stock goods that the downstream retailing firm attempts to sell. Therefore, the model is not traditional in the sense that there are four total downstream goods rather than two.

We focus our attention on parameters and market settings in which the price of a good produced wholly by an integrated firm increases post integration. This phenomenon happens when the horizontal integration effect outweighs any elimination of double marginalization effect (EDM). The idea of the horizontal integration effect is described in Moresi and Salop (2013) - the downstream subsidiary of the vertically integrated firm has an incentive to raise prices post-merger because consumers substitute to another downstream good that is supplied by the integrated firm. In essence, the vertically integrated firm can behave as if horizontal integration has happened because one of the four intermediate markets is eliminated with vertical integration. The horizontal integration effect is an under-studied negative effect of vertical mergers, and in some sense, it is more important than the commonly reviewed foreclosure or raising rivals cost (RRC) effects. This is because in cases where the horizontal integration effect dominates EDM, welfare of the downstream consumer is directly impacted. Whereas it is possible that if the downstream firms are affected by foreclosure or RRC, the impacts may not be completely passed through to the consumer.

This paper is organized as follows. The next section presents the models and assumptions made about vertical integration. Then, Section 3 discusses the methodology and results from the logit model simulation. Section 4 analyzes results from the nested logit model. Concluding remarks are offered in Section 5.

2 The model

There two upstream firms or suppliers, U_A and U_B, and two downstream firms or retailers, D_1 and D_2. The downstream firms each sell two differentiated products, each product using an one input from one of the upstream suppliers. Thus, the market is composed of four goods and the outside option. Each individual consumer i achieves utility $u_{ij}(p_{jk})$ from a product sold by firm j and supplied by firm k:

$$u_{ijk} = \beta_0 - \beta_1 p_{jk} + \beta_2 \delta_2 + \beta_3 \delta_B + \epsilon_{ijk} \qquad j \in 1,2 \quad k \in A, B \tag{1}$$

where δ_2 is a dummy variable indicating the effect of a preference for downstream retailer 2's products, and δ_B is a dummy variable indicating the effect of a preference for upstream supplier B's goods. For example, u_{i1A} is the utility obtained by consumer i from the good supplied by U_A and sold by D_1.

2.1 Logit Demand

Using this utility function, we construct a demand function determined by the standard logit demand model:

$$q_{jk} = \frac{\exp(v(p_{jk}))}{1 + \sum_{allj,k} \exp(v(p_{jk}))} \cdot M \tag{2}$$

where $v(p_{jk})$ is $\beta_0 - \beta_1 p_{jk} + \beta_2 \delta_2 + \beta_3 \delta_B$ from (1). We assume that the market size is $M = 1$, so the shares of each good can be interpreted as the quantity sold.

D_1 and D_2 engage downstream in price competition, with each firm having the profit function:

$$\pi_j = (p_{jA} - w_{jA})q_{jA} + (p_{jB} - w_{jB})q_{jB} \qquad j = 1, 2 \tag{3}$$

The downstream firms simultaneously solve their first-order conditions:

$$\frac{\partial \pi_j}{\partial p_{jk}} = q_{jk} + (p_{jk} - w_{jk})\frac{\partial q_{jk}}{\partial p_{jk}} + (p_{j,-k} - w_{j,-k})\frac{\partial q_{j,-k}}{\partial p_{jk}} = 0 \quad j = 1, 2; \quad k = A, B \tag{4}$$

The two upstream firms U_A and U_B produce differentiated intermediate goods at constant marginal cost c_k $(k = A, B)$, and sell them to both downstream firms at a wholesale price $w_{jk} > c_k$, $(j = 1, 2)$, allowing for price discrimination of the downstream firms. The intermediate good is transformed into the final good by the downstream firms on a one-for-one basis at zero marginal cost.

It is assumed that the upstream marginal costs, c_k, are zero so that the wholesale price can be interpreted as the contribution margin per unit sold. Therefore, each upstream firm has the revenue/profit function:

$$\pi_j = w_{1k}q_{1k} + w_{2k}q_{2k} \qquad k = A, B \tag{5}$$

where q_{jk}, $(j = 1, 2; k = A, B)$ is the quantity obtained from (2) for the good supplied by U_k and sold by D_j. Therefore, each q_{jk} is actually $q_{jk}(\vec{p})$, a function of the vector of downstream prices. Since downstream prices are also a function of the intermediate input prices, the first-order-conditions for the upstream firm with respect to the intermediate input price must be implicitly differentiated or solved numerically. We simply note that the equilibrium intermediate input prices are determined by simultaneously solving the four first-order conditions: $\partial\pi_k/\partial w_{jk}$.

2.2 Nested Logit Demand

We use the same consumer utility function (1) for the nested logit demand model. We create two nests for our model, one with goods $\{1A, 2A\}$ and another with goods $\{1B, 2B\}$. We allow the parameters for the utility function to vary within the two nests. This is a logical way to nest the items; if we think about the model as supermarket stores stocking goods A and B on their shelves, then it is apparent that the same goods stocked at different stores are close substitutes for each other. Coefficients for the consumer utility function is allowed to vary across nests.

Given the nest specification above, we decompose the nested logit probability into two logit models. The first is the probability that we choose the nest of goods A or goods B, and the second is the probability that we choose a certain downstream retailer to purchase the good given that we are within a nest. Thus, we have the following demand:

$$q_jk = Pr(jk|k) * Pr(k) * M,\ j \in \{1,2\}\ k \in \{A,B\}, \quad \text{where} \tag{6}$$

$$Pr(jk|k) = \frac{\exp(v(p_{jk})/\lambda_k)}{\sum_{A,B}\exp(v(p_{jk})/\lambda_k)} \tag{7}$$

$$Pr(k) = \frac{\exp(y_k'\gamma + \lambda_k IV_k)}{1 + \sum_l \exp(y_l'\gamma + \lambda_l IV_l)} \tag{8}$$

$$IV_k = \log \sum_{j\in\{1,2\}} \exp(v(p_{jk})/\lambda_k) \tag{9}$$

Again, $v(p_{jk})$ is as defined above in the logit model and market size M is set equal to 1.

Equation (7) gives the conditional probability of choosing a good within a nest given that nest, and equation (8) gives the probability that a nest A or B is chosen alongside an outside good with utility normalized to 0. There are three new parameters to define: $1 - \lambda_k \in [0, 1]$ gives the correlation within a nest k, y_k is the characteristics relevant to a nest k, and γ are the coefficients for those nest-level characteristics y_k. For simplicity, we will assume that there is only one characteristic that distinguishes the nests - this assumption implies that y_k and γ are vectors of length 1.

2.3 Timing

The timing of the model operates as follows:

- *Stage 1:* Upstream and downstream firms learn of each other's marginal costs and the downstream industry demand curve.
- *Stage 2:* Upstream firm U_A and downstream firm D_1 decide whether or not to integrate.
- *Stage 3:* Upstream firms simultaneously offer take-it-or-leave-it input prices, w_{jk} to the downstream firms.
- *Stage 4:* The downstream firms then optimize their retail prices given these input prices and the demand curve. The downstream firms simultaneously order the quantity demanded from the upstream firm at their optimal prices.

