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Effects of Assumed Demand Form on Simulated Postmerger Equilibria

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Abstract. This paper investigates the properties of four demand systems used to predict the effects of differentiated products mergers: the Almost Ideal Demand System (AIDS), logit, linear, and log-linear (constant elasticity). In Monte Carlo experiments, these demand systems yield significantly different predictions, although all are calibrated to the same the same, randomly generated, premerger relative quantities and demand elasticities. The predicted price increase is greatest with log-linear demand, followed by the AIDS. The linear and logit demand forms result in significantly lower postmerger prices. The results highlight the importance of the inherent higher-order properties of demand systems, i.e., their "curvature."

Key words: Mergers, antitrust, AIDS, logit, Computed Nash Equilibria.

JEL Classification: L41-horizontal anticompetitive practices.

I. Introduction

In 1992 the U.S. Department of Justice and Federal Trade Commission issued new Merger Guidelines, which divide potential anticompetitive effects into those that involve some form of coordination and those that do not. The latter are termed unilateral effects, and in differentiated products industries, the federal enforcement agencies have been focusing primarily on unilateral effects (see Shapiro, 1996). Merger simulation has been advanced in policy debates and extensively used in actual merger investigations to assess the unilateral effects of differentiated products mergers (see Hausman and Leonard, 1997; Werden, 1997a,b,d; Werden and Froeb, 1996).

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Merger simulation predicts postmerger equilibrium using a tractable oligopoly model calibrated to fit the observed premerger equilibrium. The outputs from merger simulation are predictions of postmerger prices and outputs. Consequently, merger simulation provides a quantitative basis for making the Williamsonian welfare trade-off. As explained by Werden (1997a, pp. 364–370, 381–382, 1997b, p. 30), merger simulation eliminates the always contentious and unpredictable line drawing required by traditional market delineation, and eliminates much of the subjective and idiosyncratic judgment otherwise inherent in the assessment of mergers. For these reasons, businessmen contemplating differentiated products mergers should find it no more difficult to predict whether their mergers will be challenged, even though merger simulation requires some form of estimation of the relevant demand elasticities.

A merger simulation is built on three key assumptions. The heart of a merger simulation is the assumed competitive interaction for the industry. The conventional assumption for differentiated products industries is noncooperative price-setting in a one-shot game, which is commonly termed "Bertrand competition." A second assumption concerns the shape of marginal cost curves, and it is conventionally assumed that marginal cost does not vary in the relevant range. The final assumption concerns the demand system, and each demand system has certain inherent curvature properties. These higher-order properties are important because mergers of competitive significance involve significant movements away from the premerger equilibrium.

The purpose of this paper is to examine systematically the implications of four demand systems that have been used in merger simulations: the Almost Ideal Demand System (AIDS), (nested) logit demand, linear demand, and log-linear or constant elasticity demand. The different curvature properties of these four demand systems are illustrated in Figure 1. For a single product, the four demand curves are plotted above a common competitive equilibrium price and quantity ($P = 4$, $Q = 10$). The four demand curves not only intersect at this price and quantity, they also exhibit the same elasticity, ϵ, at that price and quantity (-2). Hence, all four demand curve share a common point and slope at that point. Assuming marginal cost (MC) is constant, each of the demand curves is extended to upward to the monopoly price and quantity, as determined by the familiar first-order condition $(P - MC)/P = -1/\epsilon$.

The differences in monopoly prices are attributable to differences in the elasticity functions associated with the four demand systems, and they are plotted in Figure 2. With log-linear demand, the elasticity of demand is constant, while for the other systems, demand becomes more elastic as price increases. The difference between the monopoly and competitive prices depends on the rate of change of the elasticity of demand.

