The Price Effects of Rising Concentration in
US Food Manufacturing

by

Vaughan Dickson and Yingfeng Sun

UNB

DEPARTMENT OF ECONOMICS
THE UNIVERSITY OF NEW BRUNSWICK
FREDERICTON, CANADA

The Price Effects of Rising Concentration in US Food Manufacturing

Vaughan Dickson and Yingfeng Sun, Department of Economics, UNB, November 2004

Abstract

Since the 1960's concentration in the U.S. food processing industries has increased dramatically in comparison to the rest of manufacturing. This paper investigates the price and cost consequences of these large changes in concentration for 35 food processing industries for the period 1963 to 1992. A two equation model is estimated, where the first equation is a price equation that relates changes in prices to changes in CR4, to changes in average variable cost, and to other control variables, while the second equation is an average cost equation that relates changes in average variable cost to initial concentration levels, to changes in concentration, to changes in input prices and other control variables. The first equation identifies a market power effect by focussing on the effects of concentration on price, holding cost constant, while the second equation identifies an efficiency effect by focussing on how concentration influences unit costs. These equations are estimated for differences in prices and average costs that cover intervals of five, ten and twenty years. The results indicate that there is both a market power and an efficiency effect from changing concentration, but that on balance the efficiency effect is stronger so that increases in concentration have produced lower prices.

The Price Effects of Rising Concentration in US Food Manufacturing

The evolution of the U.S. food processing industries over the last 40 years has sparked both interest and concern, principally because of unusually large increases in seller concentration. For example while the average four firm concentration ratio (CR4) for manufacturing remained largely unchanged from 1963 to 1992, the simple average CR4 for 35 food processing industries increased from 41 to 51 percent. These changes have prompted increased scrutiny, as illustrated by the comprehensive surveys of the issues surrounding increased concentration by Sexton (2001) and Whitley (2003), and the work of Lopez et al. (2002), which estimated both the market power and efficiency consequences of increased concentration in the food processing industries.

This paper also focuses on the market power and efficiency consequences of increases in concentration in U.S. food manufacturing industries. Specifically a two equation model is estimated for a panel of 35 food processing industries for the years 1963 to 1992 . The first equation is a price equation relating changes in prices to changes in CR4, to changes in average variable cost, and other control variables, while the second equation is an average cost equation relating changes in average variable cost to initial concentration levels, to changes in concentration, to changes in input prices and other control variables. The first equation identifies a market power effect by focussing on the effects of concentration on price, holding cost constant, while the second equation identifies an efficiency effect by focussing on how concentration influences unit costs. The net effect of concentration on price can then be determined by the joint consideration of the two equations This procedure is followed for changes in prices and average costs over intervals that are respectively five, ten and twenty years in length. The results indicate both market power and efficiency effects in this sample of

industries. Increases in CR4 increase prices holding cost constant as long as CR4 is above a certain level, but increases in CR4 also reduce average costs. In addition higher initial levels of CR4 are also associated with better subsequent cost performance up to a certain point, after which higher initial levels of CR4 lead to poorer subsequent cost performance. On balance, the overall effect of increasing concentration in the food processing industries has been to reduce price.

These conclusions are in accord with recent single industry studies of food processing industries, for example Gisser (1999) on beer and Azzam (1997) on beef packing, that find price-reducing effects, but they are odds with recent work spanning most of the food industries. For example, Lopez et al. (2002) estimated, for 32 food industries from 1972 to 1992, a formal model for each industry that included an industry output demand function, an industry cost function, associated input demand functions, and an industry equilibrium condition, and determined that market power effects dominate efficiency effects so that increases in concentration would increase price (p. 123) "in nearly every case". After presenting our own results we shall discuss possible reasons for the divergent results. The following section presents the model and identifies related antecedent work. This is followed by an introduction of the data, a presentation of the regression results, and a discussion of these results.