These timing assumptions are consistent with related articles in the literature where integration occurs first, offers are made by upstream firms, and finally downstream firms price to consumers. An example of unconventional timing is in Gans (2007), where downstream firms compete in the downstream market first before negotiating with the upstream firms.

2.4 Integration

After learning about everyone's marginal costs and before any offers are made by U_A and U_B to D_1 and D_2, U_A has the opportunity to integrate with D_1. We make the following assumptions about the consequences of vertical integration.

Assumption 1: *There are no lump-sum costs to integration*

Classic papers in the vertical foreclosure literature like Hart et al. (1990) assume that there is either some lump-sum cost due to a loss in efficiency after integration. We do allow for residual marginal costs after integration like additional selling or other bureaucracy costs that impact the margin.

Assumption 2: *Integrated firms share profits*

This assumption makes sure that the integrated firm $U_A - D_1$ maximizes its joint profit function, which is:

$$\pi_{U_A - D_1} = w_{2A}x_{2A} + p_{1A}x_{1A} + p_{1B}x_{1B} \tag{10}$$

This profit functions assumes that the intermediate good price, w_{1A}, is equal to zero as a result of the integration of the two firms. Therefore, the terms of (10) can be thought about in the following manner - the first term is the profit from the upstream division selling to the remaining downstream firm, D_2, and the other two terms are the profit from the customer facing downstream division.

3 Methodology and Logit Simulation Results

3.1 Methodology

Equilibrium outcomes were simulated using a nested two-stage optimization routine using R's optim library. The inside (nested) routine optimizes downstream profits given intermediate good offers from the upstream firms. D_1 first optimizes and then D_2 responds to D_1's chosen prices. D_1 then optimizes with respect to the newly chosen prices from D_2, and then D_2 responds accordingly. This inside optimization routine stops when the profits of the downstream firms reach a relative tolerance limit or a certain number of iterations.

The outside routine optimizes the upstream firm profits, similar to the above method of the nested inside routine. U_A first offers prices to the downstream firms, which optimize their downstream prices accordingly. U_B then optimizes its offer given U_A's offer. This optimization routine stops when the profits of the upstream firms reach a relative tolerance limit or a certain number of iterations. When integrated, $U_A - D_1$ tries to maximize $\pi_A + \pi_1$ given in (10).

3.2 No Brand or Store Effects

Consider the following scenario: two clothing retailers sell two brands of generic t-shirts. Consumers do not have a preference on either retailer or t-shirt brand. If one retailer and one t-shirt manufacturer merge, we would expect to see that the merged firm sells its t-shirts at a lower price and the other t-shirt at a higher price to promote its own shirts. The remaining retailer has a hiked price on the t-shirts bought from the merged firm, because it is more profitable for the merged firm to have its t-shirts sold in house. The retailer will cut prices on the other t-shirt in an attempt to incentivize some customers to stay.

Table 1 presents the simulated equilibrium outcomes of the above scenario - when there are no store or brand effects. In the consumer utility function (1), we set $\beta_2 = \beta_3 = 0$. We fix a price coefficient[1] β_1 and vary the intercept term β_0 to allow for changes in market share.

Market share appears to not have any effect on the integration outcome. Across the board, we see that after $U_A - D_1$ integrate, p_{1A} falls due to the elimination of double marginalization (EDM). However, the amount that p_{1A} decreases by is less than the wholesale price w_{1A} when firms were unintegrated. The difference in the markup of good $1A$ between any integrated-unintegrated pair captures the additional markup attributed an increase in market power

[1]The β_1 price parameter does not affect the shares of any of the firms in the model. A higher β_1 means lower prices for consumers across the board, but markups and profits relative to price remain the same.

post-integration. This difference captures some of the horizontal integration effect. Note that for higher market shares, the horizontal integration effect increases relatively and in magnitude because the integrated firm has more market power with a higher market share.

Prices p_{1B} and p_{2A} both increase. p_{1B} increases because the downstream subsidiary of the integrated firm wants to encourage substitution to $1A$ while maintaining similar markups across the two goods. p_{2A} increases even more because of a raising rivals' cost effect (RRC) due to an increase in w_{2A}. Markups for good $2A$, decrease, indicating that the other downstream firm has lost some market power because of the competitive, lower price of $1A$. p_{2B} decreases, likely as a response by D_2 to retain some customers who are substituting away from good $2A$.

	Parameters (utility fn)				Downstream Equilibria							
Integration	β_0	β_1	β_2	β_3	p_1A	p_1B	p_2A	p_2B	w_1A	w_1B	w_2A	w_2B
0	-1	1	0	0	2.19	2.19	2.19	2.19	1.11	1.11	1.11	1.11
1	-1	1	0	0	1.18	2.28	2.28	2.17	0	1.1	1.21	1.1
0	log(4)	1	0	0	2.76	2.76	2.76	2.76	1.42	1.42	1.42	1.42
1	log(4)	1	0	0	1.8	3.06	3.04	2.63	0	1.25	1.78	1.37
0	log(100)	1	0	0	3.69	3.69	3.69	3.69	1.85	1.85	1.85	1.85
1	log(100)	1	0	0	3	4.39	4.19	3.66	0	1.39	2.63	2.09

	Parameters (utility fn)				Markups				Shares				Profits			
Integration	β_0	β_1	β_2	β_3	1A	1B	2A	2B	1A	1B	2A	2B	A	B	1	2
0	-1	1	0	0	1.08	1.08	1.08	1.08	0.035	0.035	0.035	0.035	0.079	0.079	0.076	0.076
1	-1	1	0	0	1.18	1.18	1.07	1.07	0.092	0.031	0.031	0.034	0.037	0.071	0.145	0.069
0	log(4)	1	0	0	1.34	1.34	1.34	1.34	0.126	0.126	0.126	0.126	0.358	0.358	0.336	0.336
1	log(4)	1	0	0	1.80	1.81	1.26	1.26	0.283	0.081	0.082	0.124	0.126	0.271	0.657	0.260
0	log(100)	1	0	0	1.84	1.84	1.84	1.84	0.227	0.227	0.227	0.227	0.842	0.842	0.834	0.834
1	log(100)	1	0	0	3.00	3.00	1.56	1.57	0.440	0.110	0.134	0.228	0.351	0.630	1.650	0.566

Table 1: Simulated Equilibrium - No Brand or Store Effect

3.3 Brand Effect, No Store Effects

Now consider the above scenario, except that one of the t-shirts is a branded t-shirt (think Nike, etc). Consumers prefer this t-shirt to the generic brand one, and thus the clothing retailers charge more for the branded t-shirt.

Table 2 adds a brand effect to the consumer utility equation. That is, customers have a preference for a good produced with intermediate input from U_A or U_B. Here, only $\beta_2 = 0$, while the price coefficient β_1 and the brand coefficient[2] β_3 are fixed to some value positive value. We first assume that the dominant brand is brand B, which means that the products using inputs from A will generally have a lower market share.

