EVALUATING THE LIKELY COMPETITIVE EFFECTS OF HORIZONTAL AND VERTICAL MERGERS: A NEW APPROACH

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Introduction

In a number of recent mergers, consulting experts retained by the Federal Trade Commission ("FTC") have used a new economic model to evaluate the likely competitive effects of proposed horizontal and vertical mergers.[1] This model, the computational bilateral oligopoly ("CBO") model,[2] offers a more general approach than existing models used in merger analysis in that it examines the competitive effects of both seller and buyer concentration, and can be used to evaluate both horizontal and vertical mergers. Existing models used to evaluate the likely competitive effects of mergers (based on Cournot or Bertrand models) cannot evaluate the effects of vertical mergers and do not consider the effects of buyer power.[3]

The traditional Hirschman-Herfindahl Index ("HHI") approach to assessing concentration in a market is based on the Cournot model, which assumes that a group of firms sell to a large number of passive (i.e., price-taking) consumers. Each firm chooses a quantity to produce, and then that quantity is sold at a price determined by equating aggregate supply with aggregate demand. Sellers can unilaterally affect the market price by restricting their outputs. As a result, they produce less than their efficient quantities,

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[1] The views expressed in this paper do not purport to represent those of the Federal Trade Commission. Mergers evaluated with the CBO model by consulting experts retained by the FTC include (1) Chevron Corp.'s proposed acquisition of USA Petroleum (dropped by the parties); (2) Valero L.P.'s proposed acquisition of Kaneb Services LLC (consummated subject to divestitures, see http://www.ftc.gov/os/caselist/0510022/050726do0510022.pdf); and (3) Phillips Petroleum Company's proposed merger with Conoco Inc. (consummated subject to divestitures, see http://www.ftc.gov/os/2002/08/conocophillipsdo.pdf).

[2] Kenneth Hendricks and R. Preston McAfee, *A Theory of Bilateral Oligopoly*, available at www.mcafee.cc.

[3] For use of the Cournot model in evaluating horizontal mergers, see R. Preston McAfee & Michael A. Williams, *Horizontal Mergers and Antitrust Policy*, 40 J. IND. ECON. 181 (1992); R. Preston McAfee, Joseph J. Simons & Michael A. Williams, 40 Horizontal Mergers in Spatially Differentiated Noncooperative Markets, J. IND. ECON., 349 (1992). For use of the Bertrand model in evaluating horizontal merges, see Gregory J. Werden and Luke M. Froeb, *The Effects of Mergers in Differentiated Products Industries: Logit Demand and Merger Policy*, 10 J. L. ECON. & ORG. 407 (1994).

which equate marginal costs to the market price. The markup of price over marginal cost measures a seller's market power and equals, in the Cournot model, a firm's market share divided by the elasticity of market demand.

The industry average price-cost margin (or Lerner Index) equals the sum of squared market shares (i.e., the HHI) divided by the market demand elasticity.[4] Hence, the Cournot model suggests that the HHI measures the amount by which prices exceed the competitive level. The model also implies that the larger a firm's market share, the more it under-produces so as to increase the market price. Moreover, large firms are large because they have low costs: low-cost firms produce more than high-cost firms.

The key departure in the CBO model from the traditional Cournot-based HHI framework is that, instead of submitting quantities, sellers submit supply schedules, and instead of being passive, buyers submit demand schedules. In doing so, sellers can overstate their actual costs, and buyers are permitted to understate their willingness to pay. Thus, both sellers and buyers can misrepresent their true supply and demand functions. The model balances the reported aggregate supply and aggregate demand functions, leading to a market price and quantity. Sellers under-produce so as to increase the market price. Buyers purchase less than the quantity they would actually demand at the market price so as to decrease the market price. The larger is a seller's or buyer's share of their respective markets, the more the seller or buyer distorts their behavior away from

[4] The industry Lerner Index equals the quantity-weighted average price-cost margin summed over all suppliers in the market. Specifically, let ε be the elasticity of demand, and s_i be the market share of the i^{th} firm. Let firm i have marginal cost c_i'. Then $\sum_i s_i \frac{p - c_i'}{p} = \frac{1}{\varepsilon} \sum_i s_i^2$.

efficiency. The model is based on the "supply function" approach.[5] In a supply function game, each producer picks a linear supply function to submit to the market that maximizes its profits. The CBO model adds to the supply function approach by allowing buyers to behave strategically (e.g., to exercise monopsony power) by submitting demand functions to the market, and permitting supply functions that may not be linear, although they are restricted to be feasible.