In what follows, we describe each of the demand systems in more detail, then characterize different implications of the four systems using Monte Carlo experiments. Our results highlight the important role played by the inherent curvature

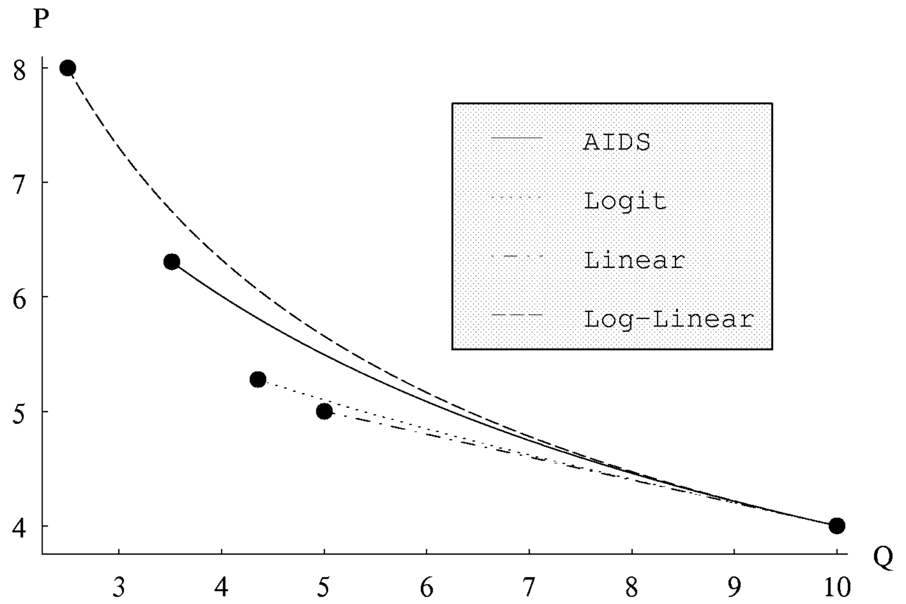

Figure 1. The four demand curves plotted between the competitive and monopoly equilibria.

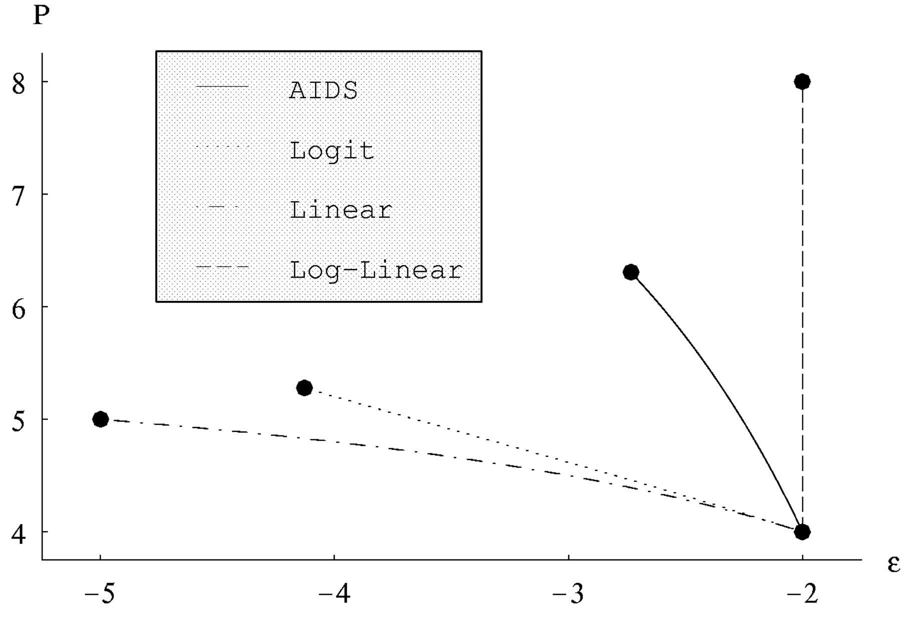

Figure 2. Elasticities of demand for the four demand curves between the competitive and monopoly prices.

properties of the assumed demand system in computing the postmerger equilibrium. Although we find that these curvature properties are very important, the choice of a demand system in practice may also depend on other characteristics, and we do not specifically recommend the use of any of these demand systems.