	Parameters (utility fn)				Downstream Equilibria							
Integration	β_0	β_1	β_2	β_3	p_1A	p_1B	p_2A	p_2B	w_1A	w_1B	w_2A	w_2B
0	-1	1	0	3	2.33	3.13	2.33	3.13	1.07	1.87	1.06	1.87
1	-1	1	0	3	1.33	3.13	2.54	3.09	0	1.79	1.28	1.83
0	log(4)	1	0	3	2.76	4.3	2.74	4.31	1.18	2.72	1.17	2.74
1	log(4)	1	0	3	1.86	4.25	3.13	4.18	0	2.39	1.63	2.67
0	log(100)	1	0	3	3.29	5.31	3.29	5.31	1.36	3.37	1.36	3.37
1	log(100)	1	0	3	2.65	5.35	3.82	5.34	0	2.7	2.15	3.66

	Parameters (utility fn)				Markups				Shares				Profits			
Integration	β_0	β_1	β_2	β_3	1A	1B	2A	2B	1A	1B	2A	2B	A	B	1	2
0	-1	1	0	3	1.26	1.26	1.27	1.26	0.021	0.188	0.021	0.188	0.045	0.702	0.264	0.264
1	-1	1	0	3	1.33	1.34	1.26	1.26	0.054	0.181	0.016	0.189	0.021	0.067	0.314	0.258
0	log(4)	1	0	3	1.58	1.58	1.57	1.57	0.069	0.296	0.070	0.294	0.163	1.610	0.575	0.572
1	log(4)	1	0	3	1.86	1.86	1.5	1.51	0.150	0.275	0.042	0.294	0.068	1.440	0.788	0.506
0	log(100)	1	0	3	1.93	1.94	1.93	1.94	0.131	0.351	0.131	0.351	0.356	2.370	0.932	0.932
1	log(100)	1	0	3	2.65	2.65	1.67	1.68	0.240	0.323	0.074	0.329	0.160	2.080	1.490	0.675

Table 2: Simulated Equilibria - B Dominant Brand

There are a few interesting observations in this scenario. The price p_{1B} after integration varies depending on the market share of the outside good. We see that the difference in p_{1B} is zero between rows 1 and 2, negative between rows 3 and 4, and positive between rows 5 and 6. Additionally, the price p_{2B} increases once the market share of the outside good is somewhat low (rows 5 and 6). In Section 3.6 we discuss more in detail why firm behavior post-integration behaves different when market share of the outside good is low.

Some observations remained the same as the no effects case. The price of p_{1A} dropped substantially as a result of EDM. However, the amount that p_{1A} decreased was inversely proportional to the market share. As market share rose, the amount that p_{1A} decreased by

[2]Like the price coefficient, changing magnitude of the brand coefficient does not change the qualitative outcome of the simulation.

was also decreasing. The price p_{2A} still increases due to a large RRC effect.

The scenario where A is the dominant brand is only slightly different compared to the scenario where B is the dominant brand. Most noticeable is the price p_{1B} now increases by a large amount after integration, whereas in the B dominant brand scenario the price effect was ambiguous. In this case, the integrated firm has its downstream subsidiary raise the price of good B by such a large amount to grab a large market share. As displayed in the last row of Table 3, good $1A$ has a very large market share, stealing almost all of the market from good $2A$ from before integration. This market share stealing phenomenon seems to exacerbate as market share increases - the difference in the market share of good $2A$ is larger between rows 5 and 6 than rows 1 and 2 of Table 3. Other effects such as EDM and RRC remain similar to the case where B is the dominant brand.

	Parameters (utility fn)				Downstream Equilibria							
Integration	β_0	β_1	β_2	β_3	p_1A	p_1B	p_2A	p_2B	w_1A	w_1B	w_2A	w_2B
0	-1	1	0	-4	2.17	2.04	2.17	2.04	1.13	1	1.13	1
1	-1	1	0	-4	1.16	2.12	2.23	2.05	0	0.959	1.19	1.02
0	log(40)	1	0	-4	4.07	2.47	4.07	2.47	2.64	1.05	2.64	1.05
1	log(40)	1	0	-4	3.13	4.38	4.44	2.28	0	1.25	3.24	1.08
0	log(1000)	1	0	-4	5.61	3.04	5.61	3.04	3.79	1.22	3.79	1.22
1	log(1000)	1	0	-4	5.03	6.18	6.2	2.9	0	1.14	4.8	1.5

	Parameters (utility fn)				Markups				Shares				Profits			
Integration	β_0	β_1	β_2	β_3	1A	1B	2A	2B	1A	1B	2A	2B	A	B	1	2
0	-1	1	0	-4	1.04	1.04	1.04	1.04	0.039	0.001	0.039	0.001	0.087	0.002	0.041	0.041
1	-1	1	0	-4	1.16	1.161	1.04	1.03	0.100	0.001	0.034	0.001	0.408	0.001	0.116	0.036
0	log(40)	1	0	-4	1.43	1.42	1.43	1.42	0.275	0.025	0.275	0.025	1.450	0.052	0.427	0.427
1	log(40)	1	0	-4	3.13	3.13	1.2	1.2	0.530	0.003	0.143	0.023	0.463	0.028	1.670	0.198
0	log(1000)	1	0	-4	1.82	1.82	1.82	1.82	0.363	0.087	0.363	0.087	2.760	0.212	0.819	0.819
1	log(1000)	1	0	-4	5.03	5.04	1.4	1.4	0.615	0.004	0.192	0.095	0.920	0.147	3.110	0.402

Table 3: Simulated Equilibrium - A Dominant Brand

3.4 Store Effects, No Brand Effects

We now explore simulation results where consumers have no preference between the upstream firms, but have a preference in the downstream retailers. Table 4 presents the scenario when the downstream firm D_1 has a much smaller market share than D_2, and integrates with U_A in order to gain efficiencies in hopes of capturing more market share.

	Parameters (utility fn)				Downstream Eq							
Integration	β_0	β_1	β_2	β_3	p_1A	p_1B	p_2A	p_2B	w_1A	w_1B	w_2A	w_2B
0	-1	1	3	0	2.27	2.27	3.09	3.09	1.22	1.22	1.47	1.47
1	-1	1	3	0	1.37	2.57	3.11	3.07	0	1.2	1.51	1.46
0	log(4)	1	3	0	2.63	2.63	4.24	4.24	1.46	1.46	1.79	1.79
1	log(4)	1	3	0	1.87	3.17	4.24	4.15	0	1.31	1.89	1.8
0	log(100)	1	3	0	3.24	3.24	5.28	5.28	1.87	1.87	1.97	1.97
1	log(100)	1	3	0	2.42	3.84	5.17	5.07	0	1.41	2.16	2.06

	Parameters (utility fn)				Markups				Shares				Profits			
Integration	β_0	β_1	β_2	β_3	1A	1B	2A	2B	1A	1B	2A	2B	A	B	1	2
0	-1	1	3	0	1.05	1.05	1.62	1.62	0.022	0.022	0.191	0.191	0.309	0.309	0.046	0.621
1	-1	1	3	0	1.37	1.37	1.6	1.61	0.052	0.016	0.184	0.192	0.277	0.300	0.093	0.601
0	log(4)	1	3	0	1.17	1.17	2.45	2.45	0.074	0.074	0.297	0.297	0.638	0.638	0.175	1.460
1	log(4)	1	3	0	1.87	1.86	2.35	2.35	0.147	0.040	0.275	0.300	0.519	0.592	0.349	1.350
0	log(100)	1	3	0	1.37	1.37	3.31	3.31	0.134	0.134	0.349	0.349	0.937	0.937	0.366	2.310
1	log(100)	1	3	0	2.42	2.43	3.01	3.01	0.245	0.060	0.317	0.351	0.684	0.806	0.738	2.010

Table 4: Simulated Equilibria - 2 Dominant Store

Downstream prices are lower as a result of integration when market share is high. One explanation for this result could be that the dominant downstream firm D_2 engages in a price war with D_1 to discourage the backwards integration and to maintain its dominant share. The only price that is hiked is p_{1B}, which is hiked by $U_A - D_1$ to encourage substitution to its other goods. This scenario is the best outcome for consumers since overall industry profits fall, which means that consumer surplus should rise as a result.