With respect to vertical mergers, there is an enormous economic theory literature, the vast majority of which is not helpful to the analysis of real mergers because the models assume that one or two sellers supply one or two buyers.[6] Alternatively, some theoretical models allow either the upstream firms or the downstream firms to have market power, but not both.[7] In contrast, the CBO model allows any number of upstream and downstream firms, and further allows both upstream suppliers and downstream buyers to exercise market power, and to the same extent. The CBO model is the first model to allow an analyst to evaluate the effects of horizontal and vertical mergers in markets in which both buyers and sellers have market power, i.e., bilateral oligopolies.

The CBO model is also useful in (non-merger) market or monopoly power analyses. Economists measure market power by the extent to which prices exceed marginal costs. By expressing the relationship between price and long-run marginal cost, the CBO model estimates firms' market or monopoly power. Moreover, the CBO model calculates the equilibrium aggregate quantity that will be produced in the market as a

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[5] Paul Klemperer & Margaret Meyer, *Supply Function Equilibria in Oligopoly Under Uncertainty*, 57 ECONOMETRICA 1243 (1989).

[6] See, e.g., Oliver Hart & Jean Tirole, *Vertical Integration and Market Foreclosure*, BROOKINGS PAPERS ON ECONOMIC ACTIVITY: MICROECONOMICS, Special Issue, 205 (1990).

[7] See, e.g., Janusz Ordover, Garth Saloner & Steven Salop, *Equilibrium Vertical Foreclosure*, 80 AMERICAN ECONOMIC REVIEW 127 (1990).

percentage of the quantity that would be produced in a perfectly competitive market. This provides a measure of the overall competitiveness of the market.

In sum, Cournot-based HHI analysis remains a useful tool in antitrust due to its simplicity. However, that approach is incomplete in that it does not consider buyer power and cannot evaluate the effects of vertical mergers. The CBO model was designed to deal with these shortcomings. Not only does it measure market concentration considering buyer power, but it also estimates the equilibrium price-cost margin given the degree of upstream (seller) and downstream (buyer) market concentration. The model is simple to apply, and permits the calculation of antitrust effects in a practical way. The primary limitation of the current version of the model is that does not apply in markets with highly differentiated products. The CBO model was developed out of work done by the authors when they were retained by the FTC in 1999 to assist in evaluating the competitive effects of the proposed merger between Exxon and Mobil.

Applying the CBO Model to the Merger of Exxon and Mobil

The merger of Exxon and Mobil raised both horizontal and vertical antitrust issues, particularly in California. Both companies were significant refiners and retailers of gasoline in California. The wholesale gasoline industry in the West Coast is relatively isolated from the rest of the country because of high transportation costs and environmental regulations.[8]

Consider gasoline refining and retailing as upstream and downstream markets, respectively. Refiners produce bulk gasoline (the intermediate good), which they either

[8] California is not interconnected via refined products pipelines to major petroleum refineries in the Gulf of Mexico. Also, California regulations, enforced by the California Air Resources Board ("CARB"), require the use of specially formulated gasoline. See, e.g., http://www.arb.ca.gov/regact/carfg304/fro1.pdf.

sell at retail themselves, or sell to other firms in the wholesale market.[9] The upstream refiners have production costs that depend on their individual capacities.[10] Capacity is not viewed as a fixed quantity, but rather as a supply function describing production costs at different output levels. Increasing capacity reduces the cost of additional production. The downstream retailers buy wholesale gasoline and then sell it to final consumers. These firms also have retailing costs that depend on the size of their capacity. Retailing capacity is closely related to the number of retailing outlets, but also includes other factors such as location.