II. Merger Simulation with Four Alternative Demand Systems

1. Merger Simulation in a Nutshell

Each product j is produced by a single firm i. Each firm can produce multiple products, and the relation $F()$ maps the products into the firms that produce them. The marginal cost of production for each product, c_j, is assumed to be constant. We assume there are no economies of scope, but different firms may have different costs. Product prices and quantities are denoted p_j and q_j. We assume Bertrand competition, so each firm maximizes its short-run profit.

$$\pi_i = \sum_{j,F(j)=i} (p_j - c_j) q_j(\mathbf{p}),$$

where $\mathbf{p}$ is the vector of all prices. For each product k, the first-order equilibrium condition is

$$0 = \frac{\partial \pi_i}{\partial p_k} = q_k(\mathbf{p}) + \sum_{j,F(j)=i} (p_j - c_j) \frac{\partial q_j(\mathbf{p})}{\partial p_k}.$$

The elasticity of demand for product j with respect to price of product k is

$$\epsilon_{jk} = \frac{\partial q_j(\mathbf{p})}{\partial p_k} \frac{p_k}{q_j(\mathbf{p})}.$$

The price-cost margin for product j is

$$\theta_j = \frac{p_j - c_j}{p_j}.$$

The first-order conditions, thus, also can be rewritten

$$1 = \sum_{j,F(j)=i} \theta_j \epsilon_{jk} \frac{p_j q_j}{p_k q_k}.$$

A merger simulation involves first "calibrating" a specified demand system, $\mathbf{q}(\mathbf{p})$, to a set of premerger equilibrium prices, quantities, and demand elasticities, then solving the premerger first-order conditions for the c_j. (Only relative quantities, termed "shares," matter in a simulation, and the quantities below can be interpreted as relative.) The postmerger equilibrium is predicted using the same first-order condition, except that a merger changes the ownership relation, F. The overall effect of any combination of product sales, swaps, and mergers of entire firms can be represented as a change in F, so the effects of all of these ownership rearrangements can be simulated in the same way. Both merger synergies and inefficiencies can be incorporated through exogenous changes in one or more of the c_j.

We examine the effects on the postmerger equilibrium of four alternative specifications for the demand system. All four demand systems can be calibrated to any set of premerger prices and relative quantities. Three of the four demand systems can be considered first-order approximations to the unknown demand surface in the neighborhood of the premerger equilibrium, because they are sufficiently flexible that they can be calibrated to fit precisely an arbitrary matrix of premerger demand elasticities. The exception is logit, which has fewer parameters and less flexibility than the other three. For example, a nonnested logit specification implies that all cross elasticities of demand with respect to a given price are the same. A nested logit specification (see Werden et al., 1996; Werden and Froeb, 1994) adds flexibility, but it remains less flexible than the others.

Mergers of competitive significance require projecting demand outside the neighborhood of the premerger equilibrium. If a merger is significantly anticompetitive, prices – and especially quantities – change enough so the curvature of the demand curves matters. Three of the four demand systems have no flexibility as to curvature once elasticities have been specified, and the fourth, AIDS, has very little. Thus, the specification of any one of these demand systems has certain unavoidable implications for the predicted postmerger equilibrium. Those implications are examined below.

2. Linear and Log-Linear Demand

Expressed as an approximation to an unknown true demand surface at premerger prices and quantities, a linear demand systems has the form

$$\mathbf{q}(\mathbf{p}) = \mathbf{q}^0 + \mathbf{M}(\mathbf{p} - \mathbf{p}^0),$$

where $\mathbf{M}$ is the matrix of price slope coefficients, i.e.,

$$m_{ij} = \frac{\partial q_i}{\partial p_j} = \epsilon_{ij}\frac{q_i^0}{p_j^0}.$$

Among other problems, the predicted equilibrium following a highly asymmetric merger is apt to yield negative quantities when the demand system is linear, unless nonnegativity constraints are imposed.

Taking a log-linear approximation, yields a constant elasticity demand system.

$$\log(q_i(\mathbf{p})/q_i^0) = \sum_{j=1}^{n} \epsilon_{ij} \log(p_j/p_j^0).$$

Postmerger equilibrium does not always exist with this demand system. Because the merging firms' own and cross elasticities of demand do not change as they raise prices, their first-order conditions may not be satisfied at finite prices or quantities. This occurs when one or both cross elasticities are sufficiently high relative to the own elasticities so that raising the price of one merging firm's product yields a gain from substitution to the other merging firm's product that exceeds the loss from substitution away from the first product. Postmerger equilibrium does not exist, for example, with symmetric merging firms having own elasticities of demand of −2 and cross elasticities of demand of 1.