When D_1 is the dominant downstream firm, integration creates a large RRC effect when market shares are high. Between the fifth and sixth rows of Table 5, the wholesale price w_{2A} almost triples from 1.66 to 4.72 as a result of integration - the largest relative change seen so far. In this case, the new integrated firm has quite a large market share, thereby able to leverage market power to charge its competitors more.

One thing to note is that the outside good has a minimum of at least ten percent market share (rows 5,6 of Table 5). When we consider an even lower outside good market share,

	Parameters (utility fn)				Downstream Equilibria							
Integration	β_0	β_1	β_2	β_3	p_1A	p_1B	p_2A	p_2B	w_1A	w_1B	w_2A	w_2B
0	-1	1	-4	0	2.17	2.17	2.04	2.05	1.08	1.08	1.04	1.04
1	-1	1	-4	0	1.16	2.23	2.11	2	0	1.07	1.11	1
0	log(40)	1	-4	0	4	4	2.35	2.34	1.7	1.7	1.29	1.29
1	log(40)	1	-4	0	3.12	4.37	4.08	2.18	0	1.25	3.05	1.15
0	log(1000)	1	-4	0	5.53	5.53	2.89	2.89	1.93	1.93	1.66	1.66
1	log(1000)	1	-4	0	5.09	6.38	5.83	2.97	0	1.3	4.72	1.86

	Parameters (utility fn)				Markups				Shares				Profits			
Integration	β_0	β_1	β_2	β_3	1A	1B	2A	2B	1A	1B	2A	2B	A	B	1	2
0	-1	1	-4	0	1.09	1.09	1	1.01	0.039	0.039	0.001	0.001	0.043	0.043	0.084	0.002
1	-1	1	-4	0	1.16	1.16	1	1	0.100	0.034	0.001	0.001	0.001	0.038	0.155	0.001
0	log(40)	1	-4	0	2.3	2.3	1.06	1.05	0.282	0.282	0.027	0.027	0.052	0.052	1.290	0.057
1	log(40)	1	-4	0	3.12	3.12	1.03	1.03	0.526	0.150	0.004	0.025	0.011	0.216	2.100	0.029
0	log(1000)	1	-4	0	3.6	3.6	1.23	1.23	0.361	0.361	0.093	0.093	0.083	0.053	2.600	0.229
1	log(1000)	1	-4	0	5.09	5.08	1.11	1.11	0.627	0.171	0.005	0.095	0.026	0.399	4.060	0.112

Table 5: Simulated Equilibrium - 1 Dominant Store

the anti-competitive effects of integration become even more amplified and the horizontal integration effect begins dominating any efficiencies. A discussion of these results is in Section 3.6.

3.5 Combined Brand and Store Effects

We now turn our attention to simulated equilibria where there are both store and brand effects. For now, assume that there are no interaction effects between the two effects.

3.5.1 Consumers Prefer U_B and D_2

In this scenario, Firms U_A and D_1 integrate in order to better compete against the dominant firms in the industry, U_B and D_2. In an industry with a low outside good market share, this is beneficial to consumers, as retail prices fall across the board. Market power becomes less conglomerated and the other retailers and manufacturers engage in a price war with the newly integrated firm in hopes of maintaining some market power.

Table 6 displays the simulation results of such an integration. Even though $U_A - D_1$ has a relatively small market share compared to goods such as $2B$ after integration, there is an observed RRC effect. EDM outweighs any markup effect, likely resulting from the lack of market power that the integrated firm has post-integration.

	Parameters (utility fn)				Downstream Eq							
Integration	β_0	β_1	β_2	β_3	p_1A	p_1B	p_2A	p_2B	w_1A	w_1B	w_2A	w_2B
0	-1	1	3	3	2.24	3.16	3.24	4.86	1.09	2.01	1.19	2.81
1	-1	1	3	3	1.3	3.25	3.31	4.84	0	1.95	1.27	2.81
0	log(4)	1	3	3	2.5	4.03	4.12	6.08	1.21	2.74	1.32	3.28
1	log(4)	1	3	3	1.63	4.06	4.14	5.98	0	2.43	1.45	3.28
0	log(100)	1	3	3	2.76	4.78	4.8	6.87	1.37	3.39	1.39	3.47
1	log(100)	1	3	3	1.87	4.58	4.62	6.58	0	2.71	1.56	3.53

	Parameters (utility fn)				Markups				Shares				Profits			
Integration	β_0	β_1	β_2	β_3	1A	1B	2A	2B	1A	1B	2A	2B	A	B	1	2
0	-1	1	3	3	1.15	1.15	2.05	2.05	0.014	0.113	0.104	0.409	0.139	1.380	0.145	1.050
1	-1	1	3	3	1.3	1.3	2.04	2.03	0.036	0.102	0.096	0.414	0.121	1.360	0.178	1.040
0	log(4)	1	3	3	1.29	1.29	2.8	2.8	0.043	0.184	0.168	0.475	0.273	2.060	0.294	1.800
1	log(4)	1	3	3	1.63	1.63	2.69	2.7	0.092	0.162	0.149	0.480	0.216	1.970	0.414	1.690
0	log(100)	1	3	3	1.39	1.39	3.41	3.4	0.077	0.204	0.201	0.505	0.386	2.440	0.392	2.410
1	log(100)	1	3	3	1.87	1.87	3.06	3.05	0.137	0.182	0.176	0.496	0.275	2.240	0.596	2.050

Table 6: Simulated Equilibria - B Dominant Brand, 2 Dominant Store

Changing market shares mainly affects the prices of B post-integration. If market shares are low/shares of the outside good are high, then prices for good B barely budge after a $U_A - D_1$ integration. However, as market shares increase, the threat of substitution to good $1A$ becomes stronger, lowering the price of good B in both downstream firms.

3.5.2 Consumers Prefer U_B and D_1

Now consider the case when U_B is the dominant upstream brand and D_1 is the dominant downstream firm. EDM dominates any markup that the integrated firm may perform. At low market shares of the outside good, all of the prices except p_{1B} fall, similar to the scenario in section 3.4 when D_2 was the dominant store. The results are presented in Table 12 in the appendix. In the extreme case when market share of the outside good is near zero, there are interesting anti-competitive effects are worth discussing. This particular scenario is discussed in Section 3.6.

3.5.3 Consumers Prefer U_A and D_2

In this scenario, the good $2A$ has the highest initial market share. After integration, the integrated firm decreases the retail price p_{1A}, trying to elicit substitution to good $1A$ instead. It keeps w_{2A} very high to capture profits from D_2, which is preferred over D_1.