In order to apply the CBO model, one must have data on (i) upstream (refining) market shares (these can be based either on revenue shares or capacity shares); (ii) downstream (retailing) market shares (again, based on either revenue shares or capacity shares); (iii) the elasticity of upstream (refining) production costs; (iv) the elasticity of downstream (retailing) costs; and (v) the elasticity of demand for the final product. Table 1 presents estimates of the market shares of the major upstream refiners and downstream retailers in California at the time of the Exxon-Mobil merger.[11] Both refining and retailing exhibit significant market concentration. At the time of the merger, Exxon and Mobil both had refining market shares of approximately 7.0%. Exxon's retailing share was approximately 8.9%, and Mobil's retailing share was approximately 9.7%.

[9] When a refiner sells bulk gasoline to a vertically integrated company, the latter adds additives. For example, when Exxon buys gasoline from Equilon (Shell-Texaco), Exxon uses its own additives. Wholesale gasoline is virtually homogeneous. For example, when gasoline is shipped via pipeline, all companies' gasoline supplies are intermingled.

[10] The size of a refinery includes not just the flow-through capacity, but also components, like cokers, that permit the production of additional gasoline instead of low value output like asphalt.

[11] Market shares are from Keith Leffler & Barry Pulliam, *Preliminary Report to the California Attorney General Regarding California Gasoline Prices* (Nov. 22, 1999).

Table 1: Market Shares, California CARB Gasoline

Company	Refining Market Share		Refining Capital Share		Retail Market Share		Retail Capital Share	
	Pre-Merger	Post-Merger	Pre-Merger	Post-Merger	Pre-Merger	Post-Merger	Pre-Merger	Post-Merger
Chevron	26.4	26.6	29.5	29.5	19.2	19.5	19.0	19.0
Tosco	21.5	21.7	21.7	21.7	17.8	18.0	17.8	17.8
Equilon	16.6	16.7	16.1	16.1	16.0	16.2	16.0	16.0
Arco	13.8	13.9	13.0	13.0	20.4	20.7	22.0	22.0
Mobil	7.0	0.0	6.2	0.0	9.7	0.0	9.3	0.0
Exxon	7.0	13.3	6.2	12.4	8.9	17.5	8.5	17.8
Ultramar	5.4	5.4	4.7	4.7	6.8	6.9	6.4	6.4
Paramount	2.3	2.3	2.0	2.0	0.0	0.0	0.0	0.0
Kern	0.0	0.0	0.0	0.0	0.3	0.3	0.27	0.27
Koch	0.0	0.0	0.0	0.0	0.2	0.2	0.18	0.18
Vitol	0.0	0.0	0.0	0.0	0.2	0.2	0.18	0.18
Tesoro	0.0	0.0	0.0	0.0	0.2	0.2	0.18	0.18
PetroDiamond	0.0	0.0	0.0	0.0	0.1	0.1	0.09	0.09
Time	0.0	0.0	0.0	0.0	0.1	0.1	0.09	0.09
Glencoe	0.0	0.0	0.0	0.0	0.1	0.1	0.09	0.09

Table 1 also presents estimates based on the CBO model of the effects of the merger between Exxon and Mobil. Notice that the market share of the merged firm falls compared to the combined shares of the two pre-merger firms. This decline in market share occurs because the merged firm reduces output unilaterally to increase market price. In contrast, the refining and retailing capital shares of the non-merging firms are the same pre- and post-merger. This holds because their share of the overall stock of capital in refining and retailing is unaffected by the merger—only the intensity of use changes.

We estimate the effect of the merger on the retail price and the aggregate quantity produced. Table 2 shows the expected percentage changes in prices and quantities. Columns 1-3 show alternative values for the demand and cost elasticities. Three cases are then considered: no divestitures, divestiture of Exxon's Benicia, California refinery,

and divestiture of Exxon's California retail gasoline stations. In the absence of any divestitures, the model predicts that the merger would cause retail gasoline prices to increase by approximately 1% and aggregate production to decline by approximately 0.3%. Divesting Exxon's Benicia refinery solves most of the antitrust issues, with the merger predicted to increase retail gasoline prices by approximately 0.1% and reduce aggregate production by approximately 0.03%. In contrast, the divestiture of Exxon's retail gasoline stations located in California has little beneficial effect, resulting in essentially the same expected changes in post-merger prices and quantities. In the actual merger, Exxon agreed to divest both its Benicia refinery and all its 368 California retail gasoline stations.[12]