3. Logit Demand

A logit demand system generally is motivated by a random utility model in which consumers make a discrete choice among an exhaustive set of alternatives, selecting the alternative yielding the greatest utility (see Ben-Akiva and Lerman, 1985; McFadden, 1974). We consider a variation of the logit employed by Anderson et al. (1992) and Werden and Froeb (1994) that models the indirect utility of customer i for choice j as

$$u_i = v_j + \mu_{ij}$$

$$v_j = (\eta_j - p_j)/\lambda.$$

If the μ_{ij} are distributed as independent extreme value variates, choice probabilities have the form:

$$s_j(\mathbf{p}) = \frac{e^{(\eta_j - p_j)/\lambda}}{\sum_{k=1}^{n} e^{(\eta_k - p_k)/\lambda}} = \frac{e^{v_j}}{\sum_{k=1}^{n} e^{v_k}}.$$

The prices of "inside" goods are determined by Bertrand competition with the products involved in the merger and therefore change in response to a merger; the prices of "outside" goods are held constant. Since their prices are constant, we aggregate the outside goods into a single no purchase option with choice probability $s_0(\mathbf{p}^0)$. Following Werden and Froeb (1994), the choice probability of the outside good is not the actual frequency with which consumers purchase none of the inside goods, but rather a scaling value that results in the inside goods having a premerger aggregate demand elasticity

$$\epsilon = \left[\frac{\partial(1 - s_0(\theta\mathbf{p}^0))}{\partial\theta}\right]_{\theta=1} \frac{\bar{p}^0}{(1 - s_0(\mathbf{p}^0))} = \frac{\bar{p}^0 s_0(\mathbf{p}^0)}{\lambda},$$

where $\bar{p}^0$ is the weighted average price of the inside goods at the premerger prices and quantities.

With multiple inside goods, the product-specific own and cross elasticities of demand are

$$\epsilon_{jj} = p_j(1 - s_j(\mathbf{p}))/\lambda$$

$$\epsilon_{jk} = p_k s_k(\mathbf{p}))/\lambda.$$

The equality of the cross elasticities with respect to a particular price is a direct consequence of the Independence of Irrelevant Alternatives (IIA) property of the logit model (see Werden et al., 1996), and it is a limiting feature of logit demand. The logit model can be generalized to admit nests or correlation among the μ_{ij}'s.

4. AIDS DEMAND

The Almost Ideal Demand System is derived as a first-order approximation to any demand function resulting from an individual's utility maximization (Deaton and Muelbauer, 1980a,b). With the AIDS, the budget share of the good i is given by

$$w_i = \alpha_i + \sum_j \gamma_{ij} \log(p_j) + \beta_i \log(x/P),$$

where x is the total expenditure and P is a price index given by

$$\log(P) = \alpha_0 + \sum_k \alpha_k \log(p_k) + \frac{1}{2} \sum_k \sum_l \gamma_{kl} \log(p_k) \log(p_l).$$

The term x/P represents the real expenditure level.

The total expenditure on the good i good is xw_i, so the quantity of good i demanded is $q_i = xw_i/p_i$. We adopt the same distinction between "inside" and "outside" goods that we exploited in the logit model; the prices of inside goods are determined through an oligopoly interaction with the merging products, while the prices of outside goods are constant. For outside goods, it follows that the $\gamma_{ij} \log(p_j)$ terms are constant and can be absorbed into the α_i parameters. Similarly for the price index, the $\gamma_{kl} \log(p_k) \log(p_l)$ terms are constant and can be absorbed into the $\alpha_k \log(p_k)$ term, and the $\gamma_{kl} \log(p_k) \log(p_l)$ terms can be absorbed into the α_0 term. For purposes of merger simulations, aggregate expenditures on all goods can be treated as fixed, so we can also absorb the $\log(x)$ term into α_0 and rescale all of the coefficients to eliminate the x. Redefining all parameters, we then have

$$q_i = \frac{\alpha_i - \beta_i \alpha_0 + \sum_j (\gamma_{ij} - \beta_i \alpha_j) \log(p_j) - \frac{\beta_i}{2} \sum_k \sum_l \gamma_{kl} \log(p_k) \log(p_l)}{p_i}.$$

This makes expenditure a linear function of the $\log(p_j)$ and the term $\sum_k \sum_l \gamma_{kl} \log(p_k) \log(p_l)$. The elasticities of demand are given by

$$\epsilon_{ij} = \left[\gamma_{ij} - \beta_i \left(\alpha_j + \frac{1}{2} \sum_k (\gamma_{kj} + \gamma_{jk}) \log(p_k) \right) \right] / w_i - \delta_{ij},$$

where $\delta_{ij} = 1$ if $i = j$ and $\delta_{ij} = 0$ if $i \neq j$.