Results are in Table 13 in the Appendix. The equilibrium outcomes mirror those in Table 4 of Section 3.4 when D_2 is the dominant store. For example, in a small outside good share scenario, all prices except p_{1B} fall. The markup on p_{1B} is quantitatively larger in this case, but the overall qualitative effect remains similar.

3.5.4 Consumers Prefer U_A and D_1

When the dominant firms in the upstream and downstream want to merge, the result is similar to Section 3.3 when U_A is the dominant brand. The integrated firm leverages its market power to increase margins post-integration. Not only to the downstream consumers face the consequences, there is also a large RRC effect, with the wholesale price w_{2A} more than doubling under certain parameters. Simulation results are in Table 14 in the Appendix. Since this is another scenario where D_1 is the dominant downstream firm, the anti-competitive effects of integration are worth looking at when the market share of the outside good approaches zero. Section 3.6 discusses this result in detail.

3.6 High Market Shares/Low Share of Outside Good

Throughout the section, the results that have been presented usually have the pre-integration outside good market share between 5 and 90 percent. In other words, the four goods $\{1A, 1B, 2A, 2B\}$ have a combined $10-95$ percent of the entire market pre-integration. While this does not affect much of the analysis conducted above, it has big implications for the scenario when D_1 is the dominant downstream firm.

	Parameters (utility fn)				Downstream Equilibria							
Integration	β_0	β_1	β_2	β_3	p_1A	p_1B	p_2A	p_2B	w_1A	w_1B	w_2A	w_2B
0	10	1	-3	0	5.46	5.46	3.38	3.38	2	2	1.98	1.98
1	10	1	-3	0	6.48	7.84	6.95	5.08	0	1.36	5.76	3.9
0	10	1	-3	3	4.87	6.95	2.8	4.86	1.4	3.48	1.4	3.46
1	10	1	-3	3	6.29	8.94	6.72	7.13	0	2.65	5.53	5.93
0	10	1	-3	-3	6.81	4.75	4.72	2.74	3.45	1.39	3.33	1.36
1	10	1	-3	-3	7.18	8.31	7.8	3.42	0	1.13	6.67	2.3

	Parameters (utility fn)				Markups				Shares				Profits			
Integration	β_0	β_1	β_2	β_3	1A	1B	2A	2B	1A	1B	2A	2B	A	B	1	2
0	10	1	-3	0	3.46	3.46	1.4	1.4	0.356	0.356	0.142	0.142	0.992	0.992	2.470	0.398
1	10	1	-3	0	6.48	6.48	1.19	1.18	0.658	0.170	0.021	0.133	0.119	0.747	5.360	0.181
0	10	1	-3	3	3.47	3.47	1.4	1.4	0.203	0.508	0.080	0.205	0.397	2.480	2.470	0.399
1	10	1	-3	3	6.29	6.29	1.19	1.2	0.344	0.487	0.011	0.149	0.062	2.180	5.230	0.191
0	10	1	-3	-3	3.36	3.36	1.39	1.38	0.504	0.198	0.204	0.073	2.420	0.374	2.360	0.383
1	10	1	-3	-3	7.18	7.18	1.13	1.12	0.827	0.013	0.022	0.088	0.148	0.218	6.030	0.124

Table 7: Simulated Equilibrium - Low market share of outside good

Table 7 displays the outcomes when consumers prefer downstream firm D_1 and market share of the outside good is very low pre-integration ($< 3\%$). We see that post-integration, prices rise across the board, including p_{1A}. We call this phenomenon when p_{1A} rises post-integration the *horizontal integration effect*. Even though vertical integration has its efficiencies, under these above circumstances it is actually more profitable for the firm to raise prices rather than lower them. This is the only scenario under the standard logit demand model where the EDM effect is overwhelmed by the horizontal integration effect. Row 1 and Row 2 analyzes the case when there is only a preference for D_1 and no upstream brand preferences. Rows 3-6 analyze the case when there is a preference for D_1 and a brand effect. These rows demonstrate that the brand effect qualitatively provides the same result - prices rise across the board for each downstream good no matter which brand A or B was preferred. When vertical integration happens, it is more likely that backwards integration occurs because profits of D_1 are generally higher than the profits of U_A except for the last scenario where U_A and D_1 are equally favored (rows 5 and 6).

A possible scenario involving such a situation is the following: Consider a chain of large hospitals acquiring a major pharmaceutical company (or vice versa). The hospitals can now supply their patients with some drug that has very few substitutes outside of a generic or some inferior alternative. Other health suppliers in the city that these hospitals operate in will be impacted by the RRC effect as the hospital-pharmaceutical integrated firm charges them more for the drug. They can also afford to charge insurers more for the drug, thereby raising the price of the drug to consumers after integration. While such an scenario may seem somewhat unrealistic, any type of market with a dominant downstream firm and few substitute goods can see this effect.

Overall, the horizontal integration effect dominates when the integrated firm has psuedo-monopoly market power post integration. we see that shares of goods $1A$ and $1B$ are very high post integration, indicating that the integrated firm's downstream subsidiary has substantial market power. If regulators can foresee such an occurrence, then blocking vertical integration is beneficial to both consumer welfare and market competitiveness.

4 Nested Logit Results

We now turn our attention to the nested logit model for demand estimation. This model is more flexible than the model in Section 3; we can now control the degree of competition within a nest through λ_k, which allows us to control the magnitude of markups across the different downstream stores. Additionally, we can vary the markups between goods within a downstream store through the various nest-level parameters. This richer demand model enables us to find more scenarios where the horizontal integration effect dominates post-integration.

4.1 Effects of New Parameters

Since we use the same utility function (1) in both the logit and the nested logit model, we do not need to individually isolate each parameter $\beta_0, \beta_1, \beta_2$ and β_3 to study the effect of each parameter on the equilibrium outcomes [3]. Moreover, the nested logit houses the regular logit model when $\lambda_k = 1$ and $\gamma = 0$. Because of these relations, we restrict our attention in this section to changes in the new parameters that exist only in the nested logit model.

	Parameters[a](utility fn)				Downstream Equilibria							
Integration	β_0	β_1	β_2	λ	p_1A	p_1B	p_2A	p_2B	w_1A	w_1B	w_2A	w_2B
0	-1	1	0	0.9	2.42	2.42	2.42	2.42	1.28	1.28	1.28	1.28
1	-1	1	0	0.9	1.5	2.6	2.6	2.35	0	1.19	1.53	1.25
0	-1	1	0	0.5	2.03	2.03	2.03	2.03	1.27	1.27	1.27	1.27
1	-1	1	0	0.5	1.45	2.12	2.1	2.02	0	1.19	1.49	1.26
0	-1	1	0	0.1	1.48	1.48	1.48	1.48	1.29	1.29	1.29	1.29
1	-1	1	0	0.1	1.36	1.5	1.49	1.49	0	1.27	1.37	1.29

