Using Mergers to Test a Model of Oligopoly

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November 2008

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Introduction

- On average each year the FTC and DOJ conduct 75 major investigations of horizontal mergers.
- Two types of merger studies: retrospective and simulation studies.
- Retrospectives provide important information on antitrust policy, but often unclear on how this information guides decision making in specific cases.
- Simulating a merger with demand estimates for differentiated products and a static Bertrand pricing model is common practice, but results hinge on many strong assumptions.
- This paper uses retrospective evidence to evaluate merger simulation methodology.

Contributions

- Study two consumer product mergers with data that covers a period before and after the mergers occurred.
- Various demand systems are estimated on pre-merger data and used to simulate mergers with a static Bertrand model.
- Syrup merger had large simulated price changes (typically larger than 5%) and the oil merger had small price changes(less than 5%).
- We then add to the sample post-merger data and estimate the actual price effects with a difference and a difference-in-difference estimator.
- Simulations reverse the rank order of the price effects: predict a large price increase when actuals are low and vice versa.

Contributions

- We then study different explanations for the difference between simulated and actual price changes.
  - Changes in demand: while demand changed before and after merger, doesn't explain much of difference.
  - Changes in marginal costs: must be quite large to equate simulated and actual price changes.
  - Different assumptions on substitution to outside goods.

Simulations

- Using pre-merger data we estimate AIDS, Linear, and Logit demand with IV and OLS.
- AIDS example: Assuming static Bertrand pricing, pre-merger first-order conditions are:

$$\sum_{j \in \mathcal{J}_f} \left(\frac{p_j - mc_j}{p_j}\right) \epsilon_{j,i}(p_1, ..., p_J) s_j(p_1, ..., p_J) + s_i(p_1, ..., p_J) = 0 \quad (1)$$

- Given pre-merger prices, revenue shares, and demand estimates calibrate to pre-merger data by solving for implied marginal costs.

Simulations

- Assuming demand, marginal costs, and the nature of competition do not change, post-merger prices solve merged firms' first-order conditions:

$$\sum_{j \in \mathcal{J}_f} \left(\frac{p_j - mc_j}{p_j}\right) \epsilon_{j,i}(p_1, ..., p_J) s_j(p_1, ..., p_J)$$
$$+ \sum_{j \in \mathcal{J}_g} \left(\frac{p_j - mc_j}{p_j}\right) \epsilon_{j,i}(p_1, ..., p_J) s_j(p_1, ..., p_J)$$
$$+ s_i(p_1, ..., p_J) = 0$$

- Price effects are percentage difference between post and pre-merger prices.

Data

- IRI Scanner Data
- Pennzoil/Quaker State
- Consummated in December of 1998. Data from January, 1997 until December, 2000 over 10 regions.
- Log Cabin/Mrs. Butterworth
- Consummated in July of 1997. Data from October, 1996 until March, 1998 over 49 regions.

Actual Price Changes

Add post-merger data to the sample.

Before and after comparison:

$$\log(p_{int}) = \alpha_{in} + \sum_{m=1}^{11} \gamma_m M + \beta_d * Post + \epsilon_{int} \quad (2)$$

Change in prices relative to change in private label prices:

$$\log(p_{int}) = \alpha_{in} + \sum_{m=1}^{11} \gamma_m M + \delta * Post + \beta_{dd} * Post * Branded + \epsilon_{int} \quad (3)$$

Actual Oil Percentage Price Effects

Products	Difference in Difference	Difference
Pennzoil/Quaker State Merger		
Castrol GTX	8.05	6.77
	(1.78)	(1.46)
Havoline	-4.32	-6.43
	(1.54)	(1.54)
Mobil	7.48	5.45
	(1.25)	(1.11)
Pennzoil	3.71	1.95
	(1.91)	(1.79)
Private Label	-	-2.14
	-	(0.67)
Quaker State	7.65	5.63
	(1.53)	(1.45)
Valvoline	5.60	3.78
	(2.61)	(1.93)

Estimated and Simulated Oil Percentage Price Effects

	Estimated Price Changes		Simulated Price Changes
	Difference in Difference	Difference	AIDS
Products			OLS
Pennzoil/Quaker State Merger			
Castrol GTX	8.05	6.77	1.19
	(1.78)	(1.46)	(0.52, 1.99)
Havoline	-4.32	-6.43	0.78
	(1.54)	(1.54)	(0.27, 1.37)
Mobil	7.48	5.45	0.21
	(1.25)	(1.11)	(-0.01, 0.51)
Pennzoil	3.71	1.95	2.59
	(1.91)	(1.79)	(0.08, 5.68)
Private Label	-	-2.14	1.41
	-	(0.67)	(-0.20, 4.30)
Quaker State	7.65	5.63	7.49
	(1.53)	(1.45)	(2.81, 13.58)
Valvoline	5.60	3.78	0.78
	(2.61)	(1.93)	(0.02, 1.49)

