MERGER SIMULATIONS IN DIFFERENTIATED PRODUCT MARKETS

1. Estimate demand structure, cost structure, assume a behavioral oligopoly model and grind out the implied equilibrium prices and quantities before and after the merger.

2. In principle, this makes it unnecessary to conduct conventional market definition exercises, to measure concentration ratios and to draw inferences from them about market power. It does not help directly on the efficiencies side, but it makes it possible to see how large efficiencies must be to balance price increasing effects.

3. Alternatives to conventional structural analyses seem especially important when analyzing differentiated product markets like cereals, beer, video programming, and a variety of household products. Good transactions data (scanner data) now makes it possible to get weekly data on transactions prices for many cities for a large number of consumer goods sold in supermarkets and large drug stores.

4. Several Alternative Approaches:

Hausman:

- Demand System: Gorman multi-stage budgeting structure specified and estimated. Minimal functional form restrictions on elasticities and cross elasticities.

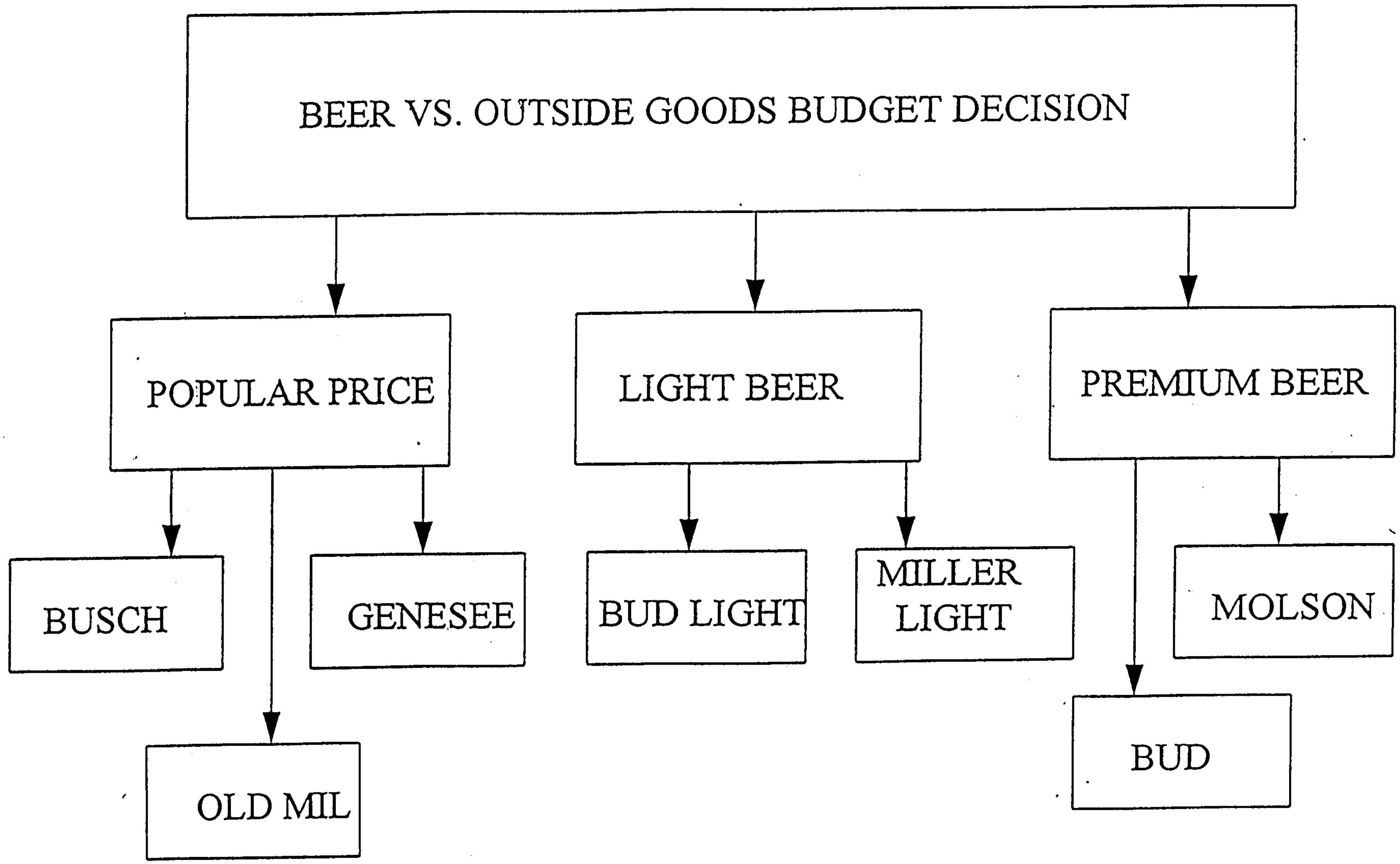
- Prices endogenous and finding instruments for identification and consistent estimation is tricky.

- Weekly scanner data across cities for brand equations. Longer more aggregated time series data for overall product elasticities.

- Costs not measured. MCs assumed constant and inferred from FOCs that define Lerner indices as a function of estimated elasticities and cross elasticities.

- Bertrand competition, no entry.

MULTISTAGE BUDGETING APPROACH



Werden & Froeb:

- Demand system: Simple logit or nested logit

- Othewise similar to Hausman

Berry, Levinson & Pakes (BLP)

- Demand system: More complex demand structure based on specification of utility function (generally work with utility function that yields logit demand structure that includes measurable attributes of the differentiated products. Also nested logit variations possible.) Allows prices of products to be either strategic substitutes or strategic complements.

- Specifies and estimates firms' costs as a function of product characteristics that consumers value.

- Define distribution of consumer characteristics and the distribution of product characteristics.

- Joint estimation of demand, cost and FOCs

- Nash-Bertrand price competition equilibrium used with estimated demand and cost structure to define FOC for equilibrium prices and quantities.