	Parameters[b](utility fn)				Markups				Shares				Profits			
Integration	β_0	β_1	β_2	λ	1A	1B	2A	2B	1A	1B	2A	2B	A	B	1	2
0	-1	1	0	0.9	1.14	1.14	1.14	1.14	0.088	0.088	0.088	0.088	0.227	0.227	0.201	0.201
1	-1	1	0	0.9	1.5	1.41	1.07	1.1	0.208	0.065	0.062	0.086	0.094	0.185	0.403	0.161
0	-1	1	0	0.5	0.76	0.76	0.76	0.76	0.095	0.095	0.095	0.095	0.241	0.241	0.145	0.145
1	-1	1	0	0.5	1.45	0.93	0.61	0.76	0.199	0.077	0.054	0.094	0.080	0.209	0.359	0.104
0	-1	1	0	0.1	0.19	0.19	0.19	0.19	0.111	0.111	0.111	0.111	0.288	0.288	0.042	0.042
1	-1	1	0	0.1	1.36	0.23	0.12	0.2	0.188	0.101	0.049	0.115	0.067	0.277	0.279	0.029

[a] Symmetric downstream firms, so parameters do not vary within nests; $\beta_3 = 0$

[b] Nest characteristics are fixed to $y = 1.5$ and $\gamma = 1$

Table 8: Simulated Equilibrium - Varying correlation in both nests

Table 8 displays the results when we vary the correlation within a nest, assuming symmetric firms and holding everything else constant. As λ decreases (and correlation increases), goods become more substitutable for each other inside a nest. This competition drives down the markup that the downstream firms can charge for the good. Furthermore, as λ decreases, there is less substitution from the B nest to good A, but substitution from $2A$ to $1A$ becomes more intense.

Table 15 in the appendix also varies the λ parameter like Table 8, but only varies λ_A in nest A. We see a similar effect as described above; as λ_A decreases (and correlation within nest A increases) there is more substitution from good $2A$ to $1A$ post-integration and less substitution from nest B.

The effect of the nest characteristics γ and y_k, $k \in \{A, B\}$ on equilibrium outcomes

[3] Assume $\beta_3 = 0$ in this section unless otherwise noted

follows a predictable pattern. As desirable characteristics increase, the downstream goods capture more market share and have a higher price. Pricing and market share patterns pre and post-integration appear to remain similar as characteristics change. These results are captured in Table 9

	Nest characteristics*			Prices							
Integration	γ	y_A	y_B	p_1A	p_1B	p_2A	p_2B	w_1A	w_1B	w_2A	w_2B
0	1	3	3	2.38	2.38	2.38	2.38	1.52	1.52	1.52	1.52
1	1	3	3	1.9	2.55	2.57	2.39	0	1.35	1.91	1.55
0	1	1.5	1.5	2.03	2.03	2.03	2.03	1.27	1.27	1.27	1.27
1	1	1.5	1.5	1.45	2.12	2.1	2.02	0	1.19	1.49	1.26
0	1	0	0	1.8	1.8	1.8	1.8	1.1	1.1	1.1	1.1
1	1	0	0	1.16	1.84	1.79	1.8	0	1.08	1.21	1.09

	Nest characteristics			Markups				Shares				Profits			
Integration	γ	y_A	y_B	1A	1B	2A	2B	1A	1B	2A	2B	A	B	1	2
0	1	3	3	0.86	0.86	0.86	0.86	0.165	0.165	0.165	0.165	0.502	0.502	0.282	0.282
1	1	3	3	1.9	1.2	0.66	0.84	0.314	0.12	0.0817	0.165	0.156	0.416	0.741	0.193
0	1	1.5	1.5	0.76	0.76	0.76	0.76	0.095	0.095	0.095	0.095	0.241	0.241	0.145	0.145
1	1	1.5	1.5	1.45	0.93	0.61	0.76	0.199	0.077	0.054	0.094	0.080	0.209	0.359	0.104
0	1	0	0	0.7	0.7	0.7	0.7	0.0368	0.0368	0.0368	0.0368	0.081	0.081	0.052	0.052
1	1	0	0	1.16	0.76	0.58	0.71	0.0837	0.0334	0.0237	0.0362	0.029	0.076	0.122	0.039

* Nest correlation fixed to $\lambda = 0.5$, Consumer utility fixed to $\beta_0 = -1, \beta_1 = 1, \beta_2 = 0, \beta_3 = 0$

Table 9: Simulated Equilibrium - Varying nest characteristics

4.2 A Dominating Horizontal Integration Effect

Now that we have analyzed the effects of the new parameters introduced in the nested logit model, we turn our attention to finding a set of parameters that creates a scenario where the horizontal integration effect dominates the elimination of double marginalization. In Section 3.6 we found that under the logit model, a high market share/low outside good share scenario created this effect. Because the nested logit houses the logit, we should expect the same result in this model.

Another scenario in which we should expect this result is when good $2A$ has a high market share but a low markup. In this situation, the integrated $U_A - D_1$ firm may not want to lower prices because it makes a large margin off of selling the intermediate product to D_2. To achieve this situation, we will have a low value for λ_A and a positive value for the store brand preference β_2. Thus, the integrated firm is tempted to raise the price of $1A$ since 1.) there will be more substitution to $1A$ because of $2A$'s higher share when the firms are unintegrated and 2.) the high margins to $2A$ incentivize keeping RRC lower to retain business with the other downstream competitor.

	Parameters[a](util fn)			Prices							
Integration	β_0	β_1	β_2	p_1A	p_1B	p_2A	p_2B	w_1A	w_1B	w_2A	w_2B
0	-1	1	0	1.5	2	1.5	2	1.3	1.27	1.3	1.27
1	-1	1	0	1.42	2.12	1.56	2.01	0	1.21	1.43	1.27
0	1	1	0	1.95	2.41	1.95	2.41	1.74	1.62	1.74	1.62
1	1	1	0	2.03	2.69	2.18	2.49	0	1.44	2.04	1.65
0	1	1	0.5	1.77	2.27	2.21	2.64	1.6	1.53	1.92	1.76
1	1	1	0.5	2.05	2.55	2.45	2.75	0	1.34	2.06	1.75

	Parameters[b](util fn)			Markups				Shares				Profits			
Integration	β_0	β_1	β_2	1A	1B	2A	2B	1A	1B	2A	2B	A	B	1	2
0	-1	1	0	0.2	0.73	0.2	0.73	0.115	0.093	0.115	0.093	0.300	0.235	0.090	0.090
1	-1	1	0	1.42	0.91	0.13	0.74	0.191	0.078	0.048	0.096	0.069	0.216	0.342	0.078
0	1	1	0	0.21	0.79	0.21	0.79	0.210	0.176	0.210	0.176	0.732	0.570	0.184	0.184
1	1	1	0	2.03	1.25	0.14	0.84	0.340	0.132	0.075	0.199	0.153	0.517	0.855	0.178
0	1	1	0.5	0.17	0.74	0.29	0.88	0.158	0.161	0.282	0.206	0.795	0.610	0.145	0.266
1	1	1	0.5	2.05	1.21	0.39	1	0.111	0.128	0.297	0.236	0.611	0.585	0.382	0.353

[a] These parameters along with $\beta_3 = 0$ are shared across both nests. However, $\lambda_A = 0.1$ and $\lambda_B = 0.5$
[b] Nest characteristics are fixed to $y = 1.5$ and $\gamma = 1$

Table 10: Simulated Equilibrium - High correlation Nest A

Table 10 shines light on the hypothesis given above. Nest A goods have much higher correlation than nest B goods ($\lambda_A = 0.1, \lambda_B = 0.5$). This does not give rise to a large enough horizontal integration effect when market shares for the four goods are low enough. However, as market shares rise (and more importantly, as the share of $2A$ rises), we see that the horizontal integration effect begins to dominate the EDM effect. After enabling store effects for store 2, thereby increasing the share of $2A$ even more, we observe an even larger horizontal integration effect. In the latter two scenarios, it is important to emphasize that the market share of the outside good varies between $20 - 25\%$, more realistic than the scenarios in Section 3.6 where the share of the outside good was less than 5%.

