NEW ESTIMATES OF WELFARE AND CONSUMER LOSSES IN U.S. FOOD MANUFACTURING

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SP 93-18 December 1993

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ABSTRACT

In the past 15 years, industrial-organization economists have significantly expanded the range of algorithms for calculating welfare losses due to imperfect competition. We compare eleven empirical estimates of economic losses due to market power in 47 U.S. food manufacturing industries, almost all of them previously unpublished. Each of the studies incorporate different theoretical assumptions about demand conditions, supply conditions, or industry pricing behavior; or they utilize various data sources, time periods, and assumptions about the proper competitive benchmark. The estimates of <u>average</u> allocative losses due imperfect competition range from 0.2 percent to an impossibly high 289 percent of industry output; consumer losses range from 6.0 percent to 816 percent. However, there is a high degree of congruence in the <u>rankings</u> of economic losses due to market power. Hence, from the perspective of antitrust enforcement, the choice of industry targets has not been greatly altered by advances in estimation techniques.

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Introduction

In the beginning was Harberger (1954).

His seminal investigation into the size of welfare losses due to monopoly power has spawned scores of studies, each claiming to incorporate some sort of improvement, that confirm, contradict, or at the least update Harberger's estimate. Harberger's paper is so well known that the geometric representation of the net social welfare loss due to monopoly (ΔABC in Figure 1) is now known to economists as the "Harberger Triangle."[1]

The studies that followed Harberger's paper focussed on their criticism initially on the number of measurement or data-source issues. Many studies published up through the 1960s (reviewed below) confirmed allocative losses almost as low as Harberger's (0.06 percent of GNP), but most of the subsequent responses found considerably higher estimates (some as high as seven percent). Other follow-up studies took the position that even if the Harberger loss was insignificant, a broader concept of losses was the appropriate focus of investigation. In particular, some of the profit rectangle ($\square P_M BAP_C$), conventionally regarded a pure income transfer (changes in equity), was argued to be an additional source of social loss. In addition to various empirical issues, beginning around 1980 the field of industrial organization experienced great progress in oligopoly theory, in the sense that older models were often shown to be special cases of the newer models. These theoretical advances resulted in the development of several formulas that permit new empirical estimates of the

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1 The triangle also represents "allocative losses" or the "deadweight loss" to society. If marginal costs are rising, the total deadweight loss includes a triangle just below ΔABC representing producer losses. Figure 1 is based on the traditional, Marshallian concept of consumer welfare and demand. Hicksian concepts of demand (the compensating and equivalent variations) may be theoretically preferred, but Willig (1976) has shown that Marshallian measures will be bracketed by the two Hicksian variations.

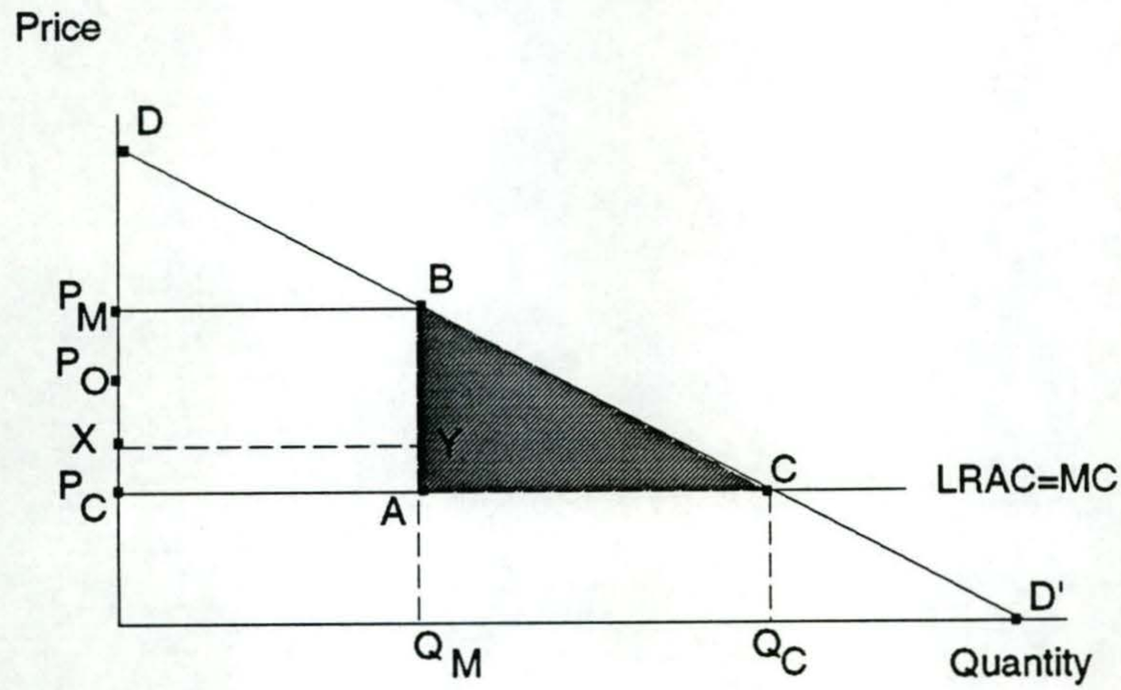

Figure 1. Welfare Losses and Income Transfers Due to Monopolistic Pricing.

losses due to market power (Appendix Table B1). These newer approaches may be evolutionary refinements of previous estimates, or they may be radical breaks from the past. Evidence of a radical break from the empirical contributions of industrial organization economics up to the 1980s might be interpreted as discrediting the Bainsian mainstream.

Having accurate estimates of economic losses due to imperfect competition is important for public policy decision making. The allocation of antitrust enforcement effort is closely related to such losses, with efficiency criteria uppermost during some political regimes and equity concerns given greater weight under other political philosophies (Preston and Connor 1992). It would be of some comfort to economists to know that the industries targeted for antitrust enforcement also had high estimated economic losses due to market power.

This paper examines the impact of the theoretical developments of the 1980s on empirical estimation of economic losses due to market power. The main question addressed is whether the new theoretical approaches produce estimates of welfare losses that diverge from those of the Bainsian tradition, or whether the previous findings may be seen in retrospect as special cases of the new estimates. Specifically, we are interested in whether eleven cross-sectional estimates of welfare loss and ten estimates of consumer overcharges due to market power in the U.S. food manufacturing industries are sensitive to the following factors:

- alternative conceptual models and their underlying assumptions,
- measurement issues, especially assumptions concerning parametric values,
- types of data employed for testing, and
- time periods.

Of the 21 sets of loss estimates presented in this paper, only three or four were previously published.

The alternative oligopoly models considered in this paper fall into four classes of pricing behavior: monopoly pricing, Cournot pricing, price leadership, and industry-wide oligopoly pricing whose nature is not predetermined by the researcher. Some empirical estimates are derived from predicted Lerner indexes that employ rich specifications of market structure and firm conduct, while others are calculated from formulas containing only two or three variables (numbers of companies, market concentration, and industry demand elasticity). Some estimates assume fixed values for demand or supply elasticities that the researcher defends as reasonable, while other approaches allow these parameters to vary across market observations. Another difference in empirical approaches is the competitive standard employed. While most choose perfect competition, some choose the less precise but possibly more pragmatic "workable" competition. All the estimates developed herein begin with national industry sales concentration data published by the U.S. Bureau of the Census, but some studies adjust these data for the size of geographic markets or the existence of strategic groups of firms within industries. As for data sources, some studies rely on Census price-cost margins, whereas others utilize commercial price data[2] Moreover, earlier studies tended to draw upon broadly defined, aggregated industry data, whereas some recent studies have employed micro-data sets.[3] Finally, the time periods analyzed include years between 1967 and 1987.

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[2] We did not include structure-conduct studies based on company profit data in our survey of food-manufacturing studies, though there are a few good ones available (see Connor, et al. 1985:Chapter 7).

[3] Harberger (1954) selected 73 industries to represent the U.S. manufacturing sector. For food manufacturing studies, some use 43 to 50 four-digit industries, others more than 100 five digit product classes, and two sampled hundreds of brands from among tens of thousands in the universe.

Harberger Critiqued

The history of estimation attempts may be seen as a progressive loosening of the rigid assumptions embodied in Harberger's study. In order to calculate the area of ΔABC, he made the following five key assumptions: the demand curve (DD') is linear; marginal costs (MC) are linear and constant; firms in the industry practice perfect (cartel) monopoly pricing; the competitive profit rate equals the observed average profit rate in the manufacturing sector (that is, the competitive price P_c=P_0 the observed market price, on average); and the absolute value of elasticity of own-price, retail demand (η) is unity for all industries.[4] Most of the initial criticism of Harberger focussed on measurement issues and examined the sensitivity of Harberger's estimate to changes in data bases, methods of calculation, or competitive benchmarks. However, nearly all subsequent research on welfare losses due to market power has retained one or more of these five assumptions, so they deserve to be examined in some detail:

1. Linear demand. This assumption leads to smaller welfare loss estimates compared to nonlinear demand schedules that are convex to the origin (see Figure 2). Moreover, the demand curve utilized implicitly in most research is the Marshallian (uncompensated) concept, instead of the theoretically preferred Hicksian welfare measures of change in consumer surplus. Only when the income effect of a price change is zero do the three measures coincide (Just, et al. 1982:93-94).

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[4] The formula for the change in net social welfare (DWL) is then

$$DWL = \frac{1}{2}P_cQ_c\eta(\frac{P_M-P_c}{P_c})^2.$$

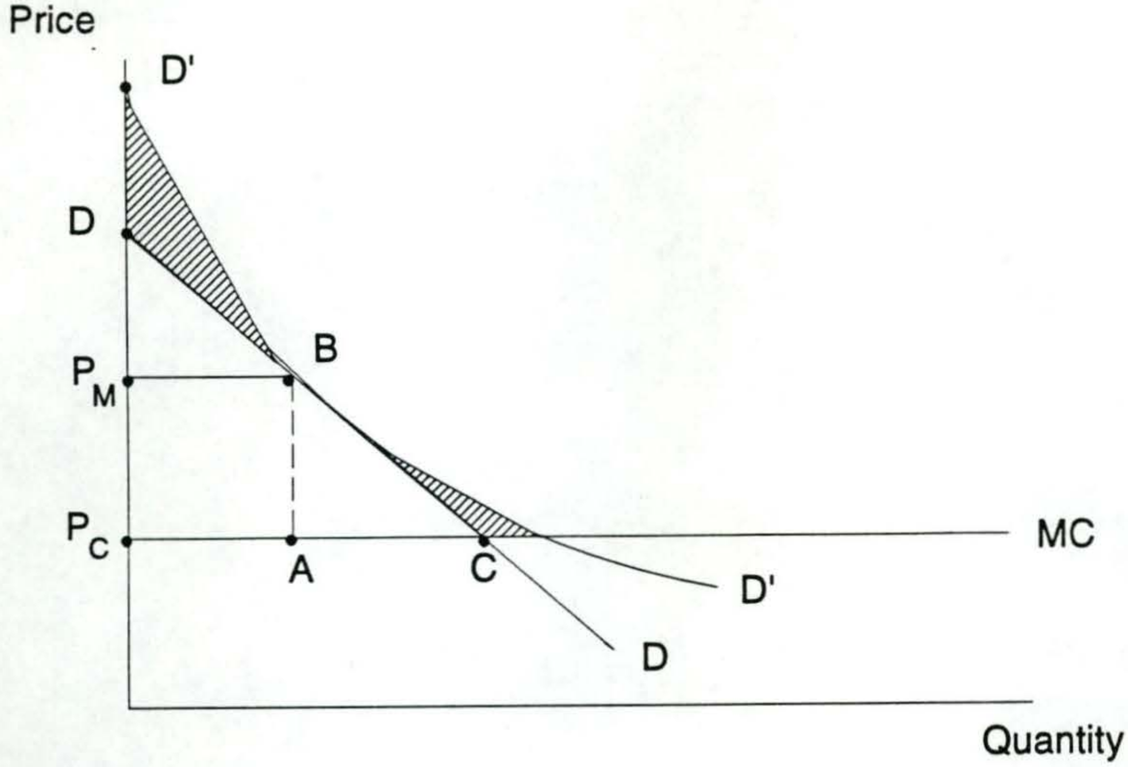

Figure 2. Welfare Losses and Income Transfers, Linear Demand (DD) Compared to Convex Demand (D'D').

Note: Shaded areas show increases in losses when demand schedule is convex compared to linear.

2. Constant marginal cost (MC) curve. One of the most frequent assumptions, widely regarded as "simplifying." But in fact the deadweight loss will vary systematically as ϵ, the MC elasticity, takes positive (diseconomies of scale) or negative (economies of scale) values. Harberger assumed $\epsilon=\infty$, which means that the deadweight loss affects only consumer surplus. Furthermore, by assuming that all firms in an industry have equal marginal costs, products are technologically standardized. The demand and supply assumptions, taken together, assume a market in long-run equilibrium.

3. Effective cartel pricing. This assumption requires a high degree of pricing cooperation based on high seller concentration, blockaded entry, and full, certain knowledge by cartel members about demand and supply conditions. Oligopolies that adopt noncooperative pricing, limit pricing, or price leadership will, *ceteris paribus*, produce different welfare losses than cartels.

4. The competitive standard. Harberger was widely criticized for adopting average manufacturing sector profits as the competitive standard (Scherer 1970, 1980). If sellers earn non-zero economic profits from market power, then by using average profits as the basis of comparison, the analyst is implicitly choosing a price like P_o instead of P_c, which will bias the estimated deadweight loss downward (Figure 1). Moreover, because economic profits become capitalized into asset values as "goodwill" by accounting methods, capital costs as stated in financial reports will be higher than their true marginal social costs, thus driving downward calculated returns on investment. On the other hand, reported accounting profits may be too high because of transitory disturbances, high industry risks, or superiority rents.

Finally, using manufacturing profits as a standard biases estimates of economy-wide dead-weight losses downward because profit rates tend to be lower in most other sectors, which have lower capital output ratios. In short, accounting profits may be biased surrogates for P_c or MC. Direct measures of prices or marginal costs should be used when available.

5. Unit demand elasticity (η=1). This was Harberger's assumption that was the most criticized, partly because it is too low to be consistent with the simple monopoly model. Unless marginal costs are zero, point B in Figure 1 must be in the elastic range of DD$'$ (that is, $\eta > 1$). Moreover, most critics found Harberger's assumption about the constancy of η across all industries difficult to accept. Because η is inversely related to the slope of BC, ceteris paribus, as η increases, so does the area of ΔABC. However, for a given demand curve, the first-order condition for profit-maximization by a monopoly requires that $\frac{P_m - P_c}{P_m} = \frac{1}{\eta}$; that is, the monopoly price wedge and η are inversely related.