- Simulate

- Nash-Bertrand price competition equilibrium used with estimated demand and cost structure to define FOC for equilibrium prices and quantities

- Simulate

"Natural Experiment" Approaches

- Explain prices based on cost variables plus market structure variables for the same products sold in different geographic markets

- Need products where geographic markets are local/regional

- Need instruments to deal with endogeneity problems

- Application in Staples/Office Depot Merger as an example

(1) $$s_{Int} = \alpha_{In} + \beta_I \log (Y_{nt} / P_{nt}) + \sum_{J \in B,P} \gamma_{IJ} \log p_{Jnt} + \varepsilon_{Int},$$

$$n = 1,\ldots,N \quad t = 1,\ldots,T$$

(2) $$\log u_{nt} = \mu_n + \delta_1 \log y_{nt} + \delta_2 \log P_{nt} + Z_{nt}\delta_3 + \varepsilon_{nt}$$

(3) $$\log p_{jnt} = \delta_j \log c_{jt} + \alpha_{jn} + w_{jnt}$$

(4) $$\pi_1 = (p_1 - c_1)\, Q_1(p)$$

(5) $$Q_1(p) + (p_1 - c_1)\,\frac{\partial Q_1(p)}{\partial p_1} = 0$$

(6) $$\frac{p_1 - c_1}{p_1} = -\frac{1}{e_{11}(p)}$$

(7) $$(p_1 - c_1)\, Q_1(p) + (p_2 - c_2)\, Q_2(p) = \pi_1 + \pi_2$$

$$s_1(p) \cdot e_{11}(p) \cdot \frac{p_1 - x_1}{p_1} + s_2(p) \cdot e_{21}(p) \cdot \frac{p_2 - x_2}{p_2} = -s_1(p) \tag{8}$$

$$s_1(p) \cdot e_{12}(p) \cdot \frac{p_1 - x_1}{p_1} + s_2(p) \cdot e_{22}(p) \cdot \frac{p_2 - x_2}{p_2} = -s_2(p)$$

$$\frac{p_i - c_i}{p_i} = -\frac{1}{e_{ii}(p)}, \qquad i = 3, \ldots, n \tag{9}$$

$$s + E' w = 0 \tag{10}$$

$$w = -(E')^{-1} s \tag{11}$$

(12)

$$\frac{(p_l - c_l)}{p_l} = \frac{w_l}{s_l}$$

	Brand 1	Brand 2
Pre-Merger Prices	$1	$1
Shares	20%	10%
Own Elasticity	-2	-2.5
Cross Elasticity w.r.t. other	0.15	0.30

(13)

$$0.2 \cdot (-2) \cdot \frac{p_1 - x1}{p_1} + 0.1 \cdot 0.3 \cdot \frac{p_2 - x_2}{p_2} = -0.2$$

$$0.2 \cdot 0.15 \cdot \frac{p_1 - x1}{p_1} + 0.1 \cdot (-2.5) \cdot \frac{p_2 - x_2}{p_2} = -0.1$$

(14)

$$\frac{p_1 - x_1}{p_1} = \frac{0.2 + 0.03 \frac{p_2 - x_2}{p_2}}{0.4}$$

REAL WORLD APPLICATION

1. Kimberly-Clark proposed to acquire Scott. Both companies made toilet paper (bath tissues):

Scott:	Cottonelle and ScotTissue ("premium product")
K-C:	Kleenex ("premium product")

2. Apply this approach using weekly retail scanner data for 5 U.S. cities January 1992-May 1995.

Table 1: Shares

Table 2: Estimated demand structure

Table 3: Price increases from merger without any reductions in MC and with marginal cost reductions claimed by the parties.

Note results are not very sensitive to alternative demand specifications. Price increases are small, despite HHI tests would suggest big problems. Cost savings from merger are likely to be important.

Table 1
Bath Tissue Dollar Shares

Kleenex	7.5%
Charmin	30.9%
Cottonelle	6.7%
Northern	12.4%
Angel Soft	8.8%
ScotTissue	16.7%
Private Label	7.6%
Other	9.4%

Table 2

Bath Tissue Demand Elasticities

		With Respect To The Price Of							
		Kleenex	Charmin	Cottonelle	Northern	Angel Soft	ScotTissue	Private Lab	Other
	Kleenex	-3.375 (0.159)	0.686 (0.169)	0.191 (0.122)	0.214 (0.143)	0.129 (0.154)	0.178 (0.157)	0.033 (0.091)	0.510 (0.131)
	Charmin	0.066 (0.043)	-2.746 (0.098)	0.039 (0.044)	0.023 (0.057)	0.036 (0.058)	0.108 (0.066)	-0.222 (0.036)	-0.090 (0.049)
Elasticity	Cottonelle	0.135 (0.138)	0.269 (0.203)	-4.517 (0.200)	0.810 (0.172)	0.512 (0.185)	0.224 (0.190)	0.051 (0.109)	0.013 (0.153)
Of	Northern	0.041 (0.086)	0.112 (0.136)	0.429 (0.091)	-4.211 (0.149)	0.550 (0.116)	0.410 (0.125)	0.121 (0.070)	-0.063 (0.099)
The Demand	Angel Soft	0.019 (0.131)	0.171 (0.199)	0.380 (0.139)	0.772 (0.165)	-4.077 (0.247)	0.075 (0.189)	0.168 (0.107)	-0.153 (0.151)
For	ScotTissue	0.061 (0.066)	0.536 (0.099)	0.143 (0.070)	0.417 (0.085)	0.123 (0.092)	-2.943 (0.137)	0.077 (0.058)	-0.109 (0.083)
	Private Lab	0.124 (0.087)	-0.112 (0.119)	0.198 (0.092)	0.494 (0.108)	0.409 (0.119)	0.417 (0.130)	-2.024 (0.105)	0.272 (0.108)
	Other	0.462 (0.100)	0.341 (0.135)	0.128 (0.104)	0.152 (0.124)	0.026 (0.136)	-0.031 (0.149)	0.181 (0.086)	-1.980 (0.175)

Table 3
Estimated Price Changes

	Linearization No Efficiencies	Exact No Efficiencies	Logit No Efficiencies	Exact Efficiencies
Kleenex	3.5%	2.4%	4.2%	0.4%
Cottonelle	2.2%	1.4%	1.0%	-0.3%
ScotTissue	1.4%	1.2%	1.4%	-1.8%
Charmin	0.0%	0.2%	0.0%	-0.1%
Northern	0.0%	0.3%	0.0%	-0.2%
Angel Soft	0.0%	0.2%	0.0%	-0.1%
Private Label	0.0%	0.7%	0.0%	-0.4%
Other	0.0%	0.7%	0.0%	-0.1%

TABLE 1

Beer Segment Conditional Demand Equations.