We also want to see if the results from Section 3.6 hold when using a nested logit model. In Table 11, we analyze the situation where the four main goods have a large market share and the outside good has a low market share.

	Parameters[a] (util fn)			Prices							
Integration	β_0	β_1	β_2	p_1A	p_1B	p_2A	p_2B	w_1A	w_1B	w_2A	w_2B
0	5	1	-2	3.74	3.74	2.11	2.11	2.23	2.23	1.37	1.37
1	5	1	-2	4.08	4.95	4.48	3.15	0	2.04	3.93	2.46
0	5	1	0	2.97	2.97	2.97	2.97	1.98	1.98	1.98	1.98
1	5	1	0	3.04	3.74	3.69	3.53	0	1.84	2.96	2.58
0	5	1	2	2.16	2.16	3.8	3.8	1.42	1.42	2.27	2.27
1	5	1	2	2.52	2.65	4.18	4.16	0	1.21	2.58	2.49

	Parameters[b] (util fn)			Markups				Shares				Profits			
Integration	β_0	β_1	β_2	1A	1B	2A	2B	1A	1B	2A	2B	A	B	1	2
0	5	1	-2	1.51	1.51	0.74	0.74	0.330	0.330	0.158	0.158	0.953	0.953	0.992	0.232
1	5	1	-2	4.08	2.91	0.55	0.69	0.609	0.199	0.005	0.133	0.020	0.733	3.060	0.094
0	5	1	0	0.99	0.99	0.99	0.99	0.247	0.247	0.247	0.247	0.980	0.980	0.492	0.492
1	5	1	0	3.04	1.9	0.73	0.95	0.457	0.160	0.123	0.245	0.362	0.925	1.690	0.322
0	5	1	2	0.74	0.74	1.53	1.53	0.163	0.163	0.336	0.336	0.993	0.993	0.241	1.020
1	5	1	2	2.52	1.44	1.6	1.67	0.168	0.135	0.334	0.357	0.864	1.050	0.619	1.130

[a] These parameters are shared across both nests. Additionally, $\beta_3 = 0, \lambda_k = 0.5$.
[b] Nest characteristics are fixed to $y = 1.5$ and $\gamma = 1$.

Table 11: Simulated Equilibrium - Nested logit with low market share for outside good

The results are similar to those in Table 7, with one difference. In the logit model, it was required to have β_2 be negative (i.e., consumers favor firm 1) for the horizontal integration effect to dominate. However, we see that with the nested logit model the store effect did not have any qualitative effect on post-integration behavior. When there is a low market share of the outside good, there is no incentive for the integrated firm to lower p_{1A} because it will not capture enough substitution from the outside good. Therefore, prices are raised to better extract profit direct substitution to $2A$ and profits are extracted from the high intermediate price w_{2A}.

In summary, the nested logit introduced the following new scenarios a substantial horizontal integration effect is observed. The first happens when correlation is high in the A nest, market shares reach some moderate threshold, and downstream markups are low. This scenario is displayed in the middle rows of Table 10. The result holds when we introduce an additional store effect favoring D_2. The second occurs in the low outside good market share scenario, but now D_2 is the preferred downstream store. These two new scenarios tell us that a key aspect of measuring anti-competitive effects is that regulators need to be able to define the market accurately and correctly identify the outside option. As these results show, post-integration behavior is not only heavily dependent but also very sensitive to the share of the outside good.

5 Conclusion

We develop a simulation model in this paper to illustrate situations where vertically integrated firms have a new strategic decision to operate in an anti-competitive manner. These firms can ignore any efficiencies gained through integration and instead raise the price of its downstream good to the final consumer. We call this effect a dominating horizontal integration effect and observe it in certain situations given assumptions on consumer demand behavior and parameters of the consumer utility function. In one scenario, we show that vertical integration in which the market share of the outside good is low causes a dominating horizontal integration effect. This effect may be explained by the lack of available market left to capture, dissuading integrating firms to pass through efficiencies to the consumer. Another scenario occurs when upstream firms have more power than the downstream firms, and therefore have a higher relative margin with respect to the final price. In this situation, the integrated firm may increase their downstream good price in order to create substitution to a competing good for which they provide an intermediate input to. Rather than losing all the profits resulting from a price increase, the integrated firm can recoup some of the losses because of increased demand for the intermediate good.

The results of this paper should be of interest to regulators and policy makers who focus on competition effects in industry. Vertical mergers are often less scrutinized than horizontal mergers because the common belief is that vertical mergers enable efficiencies without concerns of monopolizing market power. While other anticompetitive effects may occur in the intermediate good market, we show situations where the integrated firm can create negative welfare effects in both the intermediate good market and the downstream market post-integration. Regulators need to be cognizant of these situations and examine consequences of vertical merger more closely if such cases do arise.

There are many logical extensions of this paper's methodology and design. Most importantly is the lack of an empirical application, which is an obvious next step. A straightforward empirical application of this paper would find a market where vertical integration happens and estimate the consumer demand parameters before running this model. Other methodological improvements can be made in the assumptions of the consumer utility and consumer demand function. For example, one can choose an Almost Ideal Demand System or a BLP type model to simulate demand - the degree of complexity depends on what one is striving to achieve. Future projects can also alter the model structure like timing and enable partial integration to observe richer effects. Product differentiation is done through the utility function and nesting in this model, but many other adaptions may be used. The oligopoly structure in this paper can possibly be generalized to include more firms and more downstream products. One final suggestion is to include bargaining between the upstream and downstream firms, rather than having take-it-or-leave-it offers.

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6 Appendix

	Parameters (utility fn)				Downstream Equilibria							
Integration	β_0	β_1	β_2	β_3	p_1A	p_1B	p_2A	p_2B	w_1A	w_1B	w_2A	w_2B
0	-1	1	-3	3	2.39	3.1	2.05	2.39	1.04	1.74	1.03	1.36
1	-1	1	-3	3	1.41	3.09	2.43	2.35	0	1.68	1.41	1.32
0	log(4)	1	-3	3	3.03	4.51	2.2	2.97	1.15	2.63	1.09	1.86
1	log(4)	1	-3	3	2.18	4.42	3.16	2.82	0	2.26	2.05	1.71
0	log(100)	1	-3	3	4.2	6.18	2.53	4.11	1.33	3.31	1.22	2.81
1	log(100)	1	-3	3	3.6	6.16	4.43	4.07	0	2.56	3.21	2.84