Scherer (1970) suggested that η should be greater than unity because of long-term substitution of outputs among industries (e.g., aluminum for steel, petroleum for coal). Interestingly, Scherer's alternative elasticity proposals have drifted downward over time. In 1970 Scherer suggested that a reasonable average $\bar{\eta}$ = 2.5; in Scherer (1980), he proposed $\bar{\eta}$ = 2.0; and Scherer and Ross (1990) suggested $\bar{\eta}$ = 1.5 (Appendix A). The reasons for this downward trend in $\bar{\eta}$ are not made explicit in the three editions of this textbook. Moreover, the importance of very long run substitution may be of limited applicability to the consumer food products industries. It is true that the evolution of the food processing industries consists of the appearance of 70 or 80 new food product classes that supplemented the 25 or 30 in existence in 1849 (Connor 1982:Appendix Table 3). However, unlike other new manufacturing industries these new food manufacturing product classes by and large replaced already existing traditional on-farm or residential processing activities. Substitution among ingredients by processors (fructose for sucrose, soybean oil for lard, etc.) has been significant, but there is little reason to expect that processor substitution has affected consumer price responsiveness for the final products. Thus, the classic case of substitution of margarine for butter may well be the exception that proves the rule.

Industry demand elasticities also may be low if cartel member face uncertainty (see Wahlroos 1984) or if entry is not blockaded. One oligopolistic response to the threat of entry is limit pricing. With limit pricing, the observed price $P_0 < P_M$, which causes the monopoly price wedge $P_0 - P_C$ to shrink. In Figure 1, the monopoly equilibrium point moves from B towards C. It is possible that P_0 will fall for enough to make η inelastic. In an empirical study of 37 U.S. manufacturing industries with high concentration, Masson and Shaanan (1984) showed that the observed price P_0 on average was $P_0 = P_C + \frac{1}{4}\ (P_M - P_C)$. That is, the *observed* price wedge $P_0 - P_C$ was only one-fourth the theoretical monopolistic maximum.

Finally, a point not noted in this literature is that sellers below the retail level used their industry's *derived* demand curve for decision-making. As is well known, only under very special margin relationships (specifically, constant percentage mark-ups) can derived η be the same as the retail η at any given output. Otherwise, the derived η is less than the retail η. Reliable estimates of retail food demand elasticities typically fall in the 0.3 to 0.7 range (Huang 1985), so manufacturing demand elasticities may well be in the 0.1 to 0.5 range. In sum, demand elasticities in food manufacturing are likely to be much lower than the levels suggested by Scherer or Harberger.

Expanded Welfare Loss Concepts

In addition to relaxing Harberger's assumptions, more recent estimates have employed expanded definitions of social loss. Alternative concepts of social loss due to market power follow from a reëxamination of the profit rectangle P_mBAP_c in Figure 1, which is conventionally regarded as a pure income transfer. However, marginal costs can rise from P_c to X on Figure 1 for firms that exercize market power. In this case, the lower portion of the monopoly profits rectangle should be regarded as a social loss with the entire rectangle an upper bound on social losses.

Supracompetitive costs can arise from two sources. First is lax cost controls in the absence of competitive pressures, what Leibenstein (1966) called X-inefficiency. There are many possible sources of X-inefficiency in oligopolies (Franz 1988). A second, perhaps larger source is rent-seeking by firms. Posner (1975) was perhaps the first to argue that the costs of lobbying for regulations or costs incurred to raise barriers to entry should be regarded as socially wasteful. Cowling and Mueller regarded the portion of advertising expenditures by incumbent firms intended to raise entry barriers as a major source of elevated costs.

A second alternative to the Harberger concept of social loss empirical approach takes the position that finding accurate estimates of industry supracompetitive costs due to market power (point X, Figure 1) is infeasible, particularly for a large sample of industries. Instead, the focus is on estimating the trapezoid P_mBCAP_c, which is composed of a dead-weight loss and an income transfer from consumers to producers. The entire trapezoid is the *consumer loss due to market power* or, as X can conceivably rise to P_m in Figure 1, the trapezoid can be thought of as the upper limit on net social losses.

Justification for this second approach arises from a concern about household income redistribution. Oligopoly pricing is formally the same as an excise tax on consumers. Like tax-incidence analysis, one can calculate the implicit income-redistribution effects of oligopoly pricing. A study by Powell (1987) found that by reducing actual levels of four-firm concentration to 40 percent, income in the top one-sixth U.S. income stratum was reduced by 1.45 percent, but income increased in the other five strata by 0.3 to 0.7 percent. Connor, et. al. (1985) calculated benefits of similar magnitude from demonopolizing the U.S. food manufacturing industries.

Early General Studies

As noted earlier, a few early studies of welfare loss due to monopoly essentially confirmed Harberger's low estimate. Stigler (1956) and Worcester (1967) both arrived at welfare loss estimates close to 0.1 percent of GNP. However, several other studies arrived at much larger estimates of net social welfare loss, generally in the 4 percent to 7 percent range (Kamerschen 1966; Olson and Bumpass 1984; and Jenny and Weber 1983). Perhaps the best known study that resulted in large estimates is that of Cowling and Mueller (1978). They overcome the industry aggregation bias inherent in Harberger's method and data by using firm-level data. Moreover, they calculate rather than assume η by using the price-cost margins and the formula from monopoly equilibrium. Scherer and Ross (1990:664) criticize Cowling and Mueller for this method because it leads to imputed elasticities that many economists would judge to be unrealistically high. For example, if $\frac{P_M - P_C}{P_M} = 0.10$, then $\eta = 11$.

Food Manufacturing Studies

Bainsian Models

Model 1.

Parker and Connor (1978, 1979) were the first to estimate consumer loss due to market power in the U.S. food manufacturing industries. The method used for Model 1 was first developed by Collins and Preston (1968). This method is solidly in the Bainsian cross-sectional tradition of industrial-organization research, i.e., the form of the behavioral model and maintained hypotheses about the signs of the independent variables were drawn *a priori* from received theories of oligopoly and finance (Weiss 1974). Four-digit SIC industry price-cost margins were regressed against the four-firm concentration ratio, advertising intensity, an adjustment for regional markets, industry capital-output ratio, and sales growth. Although the fit of the models was quite good, this approach has several limitations. First, the fact that the sample is drawn from one year (1975) may mean that transitory disturbances other than unanticipated shifts in demand have affected the estimates of the regression coefficients.

Second, the price-cost margins are overly broad measure of profitability, containing several components of overhead expenses and other central administrative costs. For other criticisms of the cross-sectional, price-cost margin analysis of performance, see Schmalensee (1989).

The Parker-Connor approach employed three of Hargerger's assumptions: monopoly pricing, linear demand, and constant marginal costs. However, an average demand elasticity of 0.5 was adopted after a search of the food demand literature. Moreover, Parker and Connor adopted an "effective competition" or "workable competition" standard, not the usual perfect competition standard (Scherer and Ross 1990:52-54). Based on their understanding of the threshold levels of market structure (there is a substantial literature on the critical concentration level), they identified critical levels of concentration, advertising, and geographic markets extent so as to compute the upper level of workable competition in food manufacturing. The workable-competition level of profitability was subtracted from predicted monopoly profits, and a sensitivity analysis was performed. Although informed by previous research, identifying the workable competition standard requires judgement by the researcher.

The Connor-Parker study yielded an average dead-weight welfare loss twice as high as Harberger's--0.16 percent of 1977 food industry value of shipments (Table 1, column 1). The average consumer overcharge, which Harberger did not estimate, was predicted to be 7.9 percent of food-manufacturing shipments (Table 2, column 1). The total consumer loss ranged from 0 (for five industries) to 33 percent (chewing gum).

Table 1. Predicted Dead-Weight Welfare Losses Due to Imperfect Market Competition, 47 U.S. Food Manufacturing Industries, 11 Models.

SIC (1977)	Industry[c]	Estimating Model[a]										
		1	2	3	4	5	6	7	8	9	10	11
		Percent										
2011	Meat packing	0.00	0.05	0.01	0.00	0.29	0.89	14.3	0.98	24.0	0.00	0.50
2013	Meat processing	0.08	0.06	0.02	0.04	0.13	0.39	6.3	0.42	8.6	0.00	2.85
2016	Poultry dressing	0.00	0.18	0.08	0.01	0.42	1.28	20.4	1.47	----	0.00	2.30
2017	Poultry and egg processing	0.00	0.18	0.00	0.00	0.42	1.28	20.4	1.47	----	0.00	2.30
2021	Butter	0.02	0.06	0.00	0.00	0.17	0.51	8.1	0.54	11.7	0.00	0.21
2022	Cheese	0.03	0.17	0.27	0.01	0.40	1.22	19.4	1.37	43.1	0.01	1.32
2023	Preserved milk products	0.01	1.25	0.57	0.04	0.48	1.46	23.4	1.68	----	0.01	2.63
2024	Ice cream, frozen desserts	0.05	0.93L	0.60	0.01	0.14L	0.42L	6.7L	0.45L	9.8L	0.00L	2.08L
2026	Fluid milk and related	0.07	0.54L	0.50	0.01	0.22L	0.69L	11.0L	0.77L	24.0L	0.00L	0.66L
2032	Canned specialties	0.78	2.08	0.74	0.22	8.57	26.26	420.1	----	----	0.56	0.97
2033	Canned fruits and vegetables	0.07	1.34	0.18	0.06	0.98	3.00	47.9	4.00	----	0.01	2.99
2034	Dried fruits and vegetables	0.37	1.27	0.19	0.14	1.63	4.99	79.8	7.67	----	0.03	3.17
2035	Pickles and sauces	0.59	0.32	0.63	0.19	1.56	4.78	76.4	7.06	----	0.04	3.70
2037	Frozen fruits and vegetables	0.25	0.98	0.20	0.04	0.60	1.83	29.3	2.21	----	0.01	3.45
2038	Frozen specialties	0.25	1.05	0.43	0.06	0.60	1.83	29.3	2.21	----	0.01	3.45

Table 1. (Continued).

SIC (1977)	Industry	Estimating Model[a]										
		1	2	3	4	5	6	7	8	9	10	11
2041	Flour	0.05	0.48	0.23	0.02	3.70	11.34	181.4	----	----	0.05	2.97
2043	Breakfast cereals	2.10	2.64	1.42	0.20	22.32	68.34	1,093.5	----	----	0.71	19.51
2044	Rice	0.07	0.79	1.21	0.30	1.10	3.36	53.8	4.63	----	0.02	1.82
2045	Flour mixes and doughs	1.20	2.85	1.05	0.08	8.88	27.20	435.1	----	----	0.16	----
2046	Wet corn milling	0.00	0.25	0.54	0.00	15.48	47.41	758.5	----	----	0.10	0.60
2047	Pet foods	----	3.36	1.06	0.16	6.77	20.74	331.8	----	----	0.16	1.37
2048	Animal feeds	----	0.36L	0.00	0.00	1.23L	3.75L	60.1L	7.34L	----	0.01L	0.59L
2051	Bread and cakes	0.18	2.06L	0.61	0.11	0.70L	2.15L	34.9L	2.68L	----	0.01L	6.43
2052	Cookies and crackers	0.66	4.62	0.66	0.15	2.34	7.18	114.9	13.63	----	0.08	6.43
2061	Raw cane sugar	0.00	0.15	0.00	0.00	17.52	53.66	858.5	----	----	0.37	----
2062	Refined cane sugar	0.07	0.48	0.11	0.00	4.16	12.75	204.1	----	----	0.09	2.24
2063	Refined beet sugar	0.01	1.17	0.11	0.00	4.16	12.75	204.1	----	----	0.09	2.24
2065	Confectionery	0.53	2.15	0.36	0.08	5.44	16.67	266.7	----	----	0.16	2.16
2066	Chocolate	0.56	1.97	0.60	0.13	1.23	3.76	60.2	4.92	----	0.04	3.28
2067	Chewing gum	2.39	6.98	2.08	0.91	1.81	5.56	88.9	8.51	----	0.05	5.87

Table 1. (Continued).

SIC (1977)	Industry	Estimating Model										
		1	2	3	4	5	6	7	8	9	10	11
2074	Cottonseed oil	0.00	0.13	1.49[b]?	0.00	30.98	94.88	1,518.0	----	----	0.48	1.46
2075	Soybean oil	0.00	0.08	1.49[b]?	0.00	1.82	5.58	89.3	10.09	----	0.03	0.38
2076	Other vegetable oils	0.16	0.46	1.49[b]?	0.00	0.47	1.43	22.9	1.66	----	0.01	0.85
2077	Animal fats	0.01	1.39	0.00	0.00	2.07L	6.35L	101.5L	----	----	0.02	2.95
2079	Margarine, cooking oils	0.58	0.80	0.81	0.38	1.28	3.93	62.9	5.56	----	0.02	1.28
2082	Beer	0.88	1.06	0.67	0.36	2.98	9.14	146.2	17.70	----	0.12	18.27
2083	Malt	0.00	----	0.00	0.00	1.71	5.25	84.0	5.75	----	0.04	----
2084	Wine and brandy	0.32	----	0.28	0.05	1.15	3.52	56.3	4.69	----	0.02	9.20
2085	Distilled spirits	1.46	6.50	0.59	0.06	12.96	39.69	635.0	----	----	0.17	10.54
2086	Soft drinks bottling	0.96	0.85L	1.68	0.09	20.66	63.28	1,012.5	----	----	1.46	6.87L
2087	Flavorings	0.74	11.24	0.93	0.15	42.85	131.22	2,099.5	----	----	1.61	0.27
2091	Canned fish	0.17	0.67	0.00	0.07	0.35	1.08	17.3	1.21	33.3	0.00	5.48
2092	Frozen fish	0.00	0.48	0.17	0.00	0.07	0.21	3.4	0.22	4.1	0.00	3.12
2095	Coffee	0.86	----	0.78	0.06	4.57	14.00	224.0	----	----	0.09	7.56
2097	Manufactured ice	0.00	2.15L	0.00	0.01	0.31L	0.95L	15.2L	8.19L	----	0.00L	0.84L
2098	Pasta	0.59	1.61	0.00	0.07	2.96	9.08	145.3	----	----	0.06	3.03
2099	Miscellaneous prepared foods	0.69	2.91	0.45	0.31	1.36	4.18	66.8	3.32	----	0.10	23.15
20	Food manufacturing average	0.16	1.09	0.45	0.11	5.15	15.77	289.1	4.41[d]	19.8[d]	0.17	4.65

Table 1. (Continued).

L = Local or regional market, but study uses uncorrected national concentration data.

---- Undefined or not available.

[a] Model 1: Based on 1975 value of product shipments, from Parker and Connor (1978: Table C.3), unpublished estimates provided by Parker and Connor.

Model 2: Based on 1972 shipments, from Olson and Bumpass (1984), before-tax Harberger losses, unpublished estimates provided by Olson and Bumpass.