	Premium	Popular	Light
Constant	0.501	−4.021	−1.183
	(0.283)	(0.560)	(0.377)
log (Beer Exp)	0.978	0.943	1.067
	(0.011)	(0.022)	(0.015)
log ($P_{PREMIUM}$)	−2.671	2.704	0.424
	(0.123)	(0.244)	(0.166)
log ($P_{POPULAR}$)	0.510	−2.707	0.747
	(0.097)	(0.193)	(0.127)
log (P_{LIGHT})	0.701	0.518	−2.424
	(0.070)	(0.140)	(0.092)
Time	−0.001	−0.000	0.002
	(0.000)	(0.001)	(0.000)
log (# of Stores)	−0.035	0.253	−0.176
	(0.016)	(0.034)	(0.023)

Number of Observations = 101.

TABLE 2

Brand Share Equations: Premium.

	1 Budweiser	2 Molson	3 Labatts	4 Miller	5 Coors
Constant	0.393	0.377	0.230	−0.104	–
	(0.062)	(0.078)	(0.056)	(0.031)	–
Time	0.001	−0.000	0.001	0.000	–
	(0.000)	(0.000)	(0.000)	(0.000)	–
log (Y/P)	−0.004	−0.011	−0.006	0.017	–
	(0.006)	(0.007)	(0.005)	(0.003)	–
log ($P_{Budweiser}$)	−0.936	0.372	0.243	0.150	–
	(0.041)	(0.231)	(0.034)	(0.018)	–
log (P_{Molson})	0.372	−0.804	0.183	0.130	–
	(0.231)	(0.031)	(0.022)	(0.012)	–
log ($P_{Labatts}$)	0.243	0.183	−0.588	0.028	–
	(0.034)	(0.022)	(0.044)	(0.019)	–
log (P_{Miller})	0.150	0.130	0.028	−0.377	–
	(0.018)	(0.012)	(0.019)	(0.017)	–
log (# of Stores)	−0.010	0.005	−0.036	0.022	–
	(0.009)	(0.012)	(0.008)	(0.005)	–
Conditional Own Price Elasticity	−3.527	−5.049	−4.277	−4.201	−4.641
	(0.113)	(0.152)	(0.245)	(0.147)	(0.203)

$$\Sigma = \begin{Bmatrix} 0.000359 & -1.436E-05 & -0.000158 & -2.402E-05 \\ - & 0.000109 & -6.246E-05 & -1.847E-05 \\ - & - & 0.005487 & -0.000392 \\ - & - & - & 0.000492 \end{Bmatrix}$$

Note: Symmetry imposed during estimation.

TABLE 5

Overall Elasticities.

	Elasticity	Standard Error
Budweiser	−4.196	0.127
Molson	−5.390	0.154
Labatts	−4.592	0.247
Miller	−4.446	0.149
Coors	−4.897	0.205
Old Milwaukee	−5.277	0.118
Genesee	−4.236	0.129
Milwaukee's Best	−6.205	0.170
Busch	−6.051	0.332
Piels	−4.117	0.469
Genesee Light	−3.763	0.072
Coors Light	−4.598	0.115
Old Milwaukee Light	−6.097	0.140
Lite	−5.039	0.141
Molson Light	−5.841	0.148

Light Segment Own and Cross Elasticities.

	Genesee Light	Coors Light	Old Milwaukee Light	Lite	Molson Light
Genesee Light	−3.763	0.464	0.397	0.254	0.201
	(0.072)	(0.060)	(0.039)	(0.043)	(0.037)
Coors Light	0.569	−4.598	0.407	0.452	0.482
	(0.085)	(0.115)	(0.058)	(0.075)	(0.061)
Old Milwaukee Light	1.233	0.956	−6.097	0.841	0.565
	(0.121)	(0.132)	(0.140)	(0.112)	(0.087)
Lite	0.509	0.737	0.587	−5.039	0.577
	(0.095)	(0.122)	(0.079)	(0.141)	(0.083)
Molson Light	0.683	1.213	0.611	0.893	−5.841
	(0.124)	(0.149)	(0.093)	(0.125)	(0.148)

between two brands, say 1 and 2, which are in different segments G and H takes the form:

Estimated Price Increases for Hypothetical Merging Brands Assumed Efficiency Gains.

	0%	5%	10%
Coors	4.4%	−0.8%	−6.1%
	(1.2)	(1.2)	(1.1)
Labatts	3.3	−1.9	−7.0
	(1.0)	(1.0)	(0.9)

APPLICATION ISSUES

1. How much of a price increase is too much of a price increase? How does one interpret these results?

2. Adequate data are often not available to apply this technique. Alternative data sources and specifications can lead to significantly different results.

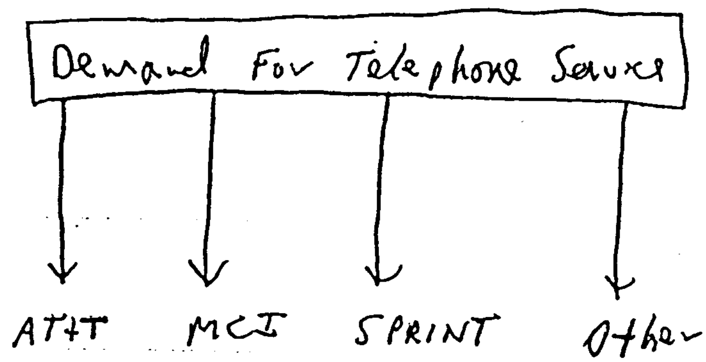
3. How should we think about behavioral assumptions? Worst case? Entry considerations?

4. How do we "test" the reasonableness of the behavioral assumptions. Check implied pre-merger prices and margins against actual pre-merger prices and margins.

5. How can judges and juries deal with this type of analysis?

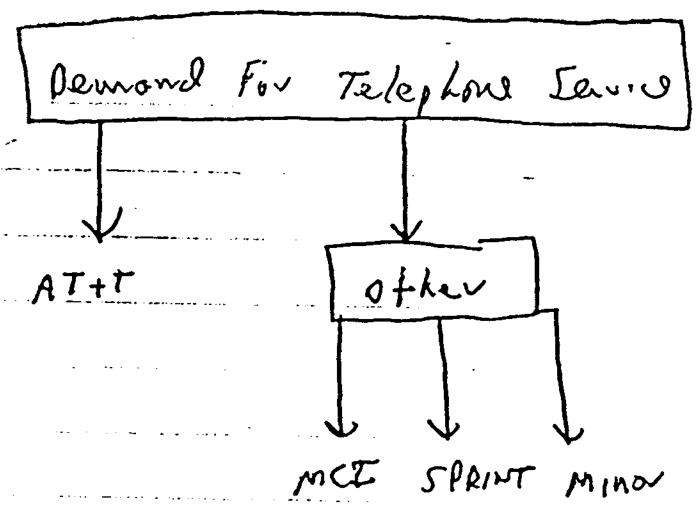
Logit Oligopoly   Werden + Froeb (1994)