Estimated and Simulated Oil Percentage Price Effects

	Estimated Price Changes		Simulated Price Changes	
			AIDS	
Products	**Difference in Difference**	**Difference**	OLS	IV
Pennzoil/Quaker State Merger				
Castrol GTX	8.05	6.77	1.19	-1.36
	(1.78)	(1.46)	(0.52, 1.99)	(-37.95, 11.43)
Havoline	-4.32	-6.43	0.78	-27.82
	(1.54)	(1.54)	(0.27, 1.37)	(-116.00, -4.67)
Mobil	7.48	5.45	0.21	3.12
	(1.25)	(1.11)	(-0.01, 0.51)	(-9.30, 25.37)
Pennzoil	3.71	1.95	2.59	216.17
	(1.91)	(1.79)	(0.08, 5.68)	(25.19, 3272.03)
Private Label	-	-2.14	1.41	24.49
	-	(0.67)	(-0.20, 4.30)	(3.25, 167.30)
Quaker State	7.65	5.63	7.49	115.79
	(1.53)	(1.45)	(2.81, 13.58)	(26.14, 1094.64)
Valvoline	5.60	3.78	0.78	32.75
	(2.61)	(1.93)	(0.02, 1.49)	(1.02, 169.87)

Estimated and Simulated Oil Percentage Price Effects

	Estimated Price Changes		Simulated Price Changes					
			AIDS		Linear		Logit	
Products	**Difference in Difference**	**Difference**	OLS	IV	OLS	IV	OLS	IV
Pennzoil/Quaker State Merger								
Castrol GTX	8.05	6.77	1.19	-1.36	0.26	0.05	0.00	0.00
	(1.78)	(1.46)	(0.52, 1.99)	(-37.95, 11.43)	(0.01, 0.58)	(-0.23, 0.41)	(0.00, 0.00)	(0.00, 0.00)
Havoline	-4.32	-6.43	0.78	-27.82	0.36	-0.67	0.00	0.00
	(1.54)	(1.54)	(0.27, 1.37)	(-116.00, -4.67)	(0.04, 0.82)	(-2.84, 1.13)	(0.00, 0.00)	(0.00, 0.00)
Mobil	7.48	5.45	0.21	3.12	0.16	0.11	0.00	0.00
	(1.25)	(1.11)	(-0.01, 0.51)	(-9.30, 25.37)	(0.02, 0.34)	(-0.14, 0.50)	(0.00, 0.00)	(0.00, 0.00)
Pennzoil	3.71	1.95	2.59	216.17	0.40	1.55	0.05	0.04
	(1.91)	(1.79)	(0.08, 5.68)	(25.19, 3272.03)	(-0.16, 1.04)	(0.58, 3.86)	(0.04, 0.06)	(0.03, 0.05)
Private Label	-	-2.14	1.41	24.49	0.16	-0.01	0.00	0.00
	-	(0.67)	(-0.20, 4.30)	(3.25, 167.30)	(-0.99, 1.58)	(-0.79, 0.73)	(0.00, 0.00)	(0.00, 0.00)
Quaker State	7.65	5.63	7.49	115.79	4.12	5.10	0.16	0.15
	(1.53)	(1.45)	(2.81, 13.58)	(26.14, 1094.64)	(1.60, 7.21)	(1.02, 12.15)	(0.14, 0.19)	(0.12, 0.17)
Valvoline	5.60	3.78	0.78	32.75	0.42	0.47	0.00	0.00
	(2.61)	(1.93)	(0.02, 1.49)	(1.02, 169.87)	(0.07, 0.79)	(0.10, 1.46)	(0.00, 0.00)	(0.00, 0.00)

Estimated and Simulated Syrup Percentage Price Effects

	Estimated Price Changes		Simulated Price Changes					
			AIDS		Linear		Logit	
Products	**Difference in Difference**	**Difference**	OLS	IV	OLS	IV	OLS	IV
Log Cabin/Mrs Butterworth Merger								
Aunt Jemima	-0.35	0.80	4.84	44.81	0.67	1.97	0.15	0.15
	(0.94)	(0.57)	(2.55, 8.22)	(-143.35, 125.98)	(0.31, 1.23)	(-44.03, 45.68)	(0.14, 0.18)	(0.13, 0.18)
Hungry Jack	-0.28	1.25	2.51	62.85	0.63	21.90	0.06	0.06
	(0.90)	(0.53)	(0.18, 6.19)	(-194.18, 190.444)	(-0.73, 2.67)	(-51.69, 54.87)	(0.05, 0.06)	(0.05, 0.07)
Log Cabin	1.40	2.74	23.50	-63.60	2.73	-60.21	5.92	5.78
	(1.40)	(0.74)	(14.84, 36.24)	(-152.90, 364.84)	(1.46, 4.35)	(-105.83, 98.37)	(5.25, 6.78)	(4.99, 6.89)
Mrs Butterworth	-2.08	-0.74	21.58	-235.18	4.42	-89.75	7.56	7.38
	(1.22)	(0.63)	(12.95, 34.53)	(-384.56, 798.41)	(3.03, 6.54)	(-172.50, 159.21)	(6.70, 8.65)	(6.37, 8.79)
Private Label	-	1.11	6.65	-62.41	1.41	-32.85	0.54	0.53
	-	(0.29)	(2.81, 10.29)	(-287.64, 344.23)	(0.48, 2.73)	(-56.20, 65.69)	(0.48, 0.62)	(0.46, 0.63)