Model 3: Based on 1975 shipments, from "Model 14" in Connor, et al. (1985: Table D-4, second column), unpublished estimates provided by Parker and Connor.

Model 4: Based on 1979-1980 price data and 1977 shipments of branded products to food stores only, from Connor and Peterson (1992: Table 1, Equation 1.3), unpublished estimates provided by the authors. This model and the following models use elasticities from Pagoulatos and Sorenson (1986).

Model 5-7: Based on 1982 concentration and product shipments data (Connor 1988: Table 11-4), calculated from formulas for Stakelberg, Cournot, and Collusive price leadership with four leaders and linear demand in Willner (1988).

Model 8-9: Same as models 5-7, except for isoelastic demand and Cournot and Collusive price leadership (Willner 1988).

Model 10: Based on 1982 concentration and shipments, Cournot industry-wide pricing, linear or isoelastic demand, formulas from Willner (1988).

Model 11: Based on 1987 concentration and shipments data, from Bhuyan and Lopez (1983: Table 1). For their formula, see Appendix B, No. 17.

[b] Alternative model specifications result in point estimates that differ by more than two standard deviations. Therefore, estimated overcharges believed to be unreliable.

[c] Some studies had only one estimate for two combined industries (e.g., 2016 + 2017). These estimates are repeated in the table.

[d] Where defined, these isoelastic estimates are on average 5.6 higher than their linear demand counterparts (Cournot pricing) or 24 times higher (collusive pricing). However, in the majority of industries, isoelastic demand produces <u>infinitely</u> high prices.

Table 2. Predicted Consumer Overcharges due to Imperfect Competition, 47 U.S. Food Manufacturing Industries, Ten Models.

SIC (1977)	Industry[c]	Estimating Model[a]									
		1	2	3	4	5	6	7	8	9	10
		Percent									
2011	Meat packing	0.0	1.31	0.2	0.0	9.3	16.3	65.2	6.66	89.2	1.02
2013	Meat processing	5.6	0.76	3.5	3.4[e]	6.7	11.8	47.0	3.87	55.6	0.71
2016	Poultry dressing	0.0	2.98	3.3	3.5[e]	16.7	29.2	116.7	6.27	----	0.83
2017	Poultry and egg processing	0.0	2.98	0.0	0.0[d]?	16.7	29.2	116.7	6.27	----	0.83
2021	Butter	3.1	1.71	2.0	0.0[e]	8.0	13.9	55.8	4.30	67.5	0.73
2022	Cheese	3.5	2.94	5.3	0.2[e]	12.6	22.1	88.2	7.23	131.3	1.70
2023	Preserved milk products	1.7	7.92	12.0[b]?	10.1	15.1	26.4	105.5	7.66	----	2.15
2024	Ice cream, frozen desserts	4.5	6.84L	13.6[b]?	2.7	8.7L	15.3L	61.1L	3.33L	70.9L	0.59L
2026	Fluid milk and related	5.3	5.21L	14.4	3.2	13.7L	24.0L	95.8L	3.87L	119.8L	1.11L
2032	Canned specialties	17.7	10.21	19.5	23.6	169.0	295.8	1,183.3	----	----	43.23
2033	Canned fruits and vegetables	5.4	8.18	5.2	8.0	32.1	56.2	224.7	10.64	----	3.74
2034	Dried fruits and vegetables	12.1	7.94	10.1	10.8	33.9	59.3	237.2	7.24	----	6.22
2035	Pickles and sauces	15.3	3.99	16.5	12.6	39.5	69.1	276.5	16.32	----	6.48
2037	Frozen fruits and vegetables	10.0	6.98	8.3	7.0	22.3	39.1	153.3	7.58	----	2.53
2038	Frozen specialties	10.0	7.26	11.8	7.7[e]	22.3	39.1	153.3	7.58	----	2.53

Table 2. (Continued).

SIC (1977)	Industry	Estimating Model[a]									
		1	2	3	4	5	6	7	8	9	10
2041	Flour	4.4	4.90	6.9	37.6[e]	102.9	180.0	720.0	----	----	12.46
2043	Breakfast cereals	29.0	11.49	27.9	38.4	385.7	675.0	2,700.0	----	----	69.60
2044	Rice	5.1	6.29	16.6	----	34.9	61.1	244.4	11.66	----	4.42
2045	Flour mixes and doughs	21.9	11.94	22.8	24.0	210.7	368.8	1,475.0	----	----	28.53
2046	Wet corn milling	1.2	3.56	11.7[b]?	----	278.2	486.9	1,947.5	----	----	43.03
2047	Pet foods	----	12.95	21.0	24.3	150.2	262.9	1,051.7	----	----	23.37
2048	Animal feeds	----	4.26L	5.4	0.0	55.4L	9.69L	387.5L	14.38L	----	5.16L
2051	Bread and cakes	8.6	10.15L	14.3	16.5	19.7L	34.5L	138.1L	8.28L	----	2.78L
2052	Cookies and crackers	16.3	15.19	18.2	16.4	47.6	86.8	347.1	26.54	----	9.41
2061	Raw cane sugar	0.0	2.66	0.0	0.0	418.6	732.5	2,930.0	----	----	31.40
2062	Refined cane sugar	5.4	4.88	7.1	0.0[d]?	87.0	152.3	609.1	----	----	12.82
2063	Refined beet sugar	1.5	7.63	7.1	0.0[d]?	87.0	152.3	609.1	----	----	12.82
2065	Confectionery	14.6	10.63	12.6	14.8	124.7	218.2	872.9	----	----	21.53
2066	Chocolate	15.0	9.91	13.5	9.7[e]	28.2	49.3	197.1	14.00	----	4.86
2067	Chewing gum	30.9	18.69	33.3	35.1	41.6	72.7	291.0	18.98	----	7.18

Table 2. (Continued).

SIC (1977)	Industry	Estimating Model[1]									
		1	2	3	4	5	6	7	8	9	10
2074	Cottonseed oil	0.8	2.49	16.5[b]?	0.0	787.1	1,377.5	5,510.0	----	----	98.10
2075	Soybean oil	0.8	2.00	16.5[b]?	0.0	47.9	83.8	335.3	20.84	----	6.28
2076	Other vegetable oils	7.9	4.71	16.5[b]?	0.0	17.4	30.4	121.6	6.86	----	1.86
2077	Animal fats	1.8	8.32	1.2	0.0	76.9	134.6	538.6	----	----	8.20
2079	Margarine, cooking oils	15.2	6.32	18.6	23.4	36.8	64.3	257.4	13.52	----	4.12
2082	Beer	18.8	7.27	17.9	20.8	52.1	91.1	364.5	33.97	----	10.32
2083	Malt	0.6	----	0.0	0.0	43.7	76.5	306.1	13.68	----	6.53
2084	Wine and brandy	11.3	----	12.7	7.6[e]	31.0	54.2	216.7	12.65	----	4.20
2085	Distilled spirits	24.2	18.02	20.9	19.2	360.0	630.0	2,520.0	----	----	41.10
2086	Soft drinks bottling	19.6	6.53L	26.3	37.9	321.4	562.5	2,250.0	----	----	85.43L
2087	Flavorings	17.2	23.71	20.7	----	925.7	1,620.0	6,480.0	----	----	179.40
2091	Canned fish	8.2	5.75	5.2	3.7[e]	11.2	19.6	78.6	7.00	118.9	1.04
2092	Frozen fish	0.5	4.90	3.9	0.0	4.0	7.0	28.1	3.25	32.2	0.31
2095	Coffee	18.6	----	20.1	9.7	91.2	159.5	638.2	----	----	12.79
2097	Manufactured ice	0.0	10.22L	0.0	3.3	18.0L	31.6L	126.3L	0.33L	----	0.65L
2098	Pasta	15.4	8.96	9.7	13.3	77.0	134.8	539.0	----	----	10.77
2099	Miscellaneous prepared foods	16.6	12.07	15.8	17.8	37.9	66.3	265.3	0.72	----	10.28
20	Food manufacturing total	7.9	5.95	11.5	15.4	115.7	202.6	815.9	10.42	85.7	19.64

Table 2. (Continued).

L = Local or regional markets, but study uses uncorrected national concentration data.

---- Undefined or not available.

[a] Model 1: Based on 1975 value of product shipments, from Parker and Connor (1978: Table C.3), unpublished estimates provided by Parker and Connor.

Model 2: Based on 1972 shipments, from Olson and Bumpass (1984), before-tax Harberger losses, unpublished estimates provided by Olson and Bumpass.

Model 3: Based on 1975 shipments, from "Model 14" in Connor, et al. (1985: Table D-4, second column), unpublished estimates provided by Parker and Connor.

Model 4: Based on 1979-1980 price data and 1977 shipments of branded products to food stores only, from Connor and Peterson (1992: Table 1, Equation 1.3), unpublished estimates provided by the authors. This model and the following models use elasticities from Pagoulatos and Sorenson (1986).

Model 5-7: Based on 1982 concentration and product shipments data (Connor 1988: Table 11-4), calculated from formulas for Stakelberg, Cournot, and Collusive price leadership with four leaders and linear demand in Willner (1988). See Appendix B, No. 13.

Model 8-9: Same as models 5-7, except for isoelastic demand and Cournot and Collusive price leadership (Willner 1988). See Appendix B, No. 18.

Model 10: Based on 1982 concentration and shipments, Cournot industry-wide pricing, linear or isoelastic demand, formulas from Willner (1988). See Appendix B, No 2.

Model 11: Based on 1987 concentration and shipments data, from Bhuyan and Lopez (1983: Table 1). For their formula, see Appendix B, No. 17.

[b] Alternative model specifications result in point estimates that differ by more than two standard deviations. Therefore, estimated overcharges believed to be unreliable.

[c] Some studies had only one estimate for two combined industries (e.g., 2016 + 2017). These are repeated.

[d] Results probably unreliable because same model yields vastly different estimates for 1979, 1890, and 1979-80 combined. Specifically, the predicted percentage Lerner Indexes for 1979 and 1980 were both more than 50% higher (or lower) than the 1979-80 prediction.

[e] Results may be unreliable because predicted Lerner indexes are sensitive to time period. Specifically, one of the years 1979 or 1980 differs by 25% or more from the 1979-80 point estimates.

Model 2.

Olson and Bumpass (1984) also performed an analysis the determinants of price-cost margins for the U.S. manufacturing sector. At our request, Olson and Bumpass prepared industry deadweight and consumer overcharge estimates for food manufacturing using a "workable competition" standard based on profits (second column in Tables 1 and 2). Olson and Bumpass assumed monopoly pricing, linear demand, and constant marginal costs; they based their benchmark profit standard on average corporate earnings before taxes and interest, adjusted downward for R&D expenditures and upward for understatement of assets due to historical-cost evaluation. They calculated a Harberger welfare loss as well as a broader estimate of losses akin to the consumer overcharge. The latter estimate uses the Cowling-Mueller method, which counts half of advertising expenditures as X-inefficiency and derives elasticities of demand directly from margins. A contribution of Olson and Bumpass was dealing with transitory disturbances by averaging over a very long period (1967-1981). For all manufacturing, Olson and Bumpass find that the U.S. (Harberger) welfare loss is 0.9 percent of 1972 output and the consumer loss was 3.3 percent. For food manufacturing, the respective estimates are 1.09 and 5.95 percent (second columns of Tables 1 and 2).

Model 3.

The second method used by Parker and Connor is their national brand-private label price approach (revised in Connor, et al. 1985). The key assumption in this study (and in Connor and Peterson 1992) is that the competitive benchmark P_c is approximated by highly disaggregated, observed prices of private-label foods. Using the percentage difference between national-brand and private-label prices as a proxy for the Lerner index, which we call a price-price margin, overcomes most of the criticisms of cross-sectional structure-performance studies (Schmalensee 1989). However, the second Parker-Connor approach still incorporates many Harberger assumptions: linear demand, constant marginal costs, monopoly pricing, and a constant price elasticity ($\eta = 0.5$). Welfare losses in food manufacturing in averaged 0.45 percent of 1975 shipments, and consumer overcharges averaged 11.5 percent (third columns of Tables 1 and 2). Total consumer losses were about twice as high as were predicted from Models 1 and 2.

A Post-Bainsian Model of Differentiated Oligopoly

Model 4.

Connor and Peterson (1992) used a different commercial food price data set to calculate a price-price margin (the Lerner index) and introduced a number of refinements in its measurement, but the concept is essentially the same price-price ratio used by Parker and Connor. However, they relaxed many of the restrictive assumptions of the Harberger method. The major change is that their estimating model is derived from an explicit *structural model of differentiated oligopoly using Cournot pricing*. Gone are the restrictive Harberger assumptions of unitary elasticity of demand, monopoly pricing, and homogeneity of goods. This last assumption in particular seems unrealistic in view of the overarching importance of product differentiation in explaining food-manufacturing competitiveness (Connor, et. al, 1985). Connor and Peterson were careful to include in their model adjustments for regional markets, import competition, and variations in the mix of mass media employed in product advertising. Another major improvement was that empirical, independently estimated elasticities of manufacturers' derived demand that vary across industries are incorporated into the model (Pagoulatos and Sorenson, 1986). The only

Harberger assumptions retained by Connor and Peterson were that of constant marginal costs and linear demand[6].

The Connor and Peterson consumer loss results are shown for the first time in Tables 1 and 2. Consumer overcharges averaged 15.4 percent of 1977 food-manufacturing shipments; the dead-weight losses were virtually at Harberger levels--0.11 percent of shipments. More detailed estimates are shown in Tables 3 and 4.

Price Leadership Models

The models discussed thus far have assumed industry-wide monopoly pricing or Cournot pricing. We are fortunate in having studies of welfare losses due to market power in food manufacturing that examined the sensitivity of estimates to alternative pricing assumptions. Instead of assuming monopoly or Cournot oligopoly pricing, Gisser (1982) presented a model based on the assumption of price leadership. Instead of linear demand, Gisser assumed an isoelastic demand function $Q = AP^{-\eta}$, where Q is quantity of a homogeneous product, P is price, η is the absolute value of elasticity of demand, and A a shift parameter. This demand curve is convex with respect to the origin. On the supply side, the MC curve is linear and the marginal cost elasticity ($\epsilon > 0$) is allowed to vary. However, Gisser assumed that both the dominant firm (or the leading firm group) and the price-taking fringe have identical supply elasticities, a convenient but restrictive assumption. Another limiting assumption was

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[6] Models 3 and 4 used significantly more disaggregated data than previous studies, which aggregated processed foods into 45 to 50 industries. The commercial data sets defined about 400 product classes; each class on average accounted for less than 0.04 percent of U.S. households' disposable income. This tiny share implies that the income effect of a price change due to market power is negligible. Thus, Marshallian welfare losses coincide with Hicksian losses (Just, et al. 1982).