Choice probabilities π_j



NESTED LOGIT

Choice probabilities



Logit Demand Specification

Brands $k = 1 \ldots n-1$

n = "outside good"

$$\pi_j = \frac{\exp(\alpha_j + \beta P_j)}{\sum_{k \neq n} \exp(\alpha_k - \beta P_k)}$$

choice probability for brand j

(note β = constant across brands)

$$\epsilon_j = \beta P_j (1 - \pi_j)$$

Own-price elasticity for brand j

$$= \left[\beta \bar{P} (1 - S_j) + \epsilon S_j\right] P_j / \bar{P}$$

$$\epsilon_{jk} = \beta P_k \pi_k$$

Cross-price elasticity of demand for product j with respect to price of brand k

$$= S_k (\beta \bar{P} - \epsilon) P_k / \bar{P}$$

constant for all brands $j \neq k$

CONSEQUENCES OF MERGERS ABSENT COST SAVINGS WITH LOGIT DEMAND STRUCTURE

- Merging firms' prices increase
- Non-merging firms' prices increase (strategic complements)
- Non-merging firms increase prices less than (weighted average) merging firms
- Consumer welfare always decreases absent cost savings
- Mergers lead to two kinds of reallocations:

  - share of industry output of non-merging firms rises since prices rise less than for merging firms

  - merging firms reallocate production from high cost firm to low-cost firm

LIMITATIONS OF LOGIT SPECIFICATION

- Underlying random utility model embodies "Independence of Irrelevant Alternatives" (IIA) assumption.

- Cross-elasticity of demand for all brands with respect to the price of a specific brand is a constant. All brands are in this sense "equally close" substitutes.

- As price rises for a brand, consumers substitute to other brands in proportion to their market shares (e.g. price of Mercedes increases and largest fraction of consumers who shift choose Toyota and Honda instead.)

- Nesting makes it possible to place more restrictions on cross-elasticities, although those within a nest will always be constant wrt to price of a particular brand in the next.

Table 3
Calculated Price and Welfare Effects of Possible Mergers
Assuming and that Mergers Do Not Affect Marginal Costs

Merger	$\Delta p_{AT\&T}$	Δp_{MCI}	Δp_{Sprint}	Δp_{Minor}	Δp_{Ind}	ΔCW	ΔW
AT&T–MCI	4.89	25.70	0.49	0.21	5.06	5.63	2.30
AT&T–Sprint	2.90	0.48	24.42	0.12	2.82	3.40	1.24
AT&T–Minor	1.22	0.20	0.12	23.82, 0.05	1.18	1.45	0.49
MCI–Sprint	0.58	2.10	3.35	0.03	1.01	0.98	0.05
MCI–Minor	0.25	0.89	0.03	3.28, 0.02	0.44	0.43	0.01
Sprint–Minor	0.16	0.04	0.85	1.96, 0.04	0.27	0.27	0.00
Minor–Minor	0.07	0.02	0.01	0.84, 0.00	0.12	0.12	0.00

Note: For mergers involving a minor firm, the Δp_{Minor} column first lists the price increase for the merging minor firm(s), then that for the nonmerging minor firm(s).

Table 5
Calculated Price and Welfare Effects of Possible Mergers
Assuming the Cost Advantages of Large Firms Can Be Extended Through Merger

Merger	$\Delta p_{AT\&T}$	Δp_{MCI}	Δp_{Sprint}	Δp_{Minor}	Δp_{Ind}	ΔCW	ΔW
AT&T–MCI	5.95	10.96	0.44	0.19	4.92	5.06	0.06
AT&T–Sprint	3.77	0.41	6.33	0.10	2.75	2.91	-0.13
AT&T–Minor	1.64	0.16	0.10	4.14, 0.04	1.15	1.21	-0.16
MCI–Sprint	0.33	2.35	0.14	0.02	0.59	0.56	-0.31
MCI–Minor	0.10	1.04	0.01	-1.14, 0.01	0.18	0.20	-0.20
Sprint–Minor	0.12	0.03	0.89	0.89, 0.01	0.20	0.20	-0.05
Minor–Minor	0.07	0.02	0.01	0.84, 0.00	0.12	0.13	-0.00

Note: For mergers involving a minor firm, the Δp_{Minor} column first lists the price increase for the merging minor firm(s), then that for the nonmerging minor firm(s).

the context of the more restrictive logit model. The results, presented in Appendix B, demonstrate that the estimates obtained from the different identifying assumptions are essentially identical.

5. Results

■ This section simulates price changes that would result from mergers in the ready-to-eat cereal industry. Five mergers and acquisitions are examined. First, I analyze Post's acquisition of the Nabisco cereal line and General Mills' acquisition of Chex. Next, I simulate the effects of the proposed purchase of Nabisco cereals by General Mills, which was called off due to antitrust concerns. Finally, I examine two hypothetical mergers: Quaker Oats with Kellogg and Quaker Oats with General Mills. The choice of these two is intended only to demonstrate how the model works.

□ **Demand.** Results of the demand estimation are presented in Table 2. The first column displays the means of the taste parameters, α and β. The next five columns

TABLE 2 **Results from Mixed Logit Model**

			Interactions with Demographic Variables:			
Variable	Means (β's)	Standard Deviations (σ's)	log(Income)	log(Income)^2	Age	Child
Price	−43.039	.339	761.747	−41.637	—	−3.053
	(11.015)	(2.119)	(214.241)	(11.799)		(4.181)
Advertising	.030	—	—	—	—	—
	(.009)					
Constant	−2.685[a]	.095	2.331	—	.4586	—
	(.135)	(.649)	(2.601)		(.650)	
Cal from fat	1.661[a]	3.396	—	—	—	—
	(.261)	(2.713)				
Sugar	18.540[a]	.845	−45.439	—	7.302	—
	(.994)	(6.337)	(14.616)		(3.978)	
Mushy	.938[a]	.348	11.322	—	1.193	—
	(.268)	(.922)	(2.435)		(.824)	
Fiber	−2.898[a]	2.036	—	—	—	−14.685
	(.445)	(4.520)				(5.866)
All-family	1.237[a]	.216	—	—	—	
	(.134)	(1.496)				
Kids	−2.539[a]	1.739	—	—	—	
	(.276)	(.740)				
Adults	3.788[a]	1.959	—	—	—	
	(.441)	(.862)				
GMM objective (degrees of freedom)				1.60 (8)		
Minimum distance χ^2 (degrees of freedom)				148 (16)		
Minimum distance weighted R^2				.51		
% of price coefficients >0				0		

Number of observations is 21,600. Except where noted, parameters are GMM estimates. All regressions include brand and time dummy variables. Robust standard errors are given in parentheses.