Table 2: Analysis of Exxon – Mobil Merger
Expected Percentage Changes in Price and Quantity

Demand Elasticity	Elasticity of Refining Costs	Elasticity of Retailing Costs	No Divestitures		Refinery Sale		Retail Sale	
			Percent Increase in Price	Percent Decrease in Quantity	Percent Increase in Price	Percent Decrease in Quantity	Percent Increase in Price	Percent Decrease in Quantity
1/3	½	5	0.94	0.31	0.09	0.03	0.90	0.30
1/5	½	5	1.36	0.27	0.11	0.02	1.29	0.25
1/3	½	3	0.97	0.32	0.15	0.05	0.89	0.30
1/3	⅓	3	1.06	0.35	0.08	0.03	1.03	0.34

We also use the model to calculate expected pre- and post-merger, price-cost margins. As shown in Table 3, the pre-merger, price-cost margins range from approximately 20% to 25%, depending on the demand and cost elasticities. With no divestitures, the post-merger, price-cost margins increase by approximately 1.5 percentage points. With the divestiture of Exxon's Benicia refinery, the post-merger,

[12] See http://www.ftc.gov/os/2001/01/exxondo.pdf.

price-cost margins increase by approximately 0.1 percentage point. As above, the divestiture of Exxon's California retail gasoline stations has little beneficial effect, with the post-merger, price-cost margins being approximately equal to the pre-merger, price-cost margins.

Table 3: Analysis of Exxon – Mobil Merger
Expected Changes in Retail Price-Cost Margins
(Quantity as a Percent of Fully Efficient Quantity in Parentheses)

Demand Elasticity	Elasticity of Refining Costs	Elasticity of Retailing Costs	Pre-Merger Price-Cost Margin	Post-Merger Price-Cost Margin with No Divestiture	Post-Merger Price-Cost Margin with Refinery Sale	Post-Merger Price-Cost Margin with Retail Sale
1/3	½	5	20.0 (94.6)	21.3 (94.3)	20.1 (94.6)	21.2 (94.3)
1/5	½	5	23.6 (95.4)	25.2 (95.2)	23.7 (95.4)	25.2 (95.2)
1/3	½	5	20.3 (94.6)	21.7 (94.3)	20.5 (94.6)	21.6 (94.4)
1/3	½	3	25.1 (93.8)	26.7 (93.5)	25.2 (93.8)	26.7 (93.5)

The table also shows the percent of the fully efficient (i.e., perfectly competitive) aggregate quantity predicted by the model both pre- and post-merger. Pre-merger, the model predicts that the quantity of retail gasoline produced and sold in California was approximately 95% of the perfectly competitive quantity. Post-merger with no divestitures, this value falls by approximately 0.3 percentage points. The divesture of Exxon's Benicia refinery eliminates essentially all of this output distortion, while the divestiture of Exxon's California gasoline stations has little impact in reducing the output distortion.[13]

[13] See, however, Justine Hastings, *Vertical Relationships and Competition in Retail Gasoline Markets: Empirical Evidence from Contract Changes in Southern California*, 94 AMERICAN ECONOMIC REVIEW 317 (2004). In an analysis of retail gasoline stations in Southern California, Hastings finds that "when independents are replaced by branded integrated stations, price competition in the market is softened, resulting in higher local market prices." Id. at 328.

Conclusions

The use of formal economic models in evaluating the likely competitive effects of mergers has increased rapidly in the past decade. The CBO model offers a more general approach than the standard Cournot model typically used in merger analysis in that it examines the competitive effects of both seller and buyer concentration, and can be used to evaluate both horizontal and vertical mergers. The major advantages of the CBO model are its applicability to a wide variety of industry structures and its low informational requirements. The major disadvantage of the CBO model is that, at present, it cannot be used to evaluate the effects of mergers involving highly differentiated products.