In applying the AIDS to mergers, economists have adopted a multistage budgeting approach, pioneered by Gorman (1995), in which consumers make budgeting decisions in a hierarchial manner. This added structure places constraints on the cross elasticities between products at different hierarchial levels. In addition, there must be a functional form specification for the "top" level, and typically, aggregate demand for an expenditure category is assumed to be determined by a log-linear demand curve (see, e.g., Hausman and Leonard, 1997; Hausman et al., 1994).

5. Elasticity Changes Resulting from Mergers

Contrasts among the four demand systems can be further illustrated by examining how the own and cross elasticities of demand change when symmetric duopolists merge. For this illustration, the four demand systems are calibrated so that the premerger, duopoly price and quantity are $P = 4$, $Q = 10$, for both firms. Due to the assumed symmetry, all of the own and cross-price elasticities of demand are equal before and after the merger. The four demand systems are calibrated so that the premerger, duopoly own and cross price elasticities are $\epsilon_{ii} = -3$ and $\epsilon_{ij} = 1$.

Figure 3 graphs the changes in the common own elasticity of demand as price is increased from the premerger, duopoly level to the postmerger, monopoly level. Price increases the most with constant elasticity demand and almost as much with AIDS demand. The price increases with linear and logit demand are roughly equal, and much lower than the other two. Except with log-linear demand, the individual product demands become increasingly elastic as price increases, with the largest elasticity change exhibited by the linear demand system. The rate of change of the own elasticity of demand is a vitally important characteristic of a four demand systems and is responsible for significant differences in monopoly prices for the four demand systems.

Figure 4 graphs the changes in the common cross elasticity of demand as price is increased from the premerger, duopoly level to the postmerger, monopoly level. Because both prices increase and both quantities decrease, the merger increases the cross elasticities of demand unless the cross partial derivative in the cross elasticity decreases rapidly. With linear demand, this partial derivative is constant, and with the AIDS, it does not decrease rapidly enough. Logit demand, is different however; cross elasticities decrease unless *industry* demand is inelastic, and it cannot be inelastic at the monopoly equilibrium. This difference in cross elasticity effect accounts for the fact that the price increase from the merger is much greater with the AIDS than with logit demand, even though the own elasticities of demand are the same, pre and postmerger, with these two demand systems.

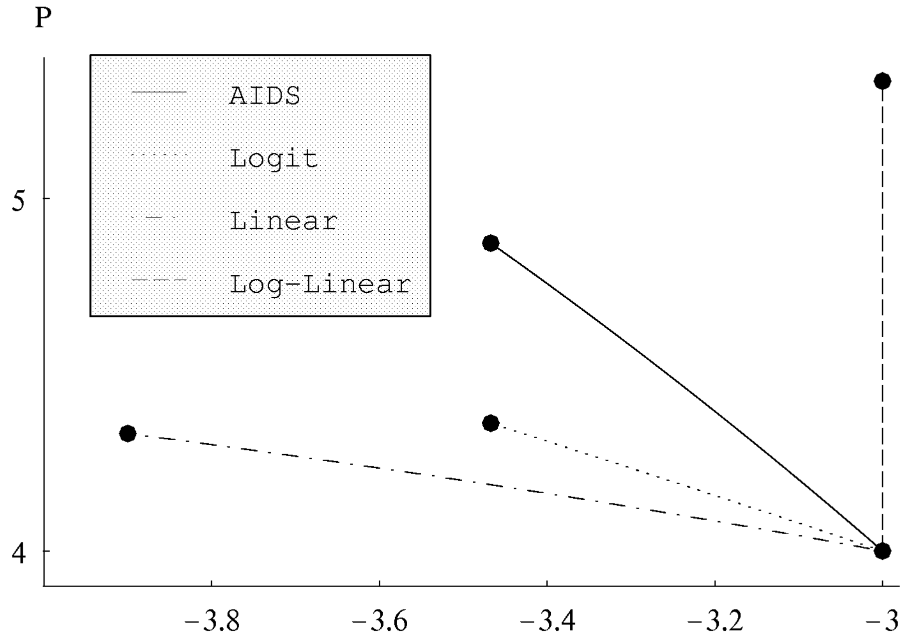

Figure 3. Symmetric own elasticities for the four demand curves between the duopoly and monopoly prices.