[a] Estimates from a second-stage minimum distance projection of the estimated brand fixed effects onto product characteristics.

TABLE 3 **Median Own and Cross-Price Elasticities**

#	Brand	K Corn Flakes	K Raisin Bran	K Frosted Flakes	K Rice Krispies
1	K Corn Flakes	−3.696	.023	.500	.010
2	K Raisin Bran	.023	−2.061	.088	.051
3	K Frosted Flakes	.361	.059	−3.546	.028
4	K Rice Krispies	.010	.048	.040	−1.320
5	K Frosted Mini Wheats	.000	.053	.003	.057
6	K Froot Loops	.000	.010	.008	.038
7	K Special K	:155	.072	.248	.039
8	K NutriGrain	.270	.094	.313	.023
9	K Crispix	.003	.038	.020	.079
10	K Cracklin Oat Bran	.000	.023	.001	.046
11	GM Cheerios	.007	.080	.035	.069
12	GM Honey Nut Cheerios	.001	.017	.017	.043
13	GM Wheaties	.503	.113	.445	.029
14	GM Total	.140	.064	.238	.042
15	GM Lucky Charms	.000	.012	.010	.041
16	GM Trix	.000	.010	.009	.043
17	GM Raisin Nut	.007	.137	.043	.059
18	P Raisin Bran	.014	.232	.063	.050
19	P Grape Nuts	.001	.048	.006	.050
20	Q 100% Natural	.000	.023	.002	.048
21	Q Life	.003	.038	.052	.048
22	Q CapNCrunch	.001	.013	.015	.038
23	R Chex	.005	.037	.028	.081
24	N Shredded Wheat	.002	.081	.018	.049
25	Outside good	.158	.036	.107	.036

Cell entries i, j, where i indexes row and j column, give the percent change in market share of brand i with a 1% change in price of j. Each entry represents the median of the elasticities from the 900 markets. K = Kellogg, GM = General Mills, P = Post, Q = Quaker Oats, R = Ralston, N = Nabisco.

This phenomenon is not limited just to my data. It appears also in Hausman (1996). This result may, however, be due to idiosyncracies of the cereal industry, since it does not seem to happen in the studies of Hausman, Leonard, and Zona (1994) and Ellison et al. (1997). It is my conjecture that this is due to a partial failure of the instrumental variables. Demand at the bottom level of the multilevel system is estimated by regressing quantities (expenditure shares) on prices of all brands in that segment. This requires that the instrumental variables have sufficient variation across brands in order to precisely estimate the effects of prices of all close competitors. For very close substitutes, prices in all markets are likely to move jointly (either due to strategic effects or common cost and demand shocks). Since the instrumental variables I use are prices in other cities, they are likely to be highly correlated across brands. Therefore, the instrumental

TABLE 3 *Extended*

GM Cheerios	GM Lucky Charms	P Raisin Bran	P Grape Nuts	Q Life	R Chex	Shredded Wheat
.011	.000	.007	.000	.000	.002	.001
.131	.008	.110	.030	.011	.012	.032
.040	.004	.021	.003	.008	.006	.005
.106	.025	.023	.030	.033	.024	.018
.102	.034	.032	.054	.044	.015	.023
.043	.111	.006	.024	.163	.010	.008
.054	.002	.025	.019	.004	.009	.028
.046	.001	.034	.011	.002	.004	.022
.103	.027	.019	.032	.035	.024	.018
.103	.040	.014	.039	.058	.012	.011
−1.709	.020	.041	.037	.028	.021	.024
.055	.099	.009	.026	.142	.012	.010
.054	.001	.041	.003	.002	.005	.007
.059	.003	.022	.020	.005	.010	.027
.049	−1.945	.007	.026	.149	.011	.009
.052	.102	.006	.024	.141	.012	.009
.160	.012	.065	.029	.019	.016	.026
.134	.009	−2.030	.036	.012	.011	.034
.089	.025	.026	−2.096	.032	.013	.070
.103	0.42	.013	.036	.063	.013	.011
.080	.072	.019	.028	.103	.014	.015
.048	.105	.007	.023	−1.559	.010	.008
.106	.024	.017	.027	.031	−1.749	.017
.099	.015	.043	.115	.020	.014	−2.268
.048	.017	.016	.017	.030	.009	.010

variables are unlikely to have enough variation, across close substitutes, to separate the effects of own price and prices of close substitutes. In the discrete-choice framework I rely on theory to derive an estimation equation, which includes only own price and not the prices of other substitutes, therefore relaxing some of the requirements from the instrumental variables.

□ **Marginal costs.** Marginal costs are recovered by assuming a premerger Nash-Bertrand equilibrium, as described in Section 3. This procedure makes several strong assumptions, which were previously discussed. Below I examine some of the implications of these assumptions. Predicted marginal costs are displayed in Table 4. Marginal cost is defined, in this context, as the cost to the manufacturer of getting a box of cereal to the shelf. It includes transportation costs from the plant to the supermarket, the retailer's cost, and markup. Therefore, these predicted costs will

TABLE 4 **Predicted Marginal Costs**

	Median Premerger Price (¢ per serving)	Median Marginal Cost (¢ per serving)		Margin $(p - mc)/p$	
		Logit	Mixed Logit	Logit	Mixed Logit
K Corn Flakes	9.8	3.1	6.5	68.5%	34.8%
K Raisin Bran	17.3	10.7	7.4	38.1%	57.4%
K Frosted Flakes	14.8	8.3	9.8	44.2%	31.9%
K Rice Krispies	13.1	6.5	1.8	50.4%	85.8%
K Frosted Mini Wheats	28.0	21.4	14.7	23.7%	46.7%
K Froot Loops	18.3	11.7	8.7	36.4%	52.4%
K Special K	20.7	14.1	14.5	31.7%	32.5%
K NutriGrain	18.0	11.4	12.0	36.4%	33.4%
K Crispix	19.3	12.6	5.8	34.3%	68.1%
K Cracklin Oat Bran	37.0	30.3	23.4	18.0%	36.7%
GM Cheerios	18.8	12.5	6.7	34.0%	63.9%
GM Honey Nut Cheerios	17.4	11.0	5.9	36.7%	64.9%
GM Wheaties	15.6	9.3	11.8	40.9%	24.0%
GM Total	22.2	15.8	16.4	28.7%	25.9%
GM Lucky Charms	20.2	13.8	8.5	31.8%	56.9%
GM Trix	23.0	16.7	9.9	27.8%	56.6%
GM Raisin Nut	32.8	26.4	21.3	19.6%	36.3%
P Raisin Bran	17.8	11.7	9.0	34.3%	48.9%
P Grape Nuts	23.6	17.5	13.5	25.8%	43.8%
Q 100% Natural	26.1	19.9	14.4	23.6%	46.1%
Q Life	15.6	9.5	4.8	39.2%	69.8%
Q CapNCrunch	14.9	8.7	5.4	41.2%	61.7%
R Chex	19.7	13.6	8.6	30.7%	57.4%
N Shredded Wheat	27.5	21.5	16.6	21.9%	39.2%