Table 3. Predicted Dead-Weight Welfare Losses due to Imperfect Competition, 125 U.S. Food Manufacturing Product Classes, Selected Models.

SIC (1977)	Product Class	Estimating Model[a]					
		3	4	5	6	7	10
		Percent					
20111	Beef packing	0.00	0.00	0.29	0.90	14.45	0.00
20112	Veal packing	0.00	0.01	0.46	1.41	22.57	0.01
20113	Lamb packing	0.00	0.00	0.53	1.62	25.98	0.01
20114	Pork packing	0.00	0.00	0.23	0.71	11.35	0.00
20115	Lard	0.02	0.00	0.24	0.75	11.94	0.00
20119	Hides, skins	0.00	0.00	----	----	----	----
20110	Miscellaneous meat, chilled or frozen	----	0.00	----	----	----	----
20116 + 36	Hams, bacon, etc.	0.01	0.00	0.09	0.27	4.25	0.00
20117 + 37	Sausage, cold cut, etc.	0.00	0.05	0.12	0.37	5.93	0.00
20118 + 38	Canned meats, stews	0.00	0.07	0.50[b]	1.54[b]	24.64[b]	0.01[b]
2013A	Natural sausage casings	0.00	0.00	----	----	----	----
2013B	Other processed meats	----	0.00	0.06	0.19	2.99	0.00

Table 3. (Continued).

SIC (1977)	Product Class	Estimating Model[1]					
		3	4	5	6	7	10
		Percent					
20161	Broilers, chilled or frozen	0.00	0.02	0.35	1.07	17.07	0.00
20162	Hens or fowl, chilled or frozen	0.00	0.00	----	----	----	0.05
20163	Turkeys, chilled or frozen	0.77	0.00	0.54	1.67	26.67	0.01
20164	Other poultry, chilled or frozen	0.01	0.00	1.86	5.70	91.27	0.06
20160	Poultry products, NSK	----	0.01	----	----	----	----
20170	Processed poultry and eggs	0.26	0.00	0.14	0.42	6.67	0.01
20210	Butter	0.11	0.00	0.17	0.51	8.09	0.00
20221	Natural aged cheese	0.10	0.00	0.20	0.60	9.61	0.00
20222	Processed cheese, imitation cheese	0.20	0.00	0.90	2.76	44.09	0.03
20220	Cheese, NSK	----	0.00	----	----	----	----
20231	Dry milk products, creamers	0.26	0.04	0.34	1.03	16.47	0.00
20232	Canned milk products	0.75	0.04	1.33	4.07	65.19	0.05
20233	Bulk processed milk	0.00	0.00	0.30	0.91	14.58	0.00
20230	Other prepared milk products, NSK	----	0.03	----	----	----	----

Table 3. (Continued).

SIC (1977)	Product Class	Estimating Model[a]					
		3	4	5	6	7	10
		Percent					
20240	Ice cream, frozen desserts	0.11	0.01	0.14L	0.42L	6.72L	0.00L
20261	Bulk fluid milk	0.00	0.00	0.33	1.02	16.33	0.00
20262	Packaged fluid milk	0.12	0.00	0.14L	0.42L	6.75L	0.00L
20263	Cottage cheese	0.38	0.03	0.36L	1.10L	17.52L	0.00L
20264	Yogurt, flavored milks	0.56	0.06	1.69	5.17	82.69	0.01
20260	Milk products, NSK	----	0.01	----	----	----	----
20321	Canned baby foods	0.71	0.11	17.01	52.08	∞	0.65
20322	Canned soups	0.66	0.41	8.57	26.26	∞	----
20323	Canned dry beans	0.34	0.02	3.92	12.00	∞	0.06
20324	Other canned specialties	1.52	0.39	8.57	26.26	∞	----
20331	Canned fruits	0.23	0.02	1.04	3.18	50.95	0.01
20332	Canned vegetables	0.20	0.01	0.66	2.01	32.24	0.01
20333	Canned hominy, mushrooms	0.21	0.01	2.56	7.83	∞	0.07
20334	Canned fruit juices, including fresh	0.42	0.01	0.73	2.23	35.68	0.02
20335	Canned vegetable juices	0.91	0.35	2.86	8.76	∞	0.21
20336	Catsup, tomato sauces, tomato paste	0.48	0.36	1.24	3.79	60.63	0.01
20338	Jams, jellies, preserves	0.18	0.36	1.19	3.63	58.13	0.02
20330	Canned fruits and vegetables, NSK	----	0.05	----	----	----	----

Table 3. (Continued).

SIC (1977)	Product Class	Estimating Model[1]					
		3	4	5	6	7	10
		Percent					
20341	Dried fruits and vegetables	0.21	0.05	1.31	4.00	64.00	0.02
20342	Dried soup mixes	0.16	0.25	3.27	10.03	∞	0.15
20340	Other dried fruits and vegetables, NSK	----	0.07	----	----	----	----
20352	Pickles, pickle products	0.16	0.06	0.94	2.89	46.23	0.01
20353	Prepared sauces, excluding tomato	1.13	0.33	1.38	4.23	67.60	0.02
20354	Mayonnaise, salad dresssings	0.67	0.19	1.90	5.81	93.03	0.07
20350	Pickles, sauces, dressings, NSK	----	0.17	----	----	----	----
20371	Frozen fruits and juices	0.42	0.02	0.68	2.08	33.33	0.01
20372	Frozen vegetables	0.31	0.05	0.55	1.69	27.00	0.01
20370	Frozen fruits and vegetables, NSK	----	0.03	----	----	----	----
20381	Frozen sweet baked goods	0.64	0.08	1.15	3.52	56.33	0.02
20382	Frozen dinners, meat pies, pizzas	0.58	0.05	0.82	2.52	40.33	0.01
20383	Other frozen specialties	0.30	0.06	0.82	2.52	40.33	0.01
20380	Frozen specialties, NSK	----	0.06	----	----	----	----
20411	Wheat flour	0.02	0.01	3.36	10.29	∞	0.05
20412	Other wheat mill products	0.01	0.34	3.64	11.16	∞	0.05
20413	Corn mill products	0.49	0.01	4.74	14.50	∞	0.07
20410	Grain mill products, NSK	----	0.02	----	----	----	----

Table 3. (Continued).

SIC (1977)	Product Class	Estimating Model[a]					
		3	4	5	6	7	10
		Percent					
20430	Breakfast cereals	2.05	0.20	22.32	68.34	∞	0.71
20440	Milled rice	0.24	0.30	1.10[b]	3.36[b]	53.78[b]	0.02[b]
20451	Prepared flour mixes and doughs	0.72	0.08	8.88	27.20	∞	0.23
20460	Wet corn milling, including fructose	0.09	0.00	13.59	41.63	∞	0.29
20471	Dog and cat food	1.12	0.17	7.29	22.32	∞	0.18
20472	Bird and specialty feeds	0.00	0.00	1.43	4.38	70.08	0.01
20470	Pet foods, NSK	----	0.15	----	----	----	----
20480	Animal feeds	0.00	0.00	0.46L	1.41L	22.56L	0.00L
20511	Bread, including frozen	0.04	0.1	0.67L	2.04L	32.60L	0.01L
20512	Rolls, stuffing, crumbs	0.15	0.20	0.33L	1.01L	16.10L	0.00L
20513	Sweet yeast goods	0.19	0.08	0.70L	2.15L	34.38L	0.01L
20514	Soft cakes	0.32	0.08	1.21L	3.72L	59.52L	0.03L
20515	Pies	0.29	0.08	1.36L	4.18L	66.88L	0.03L
20516	Pastries	1.55	0.08	0.74L	2.26L	36.21L	0.01L
20517	Cake doughnuts	0.00	0.07	2.05L	6.29L	∞L	0.05L
20510	Bread and related, NSK	----	0.11	----	----	----	----

Table 3. (Continued).

SIC (1977)	Product Class	Estimating Model[1]					
		3	4	5	6	7	10
		Percent					
20521	Crackers, pretzels	1.30	0.23	3.29	10.07	∞	0.14
20522	Cookies, wafers, cones	0.92	0.12	1.75	5.36	85.76	0.04
20520	Cookies and crackers, NSK	----	0.17	----	----	----	----
20623	Sugar (sucrose), refined	0.02	0.00	4.16	12.75	∞	0.09
20652	Chocolate confectionery	1.35	0.09	5.07	15.54	∞	0.17
20653	Nonchocolate-type confectionery	0.73	0.05	2.33	7.14	∞	0.02
20658	Prepared nuts, other confectionery	0.69	0.07	3.79	11.61	∞	0.10
20650	Confectionery, NSK	----	0.08	----	----	----	----
20660	Cocoa-bean processing	0.00	0.11	1.57	4.80	76.79	0.05
20670	Chewing gum	2.83	0.91	3.68	11.26	∞	0.13
20698	Cocoa mix, chocolate syrup	1.34	0.13	3.27	10.01	∞	0.09
20740	Cottonseed oil mills	----	0.00	25.51[b]	78.13[b]	∞[b]	0.34[b]
20750	Soybean oil mills	----	0.00	1.88[b]	5.76[b]	92.24[b]	0.03[b]
20760	Other vegetable oil mills	----	0.00	0.79	2.42	38.73	0.01
20770	Animal rendering	----	0.00	0.01L	0.03L	0.41L	0.00L

Table 3. (Continued).

SIC (1977)	Product Class	Estimating Model[a]					
		3	4	5	6	7	10
		Percent					
20791	Shortening, cooking oils	0.16	0.72	1.19	3.63	58.13	0.01
20792	Margarine	1.46	0.21	1.62	4.98	79.61	0.03
20790	Consumer oil products, NSK	----	0.57	----	----	----	----
20820	Malt beverages	0.41	0.36	2.99	9.14	∞	0.14
20830	Malt	----	0.00	2.11	6.46	∞	0.01
20840	Wine and brandy	0.43	0.05	1.15[b]	3.52[b]	56.33[b]	0.02
20853	Bottled spirits	0.83	0.06	12.25[b]	37.52[b]	∞[b]	0.15[b]
20850	Distilled liquors, NSK	----	0.06	----	----	----	----
20860	Bottled soft drinks, including fruit drinks (not 100% juice)	0.43	0.09	20.66	63.28	∞	0.74
20871	Flavoring extracts	0.02	0.01	0.48	1.48	23.68	0.02
20872	Liquid beverage bases, consumer	0.04	0.03	2.06	6.32	∞	0.19
20873	Liquid beverage bases, producer (see 20860)	----	----	----	----	----	----
20874	Other flavorings, excluding syrups	0.67	0.21	2.78	8.53	∞	0.56
20870	Flavorings, NSK	----	0.14	----	----	----	----
20910	Canned, cured seafood	0.53	0.07	0.35	1.08	17.29	0.00
20922	Prepared, packaged fresh seafood	0.00	----	0.03	0.11	1.70	0.00
20923	Frozen fish	0.07	0.02	0.10	0.31	4.95	0.00
20924	Frozen shellfish	0.00	0.00	0.06	0.19	3.11	0.00
20920	Prepared seafood, NSK	----	0.00	----	----	----	----

Table 3. (Continued).

SIC (1977)	Product Class	Estimating Model[a]					
		3	4	5	6	7	10
20951	Roasted coffee	0.68	0.03	3.57	10.92	∞	0.09
20952	Concentrated coffee	0.82	0.15	8.37	25.64	∞	0.31
20950	Coffee, NSK	----	0.06	----	----	----	----
20970	Manufactured ice	0.40	0.01	0.16L	0.48L	7.61L	0.00L
20980	Pasta, pasta products, except canned	0.37	0.07	2.96	9.08	∞	0.01
20991	Ready-to-mix desserts	1.05	0.77	3.44	10.53	∞	0.12
20992	Chips, salty snacks	0.72	0.29	2.06	6.32	∞	0.19
20993	Sweetening syrups	1.20	0.20	1.81	5.53	88.53	0.03
20994	Baking powder, yeast	0.55	0.12	3.52	10.79	∞	0.14
20995	Tea, packaged	0.93	0.48	3.97	12.16	∞	0.14
20996	Vinegar and cider	0.52	0.04	1.81	5.53	88.53	0.03
20999	Dry prepared entrees and mixes, refrigerated perishable foods, spices, peanut butter, etc.	0.20	0.26	0.43	1.31	20.93	0.00
20990	Prepared foods, NSK	----	0.30	----	----	----	----
20	All food and beverages, average	0.45	0.11	5.15	15.77	289.1+	4.41+

---- = Not available or elasticities not applicable.

+ = Average does not include observations of infinity.

L = national concentration used for local market.

Table 3 (Continued).

[a] Model 3: Based on 1975 value of product shipments, calculated from data shown in Parker and Connor (1978:65-66).

Model 4: Based on 1979-80 price data and 1977 domestic branded food-store shipments, unpublished estimates from Connor and Peterson (1992:Table 1, Equation 1.3).

Model 5-7: Based on 1982 concentration and product shipments data (Connor 1988: Table 11-4), calculated from formulas for Stakelberg, Cournot, and Collusive price leadership with four leaders and linear demand in Willner (1988).

Model 10: Based on 1982 concentration and shipments, Cournot industry-wide pricing, linear or isoelastic demand, formulas from Willner (1988).

[b] Suspect estimate because large imports or exports.

[c] Some studies had only one estimate for two combined industries (e.g., 2016 + 2017). These estimates are repeated in the table.

[d] Where defined, these isoelastic estimates are on average 5.6 higher than their linear demand counterparts (Cournot pricing) or 24 times higher (collusive pricing). However, in the majority of industries, isoelastic demand produces <u>infinitely</u> high prices.

Table 4. Predicted Consumer Overcharges due to Imperfect Competition, 125 U.S. Food Manufacturing Product Classes, Selected Models.

SIC (1977)	Product Class	Estimating Model[a]					
		3	4	5	6	7	10
		Percent					
20111	Beef packing	0.00	0.00	9.38	16.42	65.67	1.05
20112	Veal packing	0.00	1.50	11.73	20.52	82.09	1.60
20113	Lamb packing	0.00	0.00	12.58	22.01	88.06	1.64
20114	Pork packing	0.00	0.00	8.32	14.55	58.21	0.89
20115	Lard	2.15	1.06	8.53	14.93	59.70	0.91
20119	Hides, skins	----	0.00	----	----	----	----
20110	Miscellaneous meat, chilled or frozen	----	0.00	----	----	----	----
20116 + 36	Hams, bacon, etc.	2.31	1.14	5.51	9.65	38.60	0.16
20117 + 37	Sausage, cold cut, etc.	1.07	3.84	6.52	11.40	45.61	0.40
20118 + 38	Canned meats, stews	1.75	4.51	13.28[b]	23.25[b]	92.98[b]	2.04[b]
2013A	Natural sausage casings	----	0.00	----	----	----	----
2013B	Other processed meats	----	0.00	3.76	6.58	26.32	0.19

Table 4. (Continued).