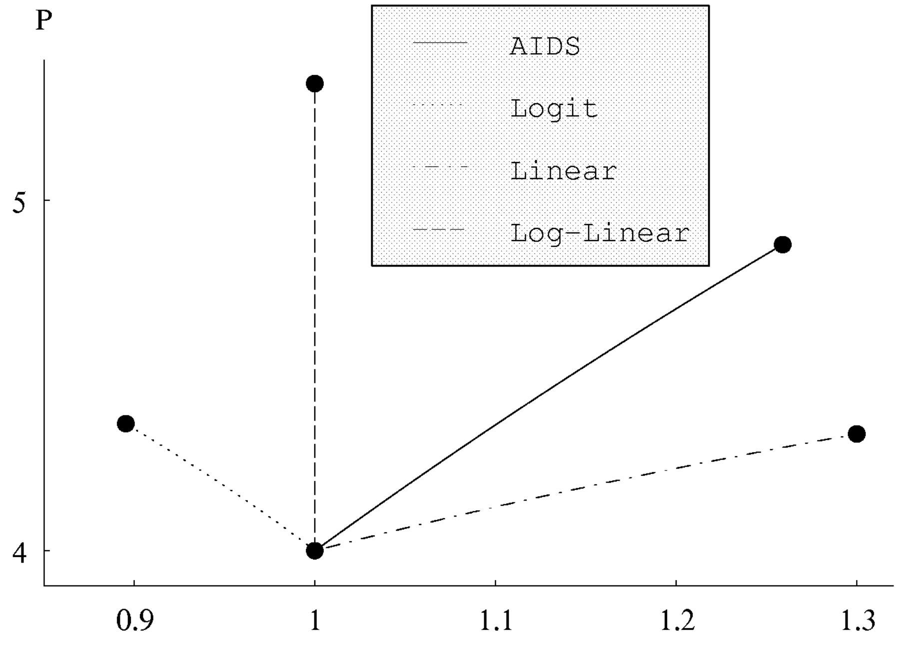

Figure 4. Symmetric cross elasticities for the four demand curves between the duopoly and monopoly prices.

III. Monte Carlo Experiments

To compare asymmetric postmerger equilibria predicted by the different demand systems, we must proceed numerically, using Monte Carlo experiments. This section reports results for each of the four demand systems from merger simulations in industries randomly configured using the uniform pseudo random number generators built into *Mathematica*. An integer number of single-product firms is chosen from the interval [4, 8] and we "merge" the first two. We arbitrarily set all premerger prices to one, and choose premerger quantities from the interval [10, 50]. As noted above, only relative quantities matter, and this method was designed to commonly yield shares large enough to be of potential concern. We verified that setting premerger prices to one has no significant effect by trying alternative assumptions.

Although the nested version of the logit model is more flexible, we use only the nonnested version in these simulations. Consequently, the logit demand system is used to generate industry elasticities and the other, more flexible, demand systems are calibrated to the elasticities. The aggregate elasticity, ϵ, is chosen from the interval $[-2.5, -1]$, and the (inverse) logit scaling parameter, $1/\lambda$ is chosen on the interval $(-\epsilon, 2-\epsilon]$. These ranges were chosen to generate a distribution of own price elasticities for individual products with a minimum of about -1 and a mean between -2 and -3, and a distribution of cross elasticities with a mean of about 0.2. These are consistent with what we have seen estimated from scanner data in many merger cases (see, e.g., Hausman and Leonard (1997)). For the other three demand systems, parameter values are chosen to achieve the same premerger elasticities, prices, and relative shares as with logit demand. With the AIDS we set $\beta_i = 0$, which implies an income elasticity of 1, and that is roughly what is typically found in estimation. Changes in the β_i parameter can increase or decrease the postmerger price, but its effect typically is small. Moreover, for a hundred randomly generated industries, the overall average of the industry average price increases was almost exactly the same with $\beta_i = 0$ as with $\beta_i = 0.1$.