Prices and marginal costs are the median for each brand over the 45 cities in the last quarter of 1992. Mixed logit results are based on Table 2, while logit results are based on Appendix B. K = Kellogg, GM = General Mills, P = Post, Q = Quaker Oats, R = Ralston, N = Nabisco.

vary by market (city-quarter combination). Rather than displaying the predicted costs for a particular market, I present the median cost for each brand across the 45 cities in the last quarter of 1992.[14]

The results for the logit model are based on the estimates in Appendix B. The restrictive form of the logit model implies that the markup is equal for all brands of the same firm. This yields somewhat unrealistic patterns of marginal costs. The full model allows for heterogeneity in the marginal valuation of the brands and therefore frees the restrictions that cause this behavior. Indeed, most of the costs predicted by

[14] Means are essentially identical. I display medians to eliminate sensitivity to outliers.

TABLE 5 **Predicted Percent Change in Prices and Quantities as a Result of Mergers**

	Post and Nabisco		GM and Nabisco		GM and Chex		Kellogg and Quaker Oats		GM and Quaker Oats	
	p	*q*	*p*	*q*	*p*	*q*	*p*	*q*	*p*	*q*
K Corn Flakes	.0	.0	.0	.1	.0	.1	.0	.5	.0	.3
K Raisin Bran	.1	.1	.1	.3	.1	.2	1.4	−1.7	.5	.7
K Frosted Flakes	.0	.0	.0	.1	.0	.1	.3	−.4	.1	.3
K Rice Krispies	.0	.1	.1	.2	.1	.4	5.1	−4.1	.7	2.0
K Frosted Mini Wheats	.0	.2	.0	.2	.1	.3	2.7	−4.1	.3	2.9
K Froot Loops	.0	.1	0	.2	.1	.5	9.3	−15.3	.7	8.0
K Special K	.0	.1	.1	.2	.0	.2	.2	.2	.1	.4
K NutriGrain	.0	.0	.1	.1	.0	.1	.0	.4	.1	.3
K Crispix	.0	.1	.0	.2	.1	.4	3.4	−3.8	.5	2.7
K Cracklin Oat Bran	.0	.1	.0	.2	.0	.4	3.4	−6.8	.4	3.7
GM Cheerios	.0	.2	.7	−.9	1.1	−1.3	.5	1.3	4.1	−3.5
GM Honey Nut Cheerios	.0	.1	.5	−.6	.8	−.9	1.0	3.2	11.5	−11.2
GM Wheaties	.0	.0	.0	0	.1	−.1	.1	.5	.1	.3
GM Total	.0	.1	.3	−.8	.2	−.6	.1	.4	.2	.1
GM Lucky Charms	.0	.1	.3	−.4	.7	−.8	.8	3.3	9.3	−10.6
GM Trix	.0	.1	.3	−.3	.7	−.9	.7	3.5	8.6	−9.6
GM Raisin Nut	.0	.2	.4	−.7	.5	−.9	.3	1.5	1.8	−2.7
P Raisin Bran	.9	−1.5	.0	.5	.0	.4	.1	1.5	.2	1.7
P Grape Nuts	1.5	−2.8	.1	.7	.0	.4	.1	2.3	.1	3.0
Q 100% Natural	.0	.1	.0	.3	.0	.5	10.2	−17.0	11.4	−19.3
Q Life	.0	.1	.0	.3	.1	.5	15.5	−16.7	23.8	−25.3
Q CapNCrunch	.0	.1	.0	.3	.1	.4	16.8	−16.7	29.1	−30.9
R Chex	.0	.2	.0	.3	12.2	−19.0	.0	2.1	.1	3.4
N Shredded Wheat	3.1	−8.6	7.5	−18.8	.0	.4	.0	1.9	.0	2.5

Figures are the median change for each brand over the 45 cities in the last quarter of 1992, and are based on Table 2.

95% confidence interval of between 4.0 and 13.1). A 5% cost reduction is no longer enough to offset the effects of the merger. As seen in the second column of Table 6, the cost reduction to Shredded Wheat would need to be greater than 10% (with a 95% confidence interval of between 5.1 and 21.4) in order to reach the same equilibrium outcome.

In August 1996 General Mills purchased from Ralston the Chex cereal line. This merger was examined by the federal authorities and not challenged. The increase in price is presented in the third column of Table 5.[18] The predicted price increases and

[18] The results presented here take the premerger state as prior to the Post-Nabisco merger. I also tried to simulate these mergers sequentially, i.e., take into account that Post acquired the Nabisco cereal line when computing the premerger stats. The results were essentially the same.