SIC (1977)	Product Class	Estimating Model[a]					
		3	4	5	6	7	10
		Percent					
20161	Broilers, chilled or frozen	0.00	2.88	15.24	26.67	∞	1.45
20162	Hens or fowl, chilled or frozen	0.00	0.00	32.86	57.50	∞	5.72
20163	Turkeys, chilled or frozen	10.91	0.82	19.05	33.33	∞	2.38
20164	Other poultry, chilled or frozen	2.14	0.25	35.24	61.67	∞	6.29
20160	Poultry products, NSK	----	1.83	----	----	----	----
20170	Processed poultry and eggs	10.43	0.05	17.62	30.83	∞	2.03
20210	Butter	6.59	0.00	7.97	13.94	55.77	0.73
20221	Natural aged cheese	6.37	2.59	8.86	15.50	62.00	0.69
20222	Processed cheese	8.95	0.00	18.57	32.50	∞	3.34
20220	Cheese, NSK	----	0.16	----	----	----	----
20231	Dry milk products, creamers	10.41	5.51	11.22	19.64	78.57	0.95
20232	Canned milk products	17.29	5.48	25.17	44.05	∞	5.03
20233	Bulk processed milk	----	0.00	11.90	20.83	83.33	1.24
20230	Other prepared milk products, NSK	----	4.72	----	----	----	----

Table 4. (Continued).

SIC (1977)	Product Class	Estimating Model[1]					
		3	4	5	6	7	10
		Percent					
20240	Ice cream, frozen desserts	6.86	2.39	8.73L	15.28L	61.11L	0.59L
20261	Bulk fluid milk	----	0.00	16.67	29.17	∞	1.28
20262	Packaged fluid milk	6.80	2.29	10.71L	18.75L	75.00L	0.75L
20263	Cottage cheese	12.38	5.31	17.26L	30.21L	∞L	1.47L
20264	Yogurt, flavored milks	14.69	8.64	25.60	44.79	∞	3.47
20260	Milk products, NSK	----	3.12	----	----	----	----
20321	Canned baby foods	16.81	18.84	∞	∞	∞	46.43
20322	Canned soups	16.22	35.75	∞	∞	∞	----
20323	Canned dry beans	11.75	7.60	∞	∞	∞	14.12
20324	Other canned specialties (pasta, nationality, etc.)	24.65	34.73	∞	∞	∞	----
20331	Canned fruits	9.49	4.30	33.08	57.89	∞	3.39
20332	Canned vegetables	8.93	3.28	26.32	46.05	∞	2.69
20333	Canned hominy, mushrooms	9.17	3.39	51.88	90.79	∞	8.80
20334	Canned fruit juices, including fresh	12.76	3.52	27.82	48.68	∞	3.17
20335	Canned vegetable juices	19.09	11.17	54.89	96.05	∞	14.81
20336	Catsup, tomato sauces, tomato paste	12.46	12.14	36.09	63.16	∞	3.91
20338	Jams, jellies, preserves	8.43	8.97	36.34	61.84	∞	4.76
20330	Canned fruits and vegetables, NSK	----	6.31	----	----	----	----

Table 4. (Continued).

SIC (1977)	Product Class	Estimating Model[a]					
		3	4	5	6	7	10
		Percent					
20341	Dried fruits and vegetables	9.19	7.08	38.10	66.67	∞	4.44
20342	Dried soup mixes	8.21	15.39	60.32	∞	∞	12.88
20340	Other dried fruits and vegetables, NSK	----	8.25	----	----	----	----
20352	Pickles, pickle products	8.15	7.24	30.71	53.75	∞	3.82
20353	Prepared sauces, excluding tomato	21.13	16.91	37.14	65.00	∞	4.36
20354	Mayonnaise, salad dresssings	16.46	12.72	43.57	76.25	∞	8.13
20350	Pickles, sauces, dressings, NSK	----	12.00	----	----	----	----
20371	Frozen fruits and juices	12.81	3.52	23.81	41.67	∞	3.29
20372	Frozen vegetables	11.15	6.16	21.43	37.50	∞	2.06
20370	Frozen fruits and vegetables, NSK	----	5.19	----	----	----	----
20381	Frozen sweet baked goods	15.95	7.81	30.95	54.17	∞	3.95
20382	Frozen dinners, meat pies, pizzas	15.21	6.05	26.19	45.83	∞	2.83
20383	Other frozen specialties	10.47	7.11	26.19	45.83	∞	3.30
20380	Frozen specialties, NSK	----	6.75	----	----	----	----
20411	Wheat flour	3.02	4.30	97.96	∞	∞	11.61
20412	Other wheat mill products	1.99	28.93	∞	∞	∞	11.99
20413	Corn mill products	13.95	5.68	∞	∞	∞	14.30
20410	Grain mill products, NSK	----	7.30	----	----	----	----

Table 4. (Continued).

SIC (1977)	Product Class	Estimating Model[a]					
		3	4	5	6	7	10
		Percent					
20430	Breakfast cereals	28.48	36.07	∞	∞	∞	68.60
20440	Milled rice	10.23	15.53	34.92[b]	61.11[b]	∞[b]	4.42[b]
20451	Prepared flour mixes and doughs	17.01	21.40	∞	∞	∞	38.03
20460	Wet corn milling, including fructose	6.08	----	∞	∞	∞	37.85
20471	Dog and cat food	21.10	23.67	∞	∞	∞	24.55
20472	Bird and specialty feeds	0.77	3.85	69.05	∞	∞	6.40
20470	Pet foods, NSK	----	22.38	----	----	----	----
20480	Animal feeds	0.16	----	33.93L	59.38L	∞L	2.21L
20511	Bread, including frozen	3.82	9.59	25.17L	44.05L	∞L	2.28L
20512	Rolls, stuffing, crumbs	7.36	13.40	17.69L	30.95L	∞L	1.35L
20513	Sweet yeast goods	8.61	8.47	25.85L	45.24L	∞L	2.79L
20514	Soft cakes	11.37	8.47	34.01L	59.52L	∞L	4.99L
20515	Pies	10.66	8.47	36.05L	63.10L	∞L	5.61L
20516	Pastries	9.80	8.41	26.53L	46.43L	∞L	2.95L
20517	Cake doughnuts	0.00	7.82	44.22L	77.38L	∞L	6.80L
20510	Bread and related, NSK	----	10.16	----	----	----	----

Table 4. (Continued).

SIC (1977)	Product Class	Estimating Model[1]					
		3	4	5	6	7	10
		Percent					
20521	Crackers, pretzels	22.78	15.76	62.18	∞	∞	12.63
20522	Cookies, wafers, cones	19.22	11.16	45.38	79.41	∞	7.03
20520	Cookies and crackers, NSK	----	13.48	----	----	----	----
20623	Sugar (sucrose), refined	3.60	0.00	85.71	∞	∞	12.77
20652	Chocolate confectionery	12.69	15.84	∞	∞	∞	21.73
20653	Nonchocolate-type confectionery	20.98	11.73	81.63	∞	∞	7.87
20658	Prepared nuts, other confectionery	16.46	13.94	∞	∞	∞	15.00
20650	Confectionery, NSK	----	14.44	----	----	----	----
20660	Cocoa-bean processing	----	16.95	39.17	68.55	∞	9.67
20670	Chewing gum	33.60	31.12	59.18	∞	∞	11.13
20698	Cocoa mix, chocolate syrup	23.21	9.37	31.79	55.65	∞	5.53
20740	Cottonseed oil mills	----	0.00	∞[b]	∞[b]	∞[b]	78.7[b]
20750	Soybean oil mills	----	0.00	47.06[b]	82.35[b]	∞[b]	6.11[b]
20760	Other vegetable oil mills	----	0.00	22.58	39.52	∞	2.75
20770	Animal rendering	----	0.00	48.98L	85.71L	∞L	3.37L

Table 4. (Continued).

SIC (1977)	Product Class	Estimating Model[a]					
		3	4	5	6	7	10
		Percent					
20791	Shortening, cooking oils	7.91	24.07	35.34	61.84	∞	3.79
20792	Margarine	24.11	12.99	41.35	72.37	∞	5.20
20790	Consumer oil products, NSK	----	21.32	----	----	----	----
20820	Malt beverages	12.79	15.91	51.95	90.91	∞	10.32
20830	Malt	----	0.00	48.41	84.72	∞	6.53
20840	Wine and brandy	13.66	7.19	30.95[b]	54.17[b]	∞[b]	4.20[b]
20853	Bottled spirits	18.49	18.58	∞[b]	∞[b]	∞[b]	38.70[b]
20850	Distilled liquors, NSK	----	18.58	----	----	----	----
20860	Bottled soft drinks, including fruit drinks (not 100% juice)	13.00	18.93	∞	∞	∞	61.03
20871	Flavoring extracts	3.41	11.95	∞	∞	∞	40.70
20872	Liquid beverage bases, consumer	3.75	28.17	∞	∞	∞	∞
20873	Liquid beverage bases, producer (see 20860)	----	----	----	----	----	----
20874	Other flavorings, excluding syrups	16.60	72.35	∞	∞	∞	∞
20870	Flavorings, NSK	----	60.09	----	----	----	----
20910	Canned, cured seafood	14.69	4.39	11.22	19.64	78.57	1.04
20922	Prepared, packaged fresh seafood	0.00	----	2.86	5.00	20.00	0.18
20923	Frozen fish	5.59	2.38	4.87	8.53	34.12	0.42
20924	Frozen shellfish	0.00	0.00	3.87	6.76	27.06	0.29
20920	Prepared seafood, NSK	----	0.00	----	----	----	----

Table 4. (Continued).

SIC (1977)	Product Class	Estimating Model[a]					
		3	4	5	6	7	10
		Percent					
20951	Roasted coffee	16.47	7.59	80.52	∞	∞	12.79
20952	Concentrated coffee	18.19	15.82	∞	∞	∞	23.75
20950	Coffee, NSK	----	9.88	----	----	----	----
20970	Manufactured ice	13.00	3.08	12.78L	22.37L	89.47L	0.65L
20980	Pasta, pasta products, except canned	12.11	11.76	52.86	92.50	∞	5.46
20991	Ready-to-mix desserts	20.45	28.55	60.15	∞	∞	11.03
20992	Chips, salty snacks	17.20	17.63	46.62	81.58	∞	14.05
20993	Sweetening syrups	22.07	14.57	43.61	76.32	∞	5.19
20994	Baking powder, yeast	14.76	11.44	60.90	∞	∞	11.93
20995	Tea, packaged	19.54	22.69	64.66	∞	∞	12.12
20996	Vinegar and cider	15.02	6.74	43.61	76.32	∞	5.31
20999	Dry prepared entrees and mixes, refrigerated perishable foods, spices, peanut butter, etc.	8.76	16.49	21.05	36.84	∞	1.79
20990	Prepared foods, NSK	----	17.91	----	----	----	----
20	All food and beverages, average	11.5	11.03	115.7	202.6+	815.9+	19.64

---- = Not available or elasticities not applicable.

+ = Average does not include observations of infinity.

L = national concentration used for local market.

Table 4 (Continued).

[a] Model 3: Based on 1975 value of product shipments, calculated from data shown in Parker and Connor (1978:65-66).

Model 4: Based on 1979-80 price data and 1977 domestic branded food-store shipments, unpublished estimates from Connor and Peterson (1992:Table 1, Equation 1.3).

Model 5-7: Based on 1982 concentration and product shipments data (Connor 1988: Table 11-4), calculated from formulas for Stakelberg, Cournot, and Collusive price leadership with four leaders and linear demand in Willner (1988).

Model 10: Based on 1982 concentration and shipments, Cournot industry-wide pricing, linear or isoelastic demand, formulas from Willner (1988).

[b] Suspect estimate because large imports or exports.

[c] Some studies had only one estimate for two combined industries (e.g., 2016 + 2017). These estimates are repeated in the table.

[d] Where defined, these isoelastic estimates are on average 5.6 higher than their linear demand counterparts (Cournot pricing) or 24 times higher (collusive pricing). However, in the majority of industries, isoelastic demand produces <u>infinitely</u> high prices.

that η is equal for all industries, the old Harberger assumption. In the empirical work, Gisser assumed that $\epsilon=1$ for both groups of firms and that the leading group of price-markers consists of four perfectly colluding firms.

With $\eta=0.5$, Gisser concluded that the consumer loss due to collusive price leadership was about seven percent, of which the dead-weight loss was 0.9 percent of shipments. If $\eta=1.0$, the dead-weight loss was reduced to 0.5 percent.

In a critical comment on Gisser's model, Willner (1989) applied a similar price leadership model to food manufacturing that rejected certain assumptions of Gisser and relaxes others. First, Willner considered the assumption that both price makers and price takers have identical marginal cost elasticities (ϵ) dubious because it implies that both sets of firms employ identical technologies. He argued that the leaders should be expected to dominate an industry partially because of technological superiority, while the followers are more likely to operate at full capacity just as competitive firms do. He also argued that it is practically a stylized fact that large corporations have horizontal marginal costs. Accordingly, he assumed that $\epsilon=\infty$ for the leaders and $\epsilon=0$ for the followers. Second, Willner took exception to Gisser's assuming constant, and possibly arbitrary η values. Instead, he adopts the empirical estimates of η that were used by Connor and Peterson (1992). Third, Willner derives welfare-loss algorithms under three types of pricing behavior by the leading-firm group: collusion (or dominant firm), Cournot-Nash, or the more rivalrous Stackelberg pricing rule.

Using Willner's algorithms we develop five more sets of estimates of economic losses in U.S. food manufacturing. The five models are:

- **Model 5**: Stakelberg price leadership with linear demand,
- **Model 6**: Cournot-Nash price leadership with linear demand,
- **Model 7**: Collusive price leadership with linear demand,
- **Model 8**: Cournot-Nash price leadership with isoelastic demand, and
- **Model 9**: Collusive price leadership with isoelastic demand.

(The sixth possible combination, Stakelberg pricing with isoelastic demand, was shown to be nonexistent.)

The estimates of deadweight social welfare losses for the five price-leadership models are displayed in Table 1, and the corresponding consumer overcharges are shown in Table 2. These estimates are based on formulas that contain only three variables: N (the number of firms in the price-leadership group), CRN (the N-firm concentration ratio), and η. Because the smallest CRN statistic available from official U.S. sources is CR4, these estimates implicitly assume that the non-collusive leading-firm group always consists of four firms ($N=4$). With data from commercial sources, future research would be able to demonstrate the sensitivity of the loss estimates to variation in N, including the dominant-firm case ($N=1$). A limitation of models 5 to 9 is that the CR4 data were not adjusted for international trade, regional markets, and other factors that affect appropriate market boundaries, though such adjustments have been made by previous researchers. In tables 1 and 2, special symbols are added to warn the readers about poorly defined markets. Finally, although these price leadership models assume product homogeneity, an examination of the elasticities used for calculating the welfare-loss estimates reveals that η is relatively low (in absolute value) in food industries with highly differentiated goods (breakfast cereals, alcoholic beverages) compared to industries with more standardized consumer goods (meats, milk, bread). Demand is also extremely inelastic for foodstuffs purchased mainly by food processors for further processing (vegetable oils, flour, and sugar). Thus, product differentiation may be implicitly accounted for in the variation in η.