As noted above, a linear demand system can predict negative postmerger equilibrium quantities and postmerger equilibrium may not exist with a log-linear demand system. We analyze the first 3,000 randomly generated industries that presented neither problem. Table I presents summary statistics for the 3,000 mergers – the own and cross price elasticities and the market share for the merging products and the change of the Herfindahl–Hirschman Index (ΔHHI), which is twice the product of the two shares. Postmerger prices were calculated for each firm in each random industry. From these, an industry-wide average percentage price increase from the mergers was calculated, using a fixed-weight Laspeyres price index. The ordering of price increases observed above for monopoly price increases carries over quite robustly to the merger simulations. For all 3,000 simulations, the industry average price change with the AIDS exceeds that with a logit demand system, which in turn exceeds that with a linear demand system. In just 11 of the

Table I. Summary statistics for simulated mergers

Variable	Minimum	Maximum	Mean	Median	Standard deviation
Own elasticity	−4.23	−1.04	−2.57	−2.57	−0.64
Cross elasticity	0.001	0.80	0.17	0.15	0.13
Share (%)	4.2	51.7	17.6	16.7	7.89
ΔHHI	44.0	2861.0	631.9	516.7	438.9

Table II. Median percentage price increase per 100 points of ΔHHI

ΔHHI range	Price	Linear	Logit	AIDS	Log-linear
≤ 500	Merged firm	0.281	0.502	0.580	0.929
	Industry	0.084	0.131	0.174	0.230
500–1,000	Merged firm	0.186	0.341	0.397	0.633
	Industry	0.087	0.131	0.188	0.285

simulations does the industry average price increase with an AIDS exceed that with a log-linear demand system.

Scatter plots of the price increases against ΔHHI indicate that ΔHHI has substantial predictive power, but the relationship between the price increases and ΔHHI is not quite linear and has a substantial variance that increases with ΔHHI. Moreover, the distribution of price increases for any given level of ΔHHI is skew, in that large positive outliers are more prevalent than large negative outliers.

In presenting results we ignore the 6% of the simulations for which ΔHHI exceeded 1,500 because there is a very high variance in predicted price increases in this region yet observations are very few. Because of the nonlinearity and heteroskedasticity in the relationship, we also separate the remaining observations into two groups of comparable size based on ΔHHI: ΔHHI ≤ 500 (1446 simulations) and 500 < ΔHHI < 1,500 (1375 simulations).

For each of the demand systems, Table II reports the median marginal effect on prices of a change in the Herfindahl, and Table III reports asymmetric, nonparametric confidence intervals around the medians from Table II. On each side of the median, these 90% confidence intervals contain the 45% of the empirical probability distribution.

The results from the Monte Carlo experiments tell a somewhat different story than the graphs in the earlier sections. Linear and log-linear demand result in the lowest and highest price changes, while logit and AIDS are in the middle. The median price effects with logit and AIDS are significantly, but not drastically, different in Table II. However, the distribution of the AIDS price effects is skewed

Table III. 90% confidence interval price increase per 100 points of ΔHHI

ΔHHI range	Price	Linear	Logit	AIDS	Log-linear
≤ 500	Merged firm	0.065–0.582	0.124–1.039	0.169–1.752	0.254–2.482
	Industry	0.016–0.180	0.031–0.246	0.045–0.547	0.064–0.600
500–1,000	Merged firm	0.032–0.406	0.061–0.634	0.087–1.388	0.132–1.881
	Industry	0.013–0.195	0.026–0.261	0.036–0.687	0.054–0.797

to the right; in Table III, the upper confidence bound for the AIDS is substantially greater than that with logit demand.

IV. Discussion

The four demand systems that have been used in merger simulation have inherent curvature or shape characteristics that cause significant differences in predictions of postmerger price increases. In extrapolating from premerger equilibria, elasticities of demand change in ways that significantly affect the profit-maximizing price increases following a merger and that are inherent in the functional forms of the four demand systems. This suggest a need for research empirically determining the actual curvature or shape characteristics of real world demand curves, or the development of demand systems for use in both estimation and simulation that have more flexible functional forms. For example, the Box–Cox transformation (Box and Cox, 1964) has been used to specify a flexible functional form when the true functional form is unknown.