TABLE 6 Percent Reduction in Marginal Costs Required for No Change in Predicted Postmerger Prices

	Post and Nabisco	GM and Nabisco	GM and Chex	Kellogg and Quaker Oats	GM and Quaker Oats
K Corn Flakes	0	0	0	.2	0
K Raisin Bran	0	0	0	4.0	0
K Frosted Flakes	0	0	0	1.0	0
K Rice Krispies	0	0	0	16.5	0
K Frosted Mini Wheats	0	0	0	5.2	0
K Froot Loops	0	0	0	17.4	0
K Special K	0	0	0	.6	0
K NutriGrain	0	0	0	.5	0
K Crispix	0	0	0	13.2	0
K Cracklin Oat Bran	0	0	0	5.4	0
GM Cheerios	0	2.1	3.4	0	12.1
GM Honey Nut Cheerios	0	1.2	2.3	0	29.7
GM Wheaties	0	.1	.2	0	.4
GM Total	0	.6	.4	0	.6
GM Lucky Charms	0	.9	1.6	0	19.2
GM Trix	0	.7	1.5	0	17.3
GM Raisin Nut	0	.7	.8	0	3.7
P Raisin Bran	1.7	0	0	0	0
P Grape Nuts	2.6	0	0	0	0
Q 100% Natural	0	0	0	16.8	20.1
Q Life	0	0	0	46.9	72.2
Q CapNCrunch	0	0	0	29.1	42.5
R Chex	0	0	22.1	0	0
N Shredded Wheat	5.1	10.4	0	0	0

Figures are based on Table 2.

the reductions in marginal costs required to offset the anticompetitive effects are larger than in the previous two mergers. A 12.2% price increase is predicted for Chex (with a 95% confidence interval of between 7.9 and 28.0). For this merger there were other considerations that could have counterbalanced the price increase. For example, Ralston's goal was to concentrate on its private-label business, which might thereby check the price increase of branded cereal. In the simulation this effect is not incorporated, as the outside good does not change.

The last two mergers considered are between Quaker Oats (or its three brands in the sample) and either Kellogg or General Mills. Both of these are hypothetical mergers and are used only to demonstrate the method proposed here. The results from these thought experiments can be seen in the last two columns of Tables 5 and 6.

The results in Tables 5 and 6 demonstrate the effect of a merger on prices. However, they do not give any criteria by which to judge if these price changes are large

TABLE 7 **Change in Variable Profits and Consumer Surplus as a Result of Mergers (millions of dollars per year)**

	Post and Nabisco		General Mills and Nabisco	
Consumer surplus	−13.98		−26.79	
Profits/revenues (total)	6.20	−4.77	10.66	−12.33
Kellogg	2.56	3.77	5.54	7.57
General Mills	2.34	3.65	2.63	−7.50
Post	.60	−5.17	1.54	2.94
Quaker Oats	.54	.84	1.43	2.07
Ralston	.14	.25	.30	.52
Nabisco	.01	−8.11	−.77	−17.93
Total Welfare	−7.78		−16.13	
Cost reduction (so total welfare is unchanged)	1.5%		10.8%	
Profits/revenues (total)	8.29	−1.81	16.89	−3.36
Kellogg	1.39	1.90	3.77	4.93
General Mills	1.35	1.92	.47	−13.46
Post	3.73	−.57	.65	1.18
Quaker Oats	.31	.43	1.12	1.58
Ralston	.09	.15	.20	.36
Nabisco	1.42	−5.65	10.68	2.07

The top half of the table is based on the results of Table 5. The bottom half displays the cost reductions required to keep total welfare unchanged, i.e., change in consumer surplus minus change in variable profits equals zero. The first three columns assume a fixed proportional reduction only to brands of acquired firm, while the last two columns assume cost reductions to brands of both firms.

or not. The right measure by which to answer this question is the influence of the merger on consumer welfare. In Table 7 I present changes in consumer surplus, profits, revenues, and total welfare assuming no cost reductions. I also present the breakdown in profits and revenues assuming the cost reductions keep total welfare unchanged.[19] Compensating variation, CV_i, is computed for each individual, in a sample taken from the CPS, by using equation (6). I average the compensating variation, CV_i, across the sample and multiply by the number of consumers, M in equation (7), to get total change in consumer surplus. The number of consumers is assumed to be 260 million (U.S. consumers) times 365 days.[20]

The results suggest that the Post-Nabisco merger, which was approved, has the smallest impact on consumer surplus and total welfare, approximately a reduction of \$14 and \$7 million a year, respectively (with 95% confidence intervals of between 7.0 and 27.2 million, and 1.0 and 16.7 million). The General Mills–Nabisco merger, which was not approved, would have had a higher impact on welfare. The General Mills

[19] Unlike the case examined in Table 6, the cost reductions are not unique. I assume that marginal costs were reduced by a fixed proportion for all brands of either the acquired firm (first three mergers) or both firms (last two mergers).

[20] Prices are all taken for a daily serving. Therefore, I have to multiply by the number of days to get annual aggregate demand and change in consumer surplus.

TABLE 7 *Extended*

General Mills and Chex		Kellogg and Quaker Oats		General Mills and Quaker Oats	
−43.70		−189.56		−288.64	
12.08	−2.35	62.93	9.67	95.97	27.15
6.17	8.66	13.66	−28.27	48.06	75.81
3.47	−4.68	39.71	58.15	35.70	−14.52
.98	1.86	4.75	9.12	7.17	14.20
2.19	3.28	1.79	−23.51	.01	−58.59
−1.07	−12.27	1.73	2.97	2.90	4.92
.33	.80	1.29	3.20	2.13	5.33
−31.62		−126.63		−192.67	
27.7%		5.3%		9.8%	
21.93	−.19	122.32	94.79	171.93	138.69
3.25	4.64	81.85	91.24	12.99	13.99
−.26	−13.48	26.07	23.78	138.72	161.71
.56	1.06	2.66	4.15	3.98	6.43
1.48	2.24	9.84	−27.76	13.32	−48.15
16.73	4.94	1.20	1.93	1.81	2.72
.17	.41	.72	1.45	1.11	1.98

acquisition of Chex generated an even greater reduction in consumer surplus and total welfare, $44 and $32 million, respectively,[21] yet was approved. In this acquisition there were several nonprice dimensions of competition that my model ignores, but they were important for this merger and could therefore reduce the impact on total welfare. I return to this point below. The last two mergers considered would have a substantial impact on total welfare, with a reduction of $127 and $193 million a year. These numbers are probably a lower bound on the true impact, because in these two mergers, unlike the previous mergers considered, several important brands of the merging firms are not included in the analysis.

The cost reductions required to keep consumer welfare fixed are monotonic in the original reduction in total welfare for the first three mergers. For these mergers, since there is a difference in the scale of production between the acquiring and acquired firm, it makes sense to assume that only the smaller, acquired, firm's brands will enjoy cost reductions. For the last two mergers I define the cost reductions differently. I assume that all brands of both merging firms enjoy the same percentage reduction. An alternative is to assume that only the Quaker Oats brands will enjoy the cost reduction, in which case the required cost reductions are over 80% and 90%, respectively.

6. Discussion

■ This article uses a structural model of demand and supply to simulate price equilibria and compute the social welfare changes resulting from various mergers. The

[21] With 95% confidence intervals of between 27.4 and 87.6 million, and 18.5 and 36.0, respectively.