Simulated Percentage Price Effects Using Post-Merger Data

	Estimated Price Changes		Simulated Price Changes					
	Difference in	Difference	AIDS		Linear		Logit	
Products	Difference		OLS	IV	OLS	IV	OLS	IV
Pennzoil/Quaker State Merger								
Pennzoil	3.71	1.95	6.28	2.41	2.23	1.06	0.07	0.27
	(1.91)	(1.79)	(4.19, 9.49)	(0.98, 3.93)	(1.78, 3.49)	(0.34, 2.11)	(0.06, 0.08)	(-0.59, 1.10)
Quaker State	7.65	5.63	11.75	6.14	5.04	4.30	0.26	1.10
	(1.53)	(1.45)	(6.29, 21.56)	(3.60, 8.83)	(2.32, 7.77)	(1.70, 5.69)	(0.23, 0.31)	(-2.37, 4.38)
Log Cabin/Mrs Butterworth Merger								
Log Cabin	1.40	2.74	20.31	2.65	3.34	-0.20	6.72	7.08
	(1.40)	(0.74)	(13.65, 30.85)	(-41.69, 86.23)	(2.54, 7.56)	(-47.80, 84.05)	(5.84, 7.82)	(5.98, 8.74)
Mrs Butterworth	2.08	-0.74	15.78	-2.08	3.50	7.13	8.48	8.94
	(1.22)	(0.63)	(10.47, 23.26)	(-121.96, 329.38)	(2.55, 8.03)	(-166.06, 141.98)	(7.38, 9.88)	(7.55, 11.03)

Percentage Changes in Marginal Costs Necessary to Equate Simulated and Actual Price Changes

	Simulation Model					
	AIDS		Linear		Logit	
Products	OLS	IV	OLS	IV	OLS	IV
Pennzoil/Quaker State Merger						
Pennzoil	-1.27	-75.25	2.67	5.37	2.99	2.78
Quaker State	-5.14	-67.17	-0.03	-1.50	9.01	8.36
Log Cabin/Mrs Butterworth Merger						
Log Cabin	-22.44	315.06	1.33	153.02	-10.02	-9.29
Mrs Butterworth	-23.81	599.74	-11.74	250.25	-18.46	-17.63

Simulated Percentage Price Changes with Different Overall Elasticities of Demand and OLS AIDS at Bottom Stage

Products	$e = -2$	$e = -1.67$	$e = -1.33$	$e = -1$
Pennzoil/Quaker State Merger				
Pennzoil	0.08	0.53	1.27	2.59
	(-1.50, 1.15)	(-0.92, 1.77)	(-0.28, 3.26)	(0.08, 5.68)
Quaker State	2.14	2.92	4.32	7.49
	(-0.22, 4.46)	(0.83, 5.55)	(1.64, 8.20)	(2.81, 13.58)
	$e = -2$	$e = -1.67$	$e = -1.33$	$e = -1$
Log Cabin/Mrs Butterworth Merger				
Log Cabin	6.47	11.18	16.99	23.50
	(2.17, 12.37)	(5.04, 18.09)	(11.33, 29.16)	(14.84, 36.24)
Mrs Butterworth	6.31	10.39	15.45	21.58
	(1.97, 11.03)	(5.29, 16.64)	(9.72, 24.35)	(12.95, 34.53)

Simulated Percentage Price Changes with Different Outside Shares for IV Logit

Products	$2\frac{1}{3}$ Quarts per Month	$1\frac{2}{3}$ per Month	1 per Month	$\frac{1}{3}$ per month
Pennzoil/Quaker State Merger				
Pennzoil	0.008	0.024	0.040	0.056
	(0.007, 0.01)	(0.021, 0.029)	(0.034, 0.048)	(0.048, 0.068)
Quaker State	0.027	0.083	0.139	0.195
	(0.023, 0.034)	(0.071, 0.101)	(0.119, 0.167)	(0.166, 0.236)
	1 Serving per Day	4 per Month	2 per Month	1 per Month
Log Cabin/Mrs Butterworth Merger				
Log Cabin	0.19	1.43	2.89	5.78
	(0.17, 0.22)	(1.30, 1.67)	(2.60, 3.36)	(4.99, 6.89)
Mrs Butterworth	0.22	1.66	3.42	7.38
	(0.20, 0.25)	(1.51, 1.94)	(3.07, 3.96)	(6.37, 8.79)

Conclusions

- Simulations reverse the rank order of price changes.
- Large simulated price changes for competitively benign merger, small simulated price changes for merger that resulted in moderate price increases.
- However, oil simulations are similar to actual price changes in magnitude and rank order of merging brands.
- Results are similar to Peters (2007) in reversing rank order of price effects.