Unless there is good information about the higher-order properties of the demand curve, it is probably important to conduct merger simulations under a variety of assumed demand forms in order to take account of what Leamer (1983) calls "model uncertainty." Confidence intervals for predicted postmerger prices should incorporate not only variances of estimated elasticities, but also the effects of different demand assumptions.

References

Anderson, Simon, Andre de Palma, and Jacques-Francois Thisse (1992) *Discrete Choice Theory of Product Differentiation*. Cambridge, Massachusetts: MIT Press.

Ben-Akiva, Moshe, and Steven Lerman (1985) *Discrete Choice Analysis: Theory and Application to Travel Demand*. Cambridge, Mass.: The MIT Press.

Box, G. E. P. and D. R. Cox (1964) 'An Analysis of Transformations', *Journal of the Royal Statistical Society*, Series B, **26**, 211–243.

Deaton, Angus, and John Muelbauer (1980a) *Economics and Consumer Behavior*. Cambridge: Cambridge University Press.

Deaton, Angus, and John Muelbauer (1980b) 'An Almost Ideal Demand System', *American Economic Review*, **70**, 312–326.

Froeb, Luke, and Gregory J. Werden (1996) 'Simulating the Effects of Mergers Among Noncooperative Oligopolists', in Hal Varian (ed.), *Computational Economics and Finance: Modeling and Analysis with Mathematica*. New York: Springer-Verlag/Telos.

Gorman, W. M. (1995) 'Two Stage Budgeting', in C. Blackorby and A. F. Shorrocks (eds.), *Seperability and Aggregation: Collected Works of W.M. Gorman*. Oxford: Clarendon Press.

Hausman, Jerry A., and Gregory K. Leonard (1997) 'Economic Analysis of Differentiated Products Mergers Using Real World Data', *George Mason Law Review*, **5**, 321–346.

Hausman, Jerry, Gregory Leonard, and J. Douglas Zona (1994) 'Competitive Analysis with Differenciated Products', *Annales d'Economie et Statistique*, **34**, 159–180.

Leamer, Edward (1983) 'Lets Take the 'Con' Out of Econometrics', *American Economic Review*, **73**, 31–43.

McFadden, D. (1974) 'Conditional Logit Analysis of Qualitative Choice Behavior', in P. Aarembka (ed.), *Frontiers in Econometrics*. New York: Academic Press.

Shapiro, Carl (1996) 'Mergers with Differentiated Products', *Antitrust*, Spring, 23–30.

Train, Kenneth (1986) *Qualitative Choice Analysis*. Cambridge, Mass.: MIT Press.

U.S. Department of Justice and Federal Trade Commission (1992), *Horizontal Merger Guidelines*, April 2.

Werden, Gregory J. (1997a) 'Simulating the Effects of Mergers in Differentiated Products Industries: A Practical Alternative to Structural Merger Policy', *George Mason Law Review*, **5**, 363–386.

Werden, Geregory J. (1997b) 'Simulating Unilateral Competitive Effects from Differentiated Products Mergers', *Antitrust*, Spring, 27–31.

Werden, Gregory J. (1997c) 'A Robust Test for Consumer Welfare Enhancing Mergers among Sellers of Differentiated Products', *Journal of Industrial Economics*, **44**, 409–413.

Werden, Gregory J. (1997d) 'Simulating the Effects of Differentiated Products Mergers: A Practitioners' Guide', in Julie A. Caswell and Ronald W. Cotterill (eds.), *Strategy and Policy in the Food System: Emerging Issues*. Storrs, Conn.: Food Marketing Policy Center.

Werden, Gregory J., and Luke M. Froeb (1994) 'The Effects of Mergers in Differentiated Products Industries: Logit Demand and Merger Policy', *Journal of Law, Economics, and Organization*, **10**, 407–426.

Werden, Gregory J., and Luke M. Froeb (1996) 'Simulation as an Alternative to Structural Merger Policy in Differentiated Products Industries', in Malcolm Coate and Andrew Kleit (eds.), *The Economics of the Antitrust Process*. New York: Kluwer Academic Publishers.

Werden, Gregory J., Luke M. Froeb, and Timothy J. Tardiff (1996) 'The Use of the Logit Model in Applied Industrial Organization', *International Journal of the Economics of Business*, **3**, 83–105.