	Parameters (utility fn)				Markups				Shares				Profits			
Integration	β_0	β_1	β_2	β_3	1A	1B	2A	2B	1A	1B	2A	2B	A	B	1	2
0	-1	1	-3	3	1.35	1.36	1.02	1.03	0.024	0.238	0.002	0.024	0.027	0.447	0.354	0.026
1	-1	1	-3	3	1.41	1.41	1.02	1.03	0.061	0.229	0.001	0.024	0.002	0.418	0.410	0.026
0	log(4)	1	-3	3	1.88	1.88	1.11	1.11	0.094	0.384	0.010	0.089	0.107	1.180	0.879	0.110
1	log(4)	1	-3	3	2.18	2.16	1.11	1.11	0.173	0.361	0.003	0.089	0.007	0.970	1.150	0.102
0	log(100)	1	-3	3	2.87	2.87	1.31	1.3	0.172	0.479	0.046	0.188	0.285	2.110	1.870	0.305
1	log(100)	1	-3	3	3.6	3.6	1.22	1.23	0.281	0.436	0.006	0.175	0.019	1.610	2.580	0.221

Table 12: Simulated Equilibrium - B Dominant Brand, 1 Dominant Store

	Parameters (utility fn)				Downstream Equilibria							
Integration	β_0	β_1	β_2	β_3	p_1A	p_1B	p_2A	p_2B	w_1A	w_1B	w_2A	w_2B
0	-1	1	3	-3	2.39	2.04	3.1	2.39	1.36	1.01	1.74	1.04
1	-1	1	3	-3	1.49	3.75	3.11	2.37	0	2.26	1.77	1.04
0	log(4)	1	3	-3	2.97	2.2	4.51	3.03	1.86	1.09	2.63	1.15
1	log(4)	1	3	-3	2.34	3.4	4.51	2.96	0	1.07	2.72	1.17
0	log(100)	1	3	-3	4.11	2.53	6.17	4.2	2.81	1.22	3.3	1.33
1	log(100)	1	3	-3	3.56	4.7	6.12	4.02	0	1.14	3.53	1.42

	Parameters (utility fn)				Markups				Shares				Profits			
Integration	β_0	β_1	β_2	β_3	1A	1B	2A	2B	1A	1B	2A	2B	A	B	1	2
0	-1	1	3	-3	1.03	1.03	1.36	1.35	0.024	0.002	0.237	0.024	0.447	0.027	0.026	0.354
1	-1	1	3	-3	1.49	1.49	1.34	1.33	0.057	0.000	0.228	0.024	0.404	0.026	0.086	0.328
0	log(4)	1	3	-3	1.11	1.11	1.88	1.88	0.089	0.010	0.384	0.084	1.180	0.107	0.110	0.878
1	log(4)	1	3	-3	2.34	2.33	1.79	1.79	0.155	0.003	0.357	0.084	0.970	0.101	0.369	0.787
0	log(100)	1	3	-3	1.3	1.31	2.87	2.87	0.188	0.046	0.480	0.172	2.110	0.285	0.305	1.870
1	log(100)	1	3	-3	3.56	3.56	2.59	2.6	0.282	0.004	0.436	0.178	1.540	0.258	1.020	1.600

Table 13: Simulated Equilibrium - A Dominant Brand, 2 Dominant Store

	Parameters (utility fn)				Downstream Equilibria							
Integration	β_0	β_1	β_2	β_3	p_1A	p_1B	p_2A	p_2B	w_1A	w_1B	w_2A	w_2B
0	-1	1	-3	-3	2.14	2.05	2.06	1.98	1.09	1	1.06	0.982
1	-1	1	-3	-3	1.12	2.11	2.13	3.02	0	0.984	1.13	2.02
0	log(40)	1	-3	-3	4.08	2.81	2.77	2.16	2.38	1.11	1.7	1.08
1	log(40)	1	-3	-3	3.01	4.04	4.04	2.06	0	1.03	3.02	1.04
0	log(1000)	1	-3	-3	5.88	3.96	3.86	2.45	3.22	1.3	2.59	1.18
1	log(1000)	1	-3	-3	5.27	6.38	6.2	2.3	0	1.11	5.14	1.24

	Parameters (utility fn)				Markups				Shares				Profits			
Integration	β_0	β_1	β_2	β_3	1A	1B	2A	2B	1A	1B	2A	2B	A	B	1	2
0	-1	1	-3	-3	1.05	1.05	1	0.998	0.041	0.002	0.002	0.000	0.048	0.002	0.046	0.002
1	-1	1	-3	-3	1.12	1.126	1	1	0.106	0.002	0.002	0.000	0.002	0.002	0.122	0.002
0	log(40)	1	-3	-3	1.7	1.7	1.07	1.08	0.349	0.062	0.065	0.006	0.942	0.076	0.699	0.076
1	log(40)	1	-3	-3	3.01	3.01	1.02	1.02	0.645	0.011	0.012	0.004	0.035	0.016	1.980	0.016
0	log(1000)	1	-3	-3	2.66	2.66	1.27	1.27	0.466	0.158	0.175	0.036	1.950	0.247	1.660	0.266
1	log(1000)	1	-3	-3	5.27	5.27	1.06	1.06	0.782	0.013	0.015	0.038	0.079	0.061	4.190	0.056

Table 14: Simulated Equilibrium - A Dominant Brand, 1 Dominant Store

	Parameters[a](utility fn)				Downstream Equilibria							
Integration	β_0	β_1	β_2	λ_A	p_1A	p_1B	p_2A	p_2B	w_1A	w_1B	w_2A	w_2B
0	-1	1	0	0.9	2.4	2.04	2.4	2.04	1.29	1.26	1.29	1.26
1	-1	1	0	0.9	1.47	2.13	2.55	2.03	0	1.18	1.5	1.25
0	-1	1	0	0.5	2.03	2.03	2.03	2.03	1.27	1.27	1.27	1.27
1	-1	1	0	0.5	1.45	2.12	2.1	2.02	0	1.19	1.49	1.26
0	-1	1	0	0.1	1.5	2	1.5	2	1.3	1.27	1.3	1.27
1	-1	1	0	0.1	1.42	2.12	1.56	2.01	0	1.21	1.43	1.27

	Parameters[b](utility fn)				Markups				Shares				Profits			
Integration	β_0	β_1	β_2	λ_A	1A	1B	2A	2B	1A	1B	2A	2B	A	B	1	2
0	-1	1	0	0.9	1.11	0.78	1.11	0.78	0.0883	0.0955	0.0883	0.0955	0.228	0.241	0.173	0.173
1	-1	1	0	0.9	1.47	0.95	1.05	0.78	0.208	0.0743	0.0629	0.0905	0.0944	0.201	0.377	0.137
0	-1	1	0	0.5	0.76	0.76	0.76	0.76	0.095	0.095	0.095	0.095	0.241	0.241	0.145	0.145
1	-1	1	0	0.5	1.45	0.93	0.61	0.76	0.199	0.077	0.054	0.094	0.080	0.209	0.359	0.104
0	-1	1	0	0.1	0.2	0.73	0.2	0.73	0.115	0.0925	0.115	0.0925	0.3	0.235	0.09	0.09
1	-1	1	0	0.1	1.42	0.91	0.13	0.74	0.191	0.0776	0.0479	0.0964	0.0685	0.216	0.342	0.0781

[a] Parameters displayed are for nest A only. Nest B is fixed with $\beta_0 = -1$, $\beta_1 = 1$, $\beta_2 = 0$, $\beta_3 = 0$, $\lambda = 0.5$

[b] Nest characteristics are fixed to $y = 1.5$ and $\gamma = 1$

Table 15: Simulated Equilibrium - Varying correlation in Nest A