TABLE B1 **Results from Logit Demand**

Variable	OLS (1)	(2)	(3)	IV (4)	(5)	(6)
Price	−8.57	−12.60	−12.65	−16.61	−16.97	−18.21
	(.179)	(.436)	(.467)	(.443)	(.483)	(.439)
Advertising	.034	.032	.032	.030	.030	.030
	(.002)	(.002)	(.002)	(.002)	(.002)	(.002)
Log median income	—	—	—	.99	1.00	1.01
				(.021)	(.022)	(.022)
Log of median age	—	—	—	−.02	.01	.04
				(.06)	(.06)	(.06)
Median household size	—	—	—	−.03	−.02	−.02
				(.03)	(.03)	(.03)
Measure of fit[a]	.76	99.1	98.7	59.0	51.3	54.8
		(30.1)	(16.9)	(30.1)	(16.9)	(42.6)
First stage						
R^2	—	94.5	94.4	94.5	94.5	94.7
F-statistic	—	5,179	6,740	5,046	6,483	4,959
Instruments						
Average regional prices	—	X	—	X	—	X
Cost proxies	—	—	X	—	X	X
Own price elasticity						
Mean	−1.71	−2.51	−2.51	−3.31	−3.38	−3.62
Standard	.51	.75	.75	.99	1.01	1.09
Median	−1.60	−2.36	−2.36	−3.11	−3.18	−3.41
% of inelastic demands	4.4%	0	0	0	0	0
(± 2 standard errors)	(4.1–4.9%)					

Number of observations is 21,600. Dependant variable is $\ln(S_{jt}) - \ln(S_{0t})$. All regressions include time and brand dummy variables: robust standard errors are given in parentheses.

[a] Adjusted R^2 for the OLS regression, and a test of overidentification for the instrumental-variables regressions with the .95 critical values in parentheses.

this model is interesting due to the emphasis it has received in the merger literature (Werden and Froeb, 1994).

Table B1 presents results obtained by regressing the difference of the log of each brand's observed market share and the log of the share of the outside good, $\ln(S_{jt}) - \ln(S_{0t})$, on price, advertising expenditures, brand, and time dummy variables. Column 1 displays the results of ordinary least squares. The coefficient on price and the implied own-price elasticities are relatively low. The logit demand structure does not impose a constant elasticity, and therefore the estimates imply a different elasticity for each brand-city-quarter combination. Some statistics of the own-price elasticity distribution are shown at the bottom of each column. The low elasticities and the high number of inelastic demands are not uncommon and are due to the endogeneity of prices.

Two sets of instrumental variables were explored to deal with this problem. Columns 2 and 4 present two-stage least-squares estimates using the average regional prices, described in Section 4, as instrumental variables. Columns 3 and 5 use the proxies for marginal costs described above as instrumental variables in the same regression. Finally, column 6 uses both sets of instrumental variables. Columns 4–6 include controls for market demographics.

Three conclusions should be drawn from the results in Table B1. First, once instrumental variables are used, the coefficient on price and the implied own-price elasticity increase in absolute value. This is predicted items are largely what Staples terms "price-sensitive" SKUs.[30]

We include store, SKU, and time fixed effect dummy variables in our regressions in order to control for price variation due to differences across stores, products, and months. Equations (16) and (17) are rewritten below to reflect these additional variables and the level of the data used in the analysis. For store *j*, SKU *l*, at time *t*, the reduced form price equations estimated are

(16') $p^S_{jlt} = a_o + a_1 k^S_{jlt} + \mathbf{X}_{jt}\mathbf{a}_2 + \mu_{1j} + \mu_{2l} + \mu_{3t} + v_{jlt}$

(17') $p^S_{jlt} = b_o + b_1 k^S_{jlt} + b_2 k^D_{lt} + \mathbf{X}_{jt}\mathbf{b}_3 + \mu_{1j} + \mu_{2l} + \mu_{3t} + v_{jlt}$.

The variables included are log Staples price (p^S_{jlt}), log Staples cost (k^S_{jlt}) and log average Office Depot cost (k^D_{lt}) (for corresponding SKU in the same month averaged over all Office Depot stores), fixed effect dummies for store (μ_{1j}), SKU (μ_{2l}), and time (μ_{3t}), and in some models, competitor variables (X_{jt}). The competitor variables control for the number of Staples, Office Depot, OfficeMax, Wal-Mart, Sam's Club, Computer City, Best Buy, Office 1 Superstore, Costco, BJ's, CompUSA, Kmart, and Target stores in the metropolitan statistical area (MSA). The cost variables were accounting estimates of average variable cost (essentially, cost of goods sold) supplied by the merging firms; we treat these as estimates of marginal cost. We cannot present descriptive statistics, such as the mean and standard deviation of the variables in our sample, as they are not in the public domain. The regression results are discussed below.

Table 1
Estimates of the Impact of Log Costs on Log Staples Prices

	Model 1	Model 2	Model 3	Model 4
Log Staples Cost	0.571 (194.20)	0.149 (37.62)	0.571 (195.15)	0.149 (37.65)
Log Office Depot Cost	-	0.696 (150.25)	-	0.697 (151.22)
Competitor Variables Included?	No	No	Yes	Yes
Simulated Impact on Staples Prices of Merging Staples and Office Depot	Not Applicable	Not Applicable	16.4%	16.6%
Simulated Impact on Staples Prices of Merging Staples, Office Depot, and OfficeMax	Not Applicable	Not Applicable	17.0%	17.6%

Notes: Based on models in which the log of Staples' price for each of 30 SKUs is regressed on fixed effects for store, month, and SKU, and on the variables indicated in the Table. Cost variables are entered as natural logarithms. Numbers in parentheses are t-statistics.

Appendix

Table A1
Simulated Impact of Two Hypothetical Mergers on Staples' Price
for Price Sensitive Office Products

Simulation:	Percent Impact on Prices	t-Statistic	Number of Observations in Simulation
Merge Staples and Office Depot in Markets with Office Depot Competition	18.7%	16.81	3,038
Merge Staples, Office Depot, and OfficeMax in Markets with Office Depot and OfficeMax Competition	19.7%	13.69	1,960

Notes: Simulations based on a model in which Staples' prices for price sensitive items are regressed on fixed effects for the store, fixed effects for the month, and variables which control for the number of Staples, Office Depot, OfficeMax, Wal-Mart, Sam's Club, Computer City, Best Buy, Office 1 Superstore, Costco, BJ's, CompUSA, Kmart, and Target stores in the MSA.