In general, the dead-weight welfare loss estimates from price leadership models are inversely related to η (in absolute value). For example, assuming linear demand, the average deadweight welfare loss for U.S. food manufacturing was an implausibly high 289 percent if the leaders collude; if the leaders are noncooperative Cournot firms, the loss drops to 15.77 percent; with Stackelberg pricing, the loss drops further to 5.15 percent (Table 1). With isoelastic demand schedules, the welfare losses are many times higher; in fact, in most food industries with collusive price leadership, the equilibrium price is *infinitely* high. As usual, consumer overcharges are higher than the welfare losses estimated (Table 2).

General Oligopoly Pricing

Model 10.

The final set of estimates in our survey looks at welfare losses under industry-wide general oligopoly pricing (Willner 1988, Willner and Ståhl 1992). Unlike the price-leadership models, every firm in the industry uses the same pricing rule. In the case of Model 10, all firms are Cournot-Nash oligopolists facing a linear industry demand schedule.[7] Industry elasticities of demand η are exogenously estimated separately for each industry (Pagoulatos and Sorenson, 1986). Marginal costs are constant. The data are 1982 Herfindahl indexes of concentration, uncorrected national market, SIC definitions.

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[7]Willner (1988) also derives an algorithm for calculating welfare loss under isoelastic demand, but the estimates are usually only slightly higher than the linear demand case, so they are not reproduced here.

Model 11.

This model was developed by Bhuyan and Lopez (1993), following closely work by Dickson and Yu (1989). Bhuyan and Lopez offer several alternative oligopoly models, but we will initially describe their "baseline case," which is based on uncorrected 1987 U.S. Herfindahl indexes of concentration (H). The assumptions of Model 11 are the same as for Model 10, except that the degree of industry-wide cooperation is allowed to vary across industries and demand is isoelastic. The conjectural variation elasticity for firm i is α_i, and $\alpha_i = s_i + \phi_i(1\text{-}s_i)$, where s_i is market share and ϕ_i is the cooperation parameter, which usually takes some value between 0 (Cournot) and 1 (monopoly) (Appendix B). By assuming $\alpha_i=\alpha$ for all firms, it can be shown that $\alpha=H + \phi(1\text{-}H)=\eta\cdot\mathcal{L}$, where $\mathcal{L}$ is the Lerner index. Thus, ϕ can be estimated from a computed Lerner index $(\hat{\mathcal{L}})$, $\hat{\eta}$, and H using the formula $\hat{\phi} = \dfrac{\hat{\eta}\hat{\mathcal{L}}-H}{1-H}$.

Table 1 shows the deadweight welfare loss estimates for Model 10 (which assumes ϕ=0) and Model 11 (which calculates $1>\hat{\phi}>0$). Because the concentration and elasticities are so similar, the high welfare losses shown for Model 11 may indicate significant degrees of cooperation exist in most U.S. food manufacturing industries.[8] Table 2 shows the consumer overcharges for Model 10; the much higher overcharges for Model 11 are not computed.

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[8] The 1987 values of H are slightly higher than the 1982 values used for Model 10; five $\hat{\eta}$ are also higher in Bhuyan and Lopez (1983:17) than in Willner (1988). Moreover, Model 11 assumes isoelastic demand, whereas Model 10 assumes linear demand. Finally, $\hat{\mathcal{L}}$ is a rather broad price-cost margin (industry value added less labor costs as a percentage of value of shipments) that assumes $\mathcal{L}$=0 under perfect competition, the implicit competitive standard.

Bhuyan and Lopez (1993) also perform several simulations of the effects on welfare loss due to changes in the extent of cooperation, demand and supply elasticities, and pricing behavior, which we summarize briefly. As expected, as the degree of cooperation increases (as $\phi \rightarrow 1$), so do the estimated welfare losses. There is also some variation in net welfare loss when η changes, though not as great as when α changes. For example, when $\eta = 0.5$ for all industries (the Parker-Connor assumption) and $\phi = \hat{\phi}$, the welfare loss is 8.2 percent of sales, but when η=1.5 (the Scherer-Ross suggestion), the loss falls to 1.8 percent of sales.

Under a wide range of parameters $(1.5 > \eta > 0,\ \ \infty > \epsilon \geq -2)$, pure monopoly gives rise to losses roughly ten times higher than monopolistic price leadership. However, when Cournot pricing is imposed, oligopoly and price leadership generate estimated welfare losses within a narrower range. Specifically, when diseconomics of scale are present, estimated welfare losses from the general oligopoly model are from 30 to 120 percent higher than those of the price leadership model. However, when the MC curve of the leaders is constant or negative, welfare loss estimates are 10 to 50 percent higher under price leadership compared to industry-wide oligopoly.

Comparisons of Results

Average economic losses due to imperfect competition in the U.S. food manufacturing industries from various studies are summarized in Table 5. It seems clear that the cardinal estimates of welfare losses due to market power are <u>on average</u> quite sensitive to model specification, that is, assumptions about assumptions about pricing behavior and the demand curve. The five price leadership models (5 to 9) yield economic loss estimates that are distinctly higher than the models that assume industry-wide oligopoly pricing (Models 1-4 and 10-11). One feature common to all models is that consumer overcharge estimates far exceed the deadweight welfare loss estimates--by a ratio of about 40 to one on average.

Although average estimates of welfare losses or consumer losses are quite sensitive to model specification and data sources, what about the cross-industry ranking of such losses? Were the Bainsian cross-sectional techniques of the 1960s and 1970s misconceived, superannuated by the theoretical progress of the 1980s? Were the enforcement officials in U.S. antitrust agencies who used, directly or indirectly, performance indicators to choose target industries misled by industrial studies (see Preston and Connor 1992)?

Table 6 suggests that the answer to these questions is no. For five quite different analytical methods, there is considerable overlap in the industries with the greatest consumer losses due to market power. Breakfast cereals, confectionery, flour mixes, pet foods, canned specialty items (soups, baby foods, etc.), and most highly differentiated beverage industries appear repeatedly across the five columns. Two models (5 and 10) that assume product homogeneity also list a few producer goods that appear by virtue of extremely low price elasticities (flour, sugar, corn fructose, and cottonseed oil). Yet, on the whole, the greatest losses are attributable to heavily advertised, high-value-added consumer products.

Table 5. Summary of Average Economic Losses due to Market Power in the U.S. Food Manufacturing Industries.

Empirical Approach	Losses as a Percent of Output	
	Deadweight Welfare Loss	Consumer Overcharge
	Percent	
1. Bainsian model, Census price-cost margins, monopoly pricing[a]	0.16	7.9
2. Bainsian model, Census price-cost margins, monopoly pricing[b]	1.09	6.0
3. Bainsian model, price-price-margins, monopoly pricing[a]	0.45	11.5
4. Price-price margins, differentiated oligopoly, Cournot pricing[a]	0.11	15.4
5. Stakelberg price leadership, linear demand	5.15	115.7
6. Cournot-Nash price leadership, linear demand	15.77	202.6
7. Collusive price leadership, linear demand	289.1	815.9
8. Cournot-Nash price leadership, isoelastic demand	4.4+[d]	10.4+[d]
9. Collusive price leadership, isoelastic demand	19.8+[d]	85.7+[d]
10. Industry-wide Cournot pricing, linear or isoelastic demand[c]	0.17	19.6
11. Industry-wide oligopoly pricing, isoelastic demand	4.65	----

---- = Not available.

[a] Uses "workable competition" standard based on critical concentration ratio; assumes linear demand.

[b] Uses benchmark profit rate as competitive standard; assumes linear demand.

[c] Estimates of losses are nearly invariant to the shape of the demand curve (See Table 5).

[d] Most of the industries have equilibrium prices that are infinitely high. When both methods yield finite estimates, the isoelastic-demand prices are approximately 5 to 50% higher than the linear-demand prices (Cournot case) or 50 to 100% higher (collusive case).

Source: Tables 1 and 2.

We further analyze economic losses due to market power by correlating the percentage welfare losses in the food industries across the eleven sets of estimates (Table 7). Perhaps the most striking feature of Table 7 is that none of the 55 off-diagonal correlation coefficients is significantly negative; indeed, all but a few are significantly positive coefficients. The analytical approach most strongly associated with the others is Cournot-Nash price leadership (Model 8), and the one most poorly associated with all the others is the "unconstrained" oligopoly pricing model developed by Bhuyan and Lopez (Model 11). Another noteworthy result is that when demand is linear, the price leadership models result in economic losses that are by construction perfectly correlated, irrespective of the pricing rule used by the leaders (Models 5, 6, and 7). Correlations between price leadership models with <u>different demand</u> curves are greater than 0.90. These patterns are seen even more strongly when correlating the consumer overcharges shown in Table 8.

There is also a high association among welfare loss estimates for the four models that use the price-cost or price-price margin approach (Models 1 to 4): the six correlations average 0.65. This is remarkable, given the many differences in time periods, levels of aggregation, proxies for the Lerner index, assumed pricing behavior or demand elasticities, competitive standard, and a host of other measurement considerations. However, each of the four price-cost or price-price margin models share one characteristic not found in the remaining six methods, namely, a focus on <u>product differentiation</u>. Each of the four methods varies in how it deals with differentiation, from *ad hoc, a priori* justifications (Model 1) to a more formal, theoretically explicit treatment (Model 4). As a group, the four models that incorporate product differentiation (1 to 4) are not highly correlated with the homogenous-product models (5 to 10). The 20 correlation coefficients that compare heterogeneous-

Table 6. The 15 U.S. Food Industries with the Largest Deadweight Welfare Losses due to Market Power, by Alternative Analytical Models.

Model 1: Bainsian Model, Monopoly Pricing, Census Price-Cost Margin	Model 3: Differentiated Oligopoly, Monopoly Pricing, Price-Price Margin	Model 4: Differentiated Oligopoly, Cournot Pricing, Price-Price Margin	Models 5, 6 & 7: Price Leadership, Linear Demand, Elasticity and Concentration Data	Model 10: Industry-Wide Cournot Pricing, Elasticity and Concentration Data
Chewing gum	Chewing gum	Chewing gum	Flavorings	Flavorings
Breakfast cereals	Soft drinks	Margarine & oil	Cottonseed oil	Cottonseed oil
Distilled spirits	Breakfast cereals	Beer	Breakfast cereals	Soft drinks
Flour mixes	Rice	Misc. prepared foods	Soft drinks	Breakfast cereals
Soft drinks	Pet Foods	Rice	Raw cane sugar	Raw cane sugar
Beer	Flavorings	Canned specialties	Wet corn milling	Canned specialties
Coffee	Margarine & oil	Breakfast cereals	Distilled spirits	Wet corn milling
Canned specialties	Coffee	Pickles & sauces	Flour mixes & doughs	Distilled spirits
Flavorings	Canned specialties	Pet foods	Canned specialties	Flour mixes
Misc. prepared foods	Beer	Flavorings	Pet foods	Pet foods
Cookies & crackers	Cookies & crackers	Dried fruits, vegs., soups	Confectionery	Confectionery
Pasta	Pickles & sauces	Cookies & crackers	Coffee	Flour
Pickles and sauces	Bread & cakes	Chocolate	Refined sugar	Coffee
Margarine	Chocolate	Bread & cakes	Flour	Pasta
Chocolate	Ice cream	Soft drinks	Beer	Beer

Source: Table 1.

Note: In each column the 15 industries are listed in descending order of percentage net welfare loss due to market power.

Table 7. Correlations among Estimates of Net Welfare Loss due to Market Power in U.S. Food Manufacturing.

Model Type	Model										
	1	2	3	4	5	6	7	8	9	10	11
	Correlation Coefficient (N)										
1. Bainsian, Census price-cost margins, monopoly pricing, workable competition	1.00 (N=45)										
2. Bainsian, Census price-cost margins, monopoly pricing, perfect competition	0.64 (N=37)	1.00 (N=38)									
3. Bainsian, price-price margin, monopoly pricing	0.78 (N=42)	0.58 (N=35)	1.00 (N=44)								
4. Post-Bainsian, price-price margin, Cournot pricing	0.71 (N=45)	0.45 (N=38)	0.71 (N=44)	1.00 (N=47)							
Price Leadership, linear demand:											
5. Stakelberg pricing	0.28 (N=41)	0.53 (N=37)	0.40 (N=39)	-0.03 (N=42)	1.00 (N=42)						
6. Cournot-Nash pricing	0.28 (N=41)	0.53 (N=37)	0.40 (N=39)	-0.03 (N=42)	1.00 (N=42)	1.00 (N=42)					
7. Collusive pricing	0.28 (N=41)	0.53 (N=37)	0.40 (N=39)	-0.03 (N=42)	1.00 (N=42)	1.00 (N=42)	1.00 (N=42)				
Price Leadership, Isoelastic demand:											
8. Cournot-Nash pricing	0.51 (N=25)	0.44 (N=23)	0.48 (N=23)	0.47 (N=25)	0.97 (N=25)	0.97 (N=25)	0.97 (N=25)	1.00 (N=25)			
9. Collusive pricing	0.32 (N=6)	0.15 (N=6)	0.34 (N=6)	0.27 (N=6)	0.99 (N=6)	0.99 (N=6)	0.99 (N=6)	0.99 (N=6)	1.00 (N=6)		
Industry-wide Oligopoly:											
10. Cournot-Nash pricing	0.34 (N=41)	0.65 (N=38)	0.48 (N=39)	0.06 (N=42)	0.86 (N=41)	0.86 (N=41)	0.86 (N=41)	0.81 (N=25)	0.71 (N=6)	1.00 (N=42)	
11. Unconstrained pricing	0.56 (N=39)	0.20 (N=36)	0.28 (N=37)	0.34 (N=40)	0.06 (N=39)	0.06 (N=38)	0.06 (N=39)	0.42 (N=24)	0.07 (N=6)	0.10 (N=39)	1.00 (N=40)

Note: Estimates based on uncorrected local-market observations and other unreliable estimates are omitted. The average of the 55 off-diagonal correlations above is 0.51; if no observations are omitted, the average is 0.47; dropping models 6 and 7 from consideration results in respective average correlations of 0.47 and 0.42.

Source: Table 1.

Table 8. Correlations among Estimates of Consumer Losses due to Market Power in the U.S. Food Manufacturing Industries.

Model Type	Model									
	1	2	3	4	5	6	7	8	9	10
	Correlation Coefficient (N)									
Bainsian, Census price-cost margins, monopoly pricing:										
1. Workable competition standard	1.00 (N=45)									
2. Cowling-Mueller approach, perfect competition standard	0.76 (N=37)	1.00 (N=44)								
Price-Price Margins:										
3. Monopoly pricing, workable competition	0.92 (N=39)	0.76 (N=33)	1.00 (N=47)							
4. Cournot pricing, differentiated oligopoly	0.89 (N=30)	0.74 (N=24)	0.91 (N=27)	1.00 (N=44)						
Price leadership:										
5. Stakelberg pricing, linear demand	0.18 (N=41)	0.38 (N=38)	0.37 (N=37)	0.12 (N=27)	1.00 (N=47)					
6. Cournot pricing, linear demand	0.18 (N=41)	0.38 (N=38)	0.37 (N=37)	0.12 (N=27)	1.00 (N=42)	1.00 (N=47)				
7. Collusive pricing, linear demand	0.18 (N=41)	0.38 (N=38)	0.37 (N=37)	0.12 (N=27)	1.00 (N=42)	1.00 (N=42)	1.00 (N=47)			
8. Cournot pricing, isoelastic demand	0.49 (N=25)	0.38 (N=23)	0.58 (N=22)	0.40 (N=15)	0.78 (N=26)	0.79 (N=25)	0.79 (N=25)	1.00 (N=30)		
9. Collusive pricing, isoelastic demand	0.42 (N=6)	0.18 (N=6)	0.35 (N=6)	1.00 (N=2)	0.99 (N=6)	0.99 (N=6)	0.99 (N=6)	0.96 (N=6)	1.00 (N=8)	
10. Industry-wide oligopoly, Cournot pricing	0.24 (N=40)	0.50 (N=38)	0.39 (N=36)	0.23 (N=26)	0.96 (N=41)	0.96 (N=41)	0.96 (N=41)	0.68 (N=25)	0.93 (N=6)	1.00 (N=47)

Note: Uncorrected local-market observations are omitted. The average of the 45 off-diagonal above correlations is 0.59; if no observations are omitted, the average is 0.55; dropping models 6 and 7 from consideration results in respective average correlations of 0.57 and 0.53.

Source: Table 2.

product with homogeneous-product models average only 0.33 (Table 7)[9]. The comparable deadweight loss correlations in Table 8 are also relatively low.[10]

Conclusion

Our principle finding is that model assumptions and measurement methods do affect the absolute levels of predicted estimates of economic losses due to imperfect competition, but with few exceptions such differences do not affect the ordinal industrial ranking of loss estimates. The major exception is whether the empirical method has explicitly included measures of product differentiation when calculating the Lerner index or Harberger triangle. Of course, our analysis was restricted to the domain of food manufacturing, but we expect that this conclusion may hold for other industries with differentiated products.

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[9] In this analysis, we treat Models 5, 6, and 7 as one observation.

[10] Correlations for product-class estimates are shown in Appendix C and are consistent with Table 7 and 8.

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APPENDIX A

CHANGING VIEWS ON WELFARE LOSSES

The three editions of what was once the leading advanced textbook on industrial organization illustrate the empirical side of the debate on proper measurement of U.S. welfare losses due to market power.

1970

The first edition of Scherer (1970) criticized Harberger's (1954) paper on nine points:

1. The assumption made by Harberger that market own-price demand elasticity was unity ignored the inevitable long-run substitution that occurs among industries due to technological change. The elasticity is higher, perhaps 2.5 on average (in manufacturing at least).
2. The assumption that average profitability of manufacturing is an appropriate competitive standard or benchmark biases welfare estimates downward, both in the manufacturing sector itself and outside of manufacturing. Within manufacturing because the average industry is oligopolistic, not competitive. Outside manufacturing because in most other sectors average profits on sales are lower than manufacturing.
3. Harberger's industry definitions were excessively broad, and it is better to use firm-level data. Harberger's procedure leads to an aggregation bias toward low estimates.
4. Profit data from accounting sources will be biased downward because monopoly profits can become capitalized into assets as "goodwill", thereby raising stated capital costs above their true marginal social costs. (The MC curve appears to be higher than it really is.)

Reported π may be too high because of transitory disturbances, high risks, or quasi-rents ("superiority rents") in some industries.

5. Welfare losses in industries that sell intermediate products can cause a pyramiding of losses through vertical relationships, thus understating the total loss. (This criticism does not apply to final goods industries.)

6. Instead of using P_c=MC as the competitive standard, Harberger observes costs as $X > P_c$, where X is due to X-inefficiency. See Figure 1. Sources of X-inefficiency include overpayment of workers and managers that result in productivity gains less than the wage increases; organizational slack (technical inefficiency); suboptimal scales due to efforts to produce excessive physical product variety; nonoptimal location decisions and excessive transport costs from basing-point pricing; and excess capacity due to cartel pricing.

7. To the extent that the monopoly profits rectangle P_mBAP_c is used to create or maintain market power by preventing entry or to lobby for regulatory favors, than rectangle $XYAP_c$ is also part of the net social loss. Some "excessive" advertising costs are often cited as an example of wasteful expenditures.

8. It is wrong to consider only the deadweight loss when computing social losses because the income transfers in $\square P_m BAP_c$ flow from consumers in general to higher-income groups: (stockholders, the labor aristocracy, lobbyists, advertising executives, etc.), thereby creating greater income inequality. That is, a proper measure of monopoly loss is the consumer loss trapezoid $P_m BCP_c$.

9. Dynamic losses due to slowed technological change and macroeconomic instability need to be added. Harberger's analysis is totally static.

Note that nearly all of Scherer's (1970) criticisms are measurement-related. On this basis, Scherer concludes that dead-weight loss best-guess estimate is 1.05% of GNP, or 17.5 times Harberger's estimate (p. 404:note 12). The U.S. static social losses ca. 1966 due to market power were about 6.2% of GNP, and that the consumer losses were 9.2% of GNP--figures he called "moderate," (Table A1).

1980

Ten years later, we observe a humorous volte-face from a much chastened Scherer (1980) in the revised second edition. In the preface, he apologizes to his readers that when he wrote the first edition he was only "...three to five years out of graduate school, not quite dry behind the ears" (p. iii). He humbly exaggerates that "...half the material [was] wrong" in the first edition. His reasons for changing his mind make for amusing reading (Scherer 1980:470):

i. "...the caution that comes with age."

ii. "The composite estimate [of 6.2 percent]...was surrounded with appropriate caveats, yet these were assiduously ignored by journalists and politicians...Truth was not well served."

iii. He admits that "...no cost reductions from stemming from monopoly were netted out..." largely because his own 1975 research showed that high concentration reduced suboptimal scale.

iv. A number of studies published before 1970 tended to support Harberger's small estimate: Stigler (1956), Schwartzman (1960), and Worcester (1967) are examples.

Although he still recites nearly all of the nine criticisms of Harberger above, Scherer (p. 464) lowers his dead-weight social loss to a "best-guess" point estimate of 0.86% of

GNP--20% lower than in 1970, but still 14 times Harberger's original estimate of 0.06%. The main reason for lowering his estimate was a lower adjustment for demand elasticity (2.0 instead of 2.5) and a 20% additional loss due to vertical distortions instead of 40% as formerly.

A second component of monopoly loss are inefficiencies other than the dead-weight loss. Here Scherer makes his biggest concessions. Instead of 4.7% of GNP attributable to inefficiencies, "No attempt is made...to present a similar figure" (p. 470). Presumably it is lower than 4.7%.

The third component is the income transfer created by market power. Here Scherer (1980:471) reduces his estimate to 2-3 percent instead of 3% as formerly

1990

In Scherer and Ross (1990) the chapter on welfare losses is moved to the last in the book, which seems more logical, as it is a summing-up. They note that some new research published in the 1980s continues to find dead-weight losses close to Harberger's original estimate of 0.1% of GNP. Kay (1983) uses a general equilibrium approach to measure loss, and Wahlroos (1984) considers the impact of uncertainty on measurement, yet both arrive at welfare losses close to the Harberger level. However, other new research found rather large losses, in the 4% to 7% range, confirming Kamerschen (1966) and Cowling and Mueller (1978). Examples are Olson and Bumpass (1984) for the U.S. economy in 1977 and Jenny and Weber (1983) for the French economy.

The elasticity issue is once again discussed in detail (pp. 664-65). Bergson's (1973) argument is that moderate product differentiation means that the <u>brand</u> demand curves have <u>higher</u> elasticities η_i than market demand elasticity η. Then DWL will be large <u>within</u> the industry, unless the rival brands' firms charge very similar prices and have similar costs (as is likely), in which case DWL is low within the industry. Moreover, even if η_i are high, η could be low, implying low inter-industry DWL[3]. It's an empirical question, in short!

Scherer and Ross believe that the Cowling-Mueller approach ($\eta = \frac{P}{P-C}$) produces too high estimates of η because it (1) is a monopoly (perfect cartel) model and (2) assumes blockaded entry. But Masson and Shaanan (1984) showed for 37 moderately-to-highly concentrated U.S. industries that observed rice P_0 was lower than P_m(on average, $P_0 = P_c + \frac{1}{4}(P_m - P_c)$), which they ascribe to loose oligopoly behavior. Also Gisser (1986) shows under price discrimination that $P_0 < P_m$. Second, limit pricing models show that under threat of entry $P_0 < P_m$ and P_0 can be so low that $\eta < 1$.

There is discussion on the difficulties of measuring DWL when second-best or other general-equilibrium considerations are brought in. They speculate that partial equilibrium estimates "may" be too high, but little information on this point (Friedman 1978, Kay 1983).

The bottom line for Scherer and Ross (1990) is that DWL=0.5-2.0% of GNP in 1988, with a best-guess point estimate of 1.3%--considerably higher than the second 1980 edition (0.86%) and even higher than the 1.08% estimate in 1970--and 22 times Harberger's estimate (Table A1).

Going on to consider excessive costs due to monopoly, Scherer and Ross (1990) identify (1) X-inefficiency and (2) rent-seeking. Empirical work is now vast on the existence of X-inefficiency. (See Franz (1988) or Caves and Barton (1990)). The authors believe the evidence is even stronger than before that observed costs are greater than marginal social costs ($X > P_c$). As for (2), advertising and promotion alone accounts for 1%+ of GNP; seeking favorable regulations and other rent-seeking adds 0.5 to 2.0% more. Reductions in sub-optimal capacity lower the loss, as may economies of scale in advertising. No overall estimate is given of excessive costs, but one may infer 2 to 5%.

Finally, on income redistribution due to market power, Scherer and Ross note that the most recent and comprehensive study found that of six income groups, reducing (1963) CR4 from current levels to 40% decreased income of only the top strata (by 1.45%) and increased income of all five others (by 0.3-0.7%). Other transfers deal with wealth due to monopoly industries (usually early years), wages of workers, discrimination. No overall estimate given, but something in the 2-3% range seems to be implied.

Table A1. Scherer's Estimates of U.S. Dead-Weight Welfare Losses Due to Market Power, 1970-1990.

Assumptions for Best-Guess, Partial-Equilibrium Estimate	Year Circa		
	1968	1978	1988
1. Starting Point: Harberger's (1954) estimates as a percent of GNP	0.06%	0.06%	0.06%
2. Factor to adjust for excessive P_c standard and excessive market aggregation	1.67	2.0	2.0
3. Factor to adjust for monopoly gains captured by labor (costs above competitive MC)	1.0	1.0	2.0
4. Factor to expand manufacturing estimate to nonmanufacturing sectors	3.0	3.0	3.0
5. Factor to raise own-price, consumer demand elasticity to more plausible level	2.5	2.0	1.5
6. Factor to account for additional vertical distortions	1.4	1.2	1.2
Total welfare loss: Dollar value Percent of GNP	1.05%	0.86%	1.30%

Sources: Scherer (1970:400-409), Scherer (1980:459-471), and Scherer and Ross (1990:667).

APPENDIX B

LERNER INDICES

Appendix Table B1. Variations in the Lerner Index of Market Power.

No.	Structure	Conduct	Index
1	Homogeneous products and $MC_i = AC_i$ but $MC_i \neq MC_j$.	Not specified, except profit maximization	$\mathcal{L}_i = \frac{p - mc_i}{p}$ $\mathcal{L} = \frac{p - MC}{p} = \frac{p - pc}{p}$
2	Homogeneous products, $MC_i = AC_i$, and normal demand (or convex cost function and concave inverse demand function).	Cournot (noncooperative, quantity-setting firms with identical beliefs that are mutually inconsistent). $\lambda_i = \lambda = 0 \forall_i$.	$\mathcal{L}_i = \frac{s_i}{\eta}$ $\mathcal{L} = \sum_{i=1}^{N} \frac{s_i}{\eta} = \frac{H}{\eta}$
3	Homogeneous duopoly, $MC_i = AC_i$	Stackelberg Leadership, N=2. (Leader i=1 is quantity-setting and knows that follower i=2 follows Cournot, $\lambda_2 = 0$).	$q_1^* = \frac{S}{2}$, $q_2^* = \frac{S}{4}$, $P_i = \frac{\partial Q}{\partial P} \cdot \frac{S}{4} + MC.$ $\mathcal{L} = \frac{\partial Q}{\partial P} \cdot \frac{S}{4P} = \frac{\eta Q^2}{4P}$
4	Homogeneous and $MC_i = MC_j \forall_i, j$.	Constant conjectural elasticities. $\alpha_i = \alpha \forall_i$, but collusion ($\alpha = 0$), and competition ($\alpha$ = -1) all possible. Quantity-setting firms.	$\mathcal{L}_i = \frac{\alpha_i + (1 - \alpha_i) s_i}{\eta}$ $\mathcal{L} = \frac{\alpha + (1 - \alpha) H}{\eta}$

5	Homogeneous product.	Constant conjectural derivative, $\lambda_i = \lambda \forall_i$. Quantity-setting firms.	$\mathcal{L}_i = \dfrac{(1+\lambda_i)s_i}{\eta}$ $\mathcal{L} = \dfrac{(1+\lambda)H}{\eta}$
6	Homogeneous product	Coefficient of cooperation, ϕ_i.	$\mathcal{L}_i = \dfrac{\phi_i + (1-\alpha)s_i}{\eta}$ $\mathcal{L} = \dfrac{\phi + (1-\phi)H}{\eta}$
7	Heterogeneous product, $\bar{p} = \dfrac{1}{N}\sum_{i=1}^{1} p_i$	Quantity-setting firms with $s_i' = \dfrac{q_i}{q_i + \theta Q_{-1}}$ and $\theta=1$ homogeneity, $\theta<1$ heterogeneity, $\theta>0$.	$\mathcal{L}_i = \dfrac{s_i'}{\eta'}$
8	Homogeneous product.	Price-setting (Bertrand) firms, $N \geq 2$.	$\mathcal{L}_i = 0$ $\mathcal{L} = 0$
9	Heterogeneous product, $mc_1 = mc_2 = ac$ (or $FC=0$).	Bertrand price-setting duopoly, with $\theta=1$ for homogeneity, $\theta<$ for heterogeneity	$p_1^* = p_2^* = \left(\dfrac{1-\theta}{2-\theta}\right)\dfrac{\partial q_i}{\partial p} \cdot S + mc$ $\mathcal{L}_i = \left(\dfrac{1-\theta}{2-\theta}\right)\dfrac{\partial q_i}{\partial p} \cdot S$

10	Monopoly with advertising	$\frac{\partial Q}{\partial p} < 0$ and $\frac{\partial Q}{\partial A} > 0$	$\mathcal{L}_i = \frac{1}{\eta} = \mathcal{L}$ and $\frac{A}{S} = \frac{\eta_A}{\eta}.$
11	Differentiated Oligopoly	Firms maintain λ_i and $\theta<1 \rightarrow s_i' < s_i$. Given all firms $\lambda_i = \lambda$, and $H' = \sum s_i' \left(\sum (s_i')^2\right)$. If some firms differentiate, $H'<H$, but if all firms differentiate equally $H'=H$.	$\mathcal{L}_i = \frac{(1+\theta\lambda_i)s_i}{\eta'}$ $\mathcal{L} = \frac{(1+\theta\lambda)H'}{\eta}$
12	Differentiated Oligopoly	Same as 11, but firms maintain α_i constant.	$\mathcal{L}_i = \frac{s_i' + (1-s_i')\alpha_i}{\eta'}$ If $\alpha_i = \alpha\forall_i$, then $\mathcal{L} = \frac{\alpha + (1-\alpha)H'}{\eta}$

13	Homogeneous Oligopoly, $mc_1 = mc_2 = \ldots = mc_g$, and linear demand.	Price leadership. Dominant group $(i=1,2,\ldots,G)$ and price-taking fringe $F(i=G+1,G+2,\ldots,N)$, $Q=Q_G + Q_F$, maintains $\lambda_G = \frac{\partial Q_F}{\partial Q_G}$ conjectural derivative, and $CR_G = \sum_{i=1}^{G} s_i$.	$\mathcal{L}_i = \frac{(1-\lambda_G)CR_G}{\eta} \quad \forall_i = 1,2,\ldots,G,$ but $\mathcal{L}_i = 0 \ \forall_i > G$ $\mathcal{L} = \frac{(1+\lambda_G)CR_G^2}{\eta}$
14	Homogeneous Oligopoly, $mc_1 = mc_2 = \ldots = mc_g$, and linear demand.	Price leadership. Dominant group maintains $\alpha_G = \frac{\partial Q_F}{\partial Q_G} \bullet \frac{Q_G}{Q_F}$ about fringe F. If $\alpha_G = 1$, we have umbrella pricing (fringe follows dominant group pricing perfectly). If $-1 \leq \alpha_G < 0$, fringe is aggressive.	$\mathcal{L}_i = \frac{(1-\alpha_G)CR_G+\alpha_G}{\eta}$ $\mathcal{L} = \frac{(1-\alpha_G)CR_G^2+\alpha_G}{\eta}$
15	Homogeneous Oligopoly, $mc_i = mc_j$, and linear demand.	Firm has assets worth $p^K K_i$ and variable costs wVC_i. Quantity-setting firms. $\eta = \frac{1}{a_0 + a_1}$ and $\alpha_i = \frac{a_0}{a_0 + a_1}$.	$PCM_i = \mathcal{L}_i + r_i \bullet \frac{P^k K_i}{pq_i} =$ $\frac{\alpha_i (1-\alpha_i)s_i}{\eta} + \gamma_i \frac{P^k K_i}{pq_i}$. or $PCM_i = a_0 + a_1 s_i + a_2 \frac{P^k K_i}{pq_i}$

16	Homogeneous Oligopoly, $mc_i = mc_j = \ldots = mc_g$, and linear demand.	Let $fc_i = \frac{ac_i}{mc_i}$, then $fc_i > 1$ for scale economics and $fc_i < 1$ for diseconomies. ($fc_i = 1$ see no. 15.)	$CM_i = 1 - fc_i +$ $i \left[\frac{\alpha_i + (1-\alpha_i)\, s_i}{\eta}\right] + r_i \cdot \frac{p^k K_i}{pq_i}$ and $PCM = 1 - \left(1 - \frac{\alpha}{\eta}\right) \sum_{i=1}^{N} fc_i \cdot s_i +$ $\left(\frac{1-\alpha}{\eta}\right) \sum_{i=1}^{N} fc_i s_i^2 + \bar{r}\, \frac{p^k K}{pQ}$.
17	Homogeneous oligopoly with specific demand curve and varying industry marginal costs. (If $mc = ac$, $\epsilon = \infty$.)	Oligopoly with industry demand $Q = a/P^n = aP^{-n}$, where a is a demand shifter, and industry inverse marginal cost curve $QP = S = bP^{\epsilon}$, $PQ = S = bQ^{\epsilon}$, where b is a cost shifter (ϵ affects welfare loss, but not $\mathcal{L}$). (Dickson and Yu, Clarke and Davis.) Under monopoly ($\alpha = 1$), under Cournot pricing ($\alpha = 0$), under intermediate oligopoly, let $\alpha = CR_N$ ($0 < \alpha < 1$),	$\mathcal{L} = \frac{H + \alpha(1-H)}{\eta}$ in general, with three special cases: $\mathcal{L} = \mathcal{L}_1 = \frac{1}{\eta}$ (monopoly), $\mathcal{L} = \frac{H}{\eta}$ (Cournot), and $\mathcal{L} = \frac{H + CR_N - H \cdot CR_N}{\eta}$ (intermediate oligopoly).

18	Homogeneous oligopoly with mc=ac constant for leaders and given demand curve.	Price Leadership. General oligopoly pricing by leading-firm group of G firms, including monopoly (G=1) or Cournot-Nash (G>1). Demand is given $Q=aP^{-\eta}$. Followers use competitive pricing. (Willner 1989.)	$\mathcal{L}_i = \frac{CR_G}{\eta G}$ $\forall_i=1,2,...,G.$ $\mathcal{L}_i = 0, \forall_i > G.$ $\mathcal{L} = \sum_{i=1}^{G} \mathcal{L}_i = \frac{CR_G}{\eta}.$
19	Heterogeneous Oligopoly with advertising costs and $mc_i \neq mc_j$ in general, where mc is other costs of production.	Cournot-Nash pricing and effective advertising (i.e., for a_i unit advertising expenditures of firm i, $p_i - \bar{p} > 0$, where $\bar{p} = \sum_{i=1}^{N} p_i$), but as $A=\sum a_i$ rises, $p_i-\bar{p}$ falls.	$\mathcal{L}_i = 1 - \frac{mc_i}{mc_i + a_i - (1-\alpha_i)q_i \frac{\partial p}{\partial Q}}.$ If $\alpha_i = 0$, $\mathcal{L} = \frac{H}{\eta} + \frac{A}{S}.$

Sources: Martin (1983), Dickson and Yu (1989), Willner (1988, 1989), Tirole (1988), Connor and Peterson (1992).

List of Symbols

$\mathcal{L}_i$ = The Lerner index for a firm i, $\mathcal{L}_i = \frac{P\text{-}MC_i}{P}$.

$\mathcal{L}$ = The average industry Lerner index, $\mathcal{L} = \sum_{i=1}^{n} \mathcal{L}_i = \frac{P\text{-}MC}{P}$.

p_i = The observed price of single-product firm i.

P = The observed market price, $P \geq P_c$, or $P = \frac{1}{N} \sum_{i=1}^{N} P_i$.

P_c = The competitive equilibrium market price, often not observable directly.

q_i = The output of firm i, assumed to be a single-product firm or a well defined line of business of the firm.

Q = Industry output, $Q = \sum_{i=1}^{n} q_i$, or aggregate demand.

Q_{-i} = $Q\text{-}q_i$, the output of all firms except firm i.

S = Industry sales, S=P,Q.

η = The absolute value of the market own-price elasticity of demand.

MC_i = The marginal cost of firm i for q_i.

AC_i = The average cost of firm i for q_i.

λ_i = The conjectural derivative, $\lambda_i = \frac{\alpha Q_{-i}}{\alpha q_i}$, where $1 \geq \lambda_i \geq -1$. If $\lambda_i > 0$, firm i expects all other firms in the industry to match its output restrictions, at least partially, and cooperate by withholding output from the market. ($\lambda_i = 1$ means that firm i expects perfect collusion; when N=1, $\lambda_i = 1$). If $\lambda_i < 0$, firm i expects its rivals to expand output when it contracts. (In perfect competition, $\lambda_i = -1$ for all i). If $\lambda_i = 0$, firm i follows the Cournot behavioral assumption: rival firms as a group will not change output when $\Delta q_i \neq 0$.

α_i = The conjectural variation elasticity, $\alpha_i = \frac{\delta Q_{-1}}{\delta q_i} \cdot \frac{q_i}{Q_{-1}} = \lambda_i \frac{q_i}{Q_{-i}}$. The interpretation of α_i is the same as λ_i (above), except that the expectations of firm i are expressed in percentage responses of rivals to a percentage change in q_i.

π_i = The economic profits (rents) of firm i.

ϕ_i = The coefficient of cooperation of firm i. If

$$\pi = \sum_{i=1}^{n} \pi_i \text{ , then}$$

$$\pi = \pi_i + \phi_i \sum_{j \neq i}^{n-1} \pi_j = (1-\phi_i)\pi_i + \phi_i \pi,$$

where $1 \geq \phi_i > -1$ and ϕ_i

has the same competitive interpretation as α_i.

s_i = The market share of firm i, $s_i = pq_i = \dfrac{q_i}{Q}$.

s'_i = The market share of firm i adjusted for product differentiation. Define $Q_i \leq Q$ as that portion of Q in which firm i's brand competes. Thus,

$Q_i = q_i + \theta \cdot Q_{-1}$ where $1 \geq \theta \geq 0$, and $s'_i = \dfrac{q_i}{Q_i} = \dfrac{q_i}{q_i + \theta Q_{-1}}$. When $\theta = 1$, $s'_i = s_i$.

θ = The coefficient of homogeneity. Given that $Q = q_i + \theta Q_{-1} + (1 - \theta)Q_{-1}$, then $q_i + \theta Q_{-1}$ is that portion of the market that firm i actually sells to (q_i) plus that portion it also competes for (θQ_{-1}). The remaining portion contains brands that are not substitutes for the brand that firm i makes. In price terms, $p_i = a - \dfrac{\partial Q}{\partial P}(q_i + \theta Q_{-1})$. When $\theta \to 0$, each producer is becoming a monopolist of its own brand. When $\theta = 1$, products are completely homogeneous, and $Q = q_i + Q_{-i}$, $s'_i = s_i$, and $\eta' = \eta$.

η' = The elasticity of demand adjusted for the degree of product differentiation,

$$\eta' = -\frac{\partial Q_i}{\partial P_i} \cdot \frac{P_i}{Q_i} = -\frac{\partial Q_i}{\partial P_i} \cdot \frac{P_i}{q_i + \theta Q_{-i}}. \text{ When } \theta = 1, \eta' = \eta.$$

η_A = The sales elasticity of advertising expenditures A.

w = Vector of variable input prices w_i.

VC_i = Vector of variable costs for firm i.

K_i = Capital assets of firm i.

P^k = Price vector of capital inputs.

r_i = Competitive rental cost for K_i.

ϵ = Marginal cost elasticity. For example, the inverse industry marginal cost curve can be $S = b \cdot P^{\epsilon}$, where b is a shifter.

CR_N = The N-firm concentration ratio, $CR_N = \sum_{i=1}^{n} s_i$ where firms are ranked by size. In ratio form unless stated otherwise.

H = The Herfindahl-Hirshman index of sales concentration, $H = \sum_{i=1}^{n} (s_i)^2$.

H' = The Herfindahl index of concentration corrected for differences among firms in the degree of brand differentiation. $H' = \sum_{i=1}^{n} s_i' \left[\sum_{i=1}^{n} (s_i')^2 \right]$ and in general $H' < H$. However, if all firms differentiate their brands equally, then $H' = H$.

APPENDIX C

Appendix Table C.1. Correlations Among Welfare-Loss Estimates from Various Studies, U.S. Food Manufacturing Product Classes.

					Model	
Model Type	**3**	**4**	**5**	**6**	**7**	**10**
				Correlation Coefficient (N)		
3. Bainsian, price-price margin,	**1.00**					
monopoly pricing	**(N=97)**					
4. Post-Bainsian, price-price margin,	**0.54**	**1.00**				
Cournot pricing	**(N=96)**	**(N=123)**				
Price Leadership, linear demand:						
5. Stakelberg pricing	**0.40**	**0.16**	**1.00**			
	(N=78)	**(N=80)**	**(N=81)**			
6. Cournot-Nash pricing	**0.40**	**0.16**	**1.00**	**1.00**		
	(N=78)	**(N=80)**	**(N=81)**	**(N=81)**		
7. Collusive pricing	**0.59**	**0.40**	**1.00**	**1.00**	**1.00**	
	(N=46)	**(N=48)**	**(N=48)**	**(N=48)**	**(N=49)**	
Industry-wide Oligopoly:						
10. Cournot-Nash pricing	**0.38**	**0.18**	**0.89**	**0.89**	**0.80**	**1.00**
	(N=78)	**(N=80)**	**(N=79)**	**(N=79)**	**(N=48)**	**(N=81)**

Source: Table 3.

Note: Uncorrected local-market observations are omitted, as are infinite estimates.

Appendix Table C2. Correlations Among Consumer-Overcharge Estimates from Various Studies, U.S. Food Manufacturing Product Classes.

					Model	
Model Type	3	4	5	6	7	10
				Correlation Coefficient (N)		
3. Bainsian, price-price margin,	1.00					
monopoly pricing	(N=92)					
4. Post-Bainsian, price-price margin,	0.52	1.00				
Cournot pricing	(N=89)	(N=121)				
Price Leadership, linear demand:						
5. Stakelberg pricing	0.44	0.49	1.00			
	(N=61)	(N=64)	(N=65)			
6. Cournot-Nash pricing	0.65	0.63	1.00	1.00		
	(N=47)	(N=54)	(N=55)	(N=55)		
7. Collusive pricing	0.31	0.19	1.00	1.00	1.00	
	(N=14)	(N=15)	(N=16)	(N=16)	(N=16)	
Industry-wide Oligopoly:						
10. Cournot-Nash pricing	0.33	0.60	0.88	0.87	0.93	1.00
	(N=77)	(N=76)	(N=65)	(N=54)	(N=16)	(N=78)

Source: Table 4.

Note: Uncorrected local-market observations are omitted, as are infinite estimates.