The Price and Cost Equations

In this section two equations determining industry level prices and average cost are introduced. The goal is to determine how increasing concentration in the food processing industries has affected prices. This is done by determining how CR4, and changes in CR4, affect industry average costs and therefore prices, thereby identifying an efficiency effect on prices,

and then determining how changes in CR4 change prices for given average cost, thereby identifying a market power effect. By combining the results from these two equations the overall effect of concentration on price can be determined.

First the price equation which originates with the industry level profit maximizing condition is introduced.

$$P = \frac{e}{e + \lambda} MC \tag{1}$$

In (1) P is industry output price, MC is industry marginal cost (the share-weighted average of firms' marginal cost), e is industry price elasticity of demand, and λ is the mark-up which varies between zero in perfect competition and one in monopoly.[1]

Routinely, since only average variable cost (AVC) data are available, this replaces marginal cost, and after converting to changes in logarithms:

$$\Delta LnP = \Delta Ln(\frac{e}{e + \lambda}) + \Delta LnAVC . \tag{2}$$

The above shows that prices change over time because of changes in the mark-up term and changes in average variable cost. To empirically implement (2) the following is used:

$$\Delta LnP_{it} = \alpha_0 + (\alpha_1 \Delta CR_{it} + \alpha_2 \Delta CR_{it} * ICR_{it}) + \alpha_3 \Delta LnAVC_{it} + \alpha_4 \Delta LnKQ_{it} + \sum_t a_t D_t + u_{it} \tag{3}$$

---

1 In Cournot equilbrium λ equals the Herfindahl index, while in certain kinds of dominant firms equilibrium λ equals the k-firm concentration ratio where k is the number of dominant firms. For details see Dickson (1981).

In (3) the subscript i and t stand for year and industry, ΔCR represents changes in industry concentration, ICR represents initial or beginning concentration level, $\Delta LnKQ$ is the growth rate of the real capital to output ratio, and D_t identifies year dummies. In (3), the effect of changes in the mark-up, or changes in market-power, is represented by the bracketed term, which contains the change in concentration and an interaction term of change in concentration with the initial concentration level. The expectation is that increases in concentration will increase price because of the market power effect. An interaction term is included because the effect of any increase may depend on initial levels of concentration. At low initial levels, changes in concentration may have little impact, but at higher levels changes in concentration may be more likely to reduce coordination cost among sellers and thereby increase price.

The ratio of the real capital stock to real output (KQ) is added to supplement the average variable cost measure which includes only labour costs and material costs (including energy) and consequently does not contain unavailable capital costs. It is included to control for the impact of capital cost on output price. The year dummies (D) are employed to account for any secular or cyclical effects on price. In summary, equation (3) is set-up to measure the market power effect of concentration on price, since it looks at the relationship between price and concentration, holding costs constant.

Turning now to average variable cost this is defined by:

$$AVC = \frac{W * L + POM * M + POE * E}{Q}, \tag{4}$$

In (4) *W* represents the wage for labour, *L* represents labour employed, *POM* represents the price of materials, *M* intermediate materials, *POE* the price of energy, *E* energy used in production, and *Q* represents real output. *AVC* changes over time because of changes in input prices and the input-output ratios (*L/Q*, *M/Q* and *E/Q*), where reductions in the weighted average of the input-output ratios represent the impact of technological change.

Change in *AVC* over time may be represented by *dAVC/AVC* or

$$\frac{dAVC}{AVC} = \left[\frac{W*L}{Q*AVC} \left(\frac{d(L/Q)}{L/Q} \right) + \frac{POM*M}{Q*AVC} \left(\frac{d(M/Q)}{M/Q} \right) + \frac{POE*E}{Q*AVC} \left(\frac{d(E/Q)}{E/Q} \right) \right]$$
$$+ \left[\frac{W*L}{Q*AVC} \left(\frac{dW}{W} \right) + \frac{POM*M}{Q*AVC} \left(\frac{dPOM}{POM} \right) + \frac{POE*E}{Q*AVC} \left(\frac{dPOE}{POE} \right) \right] \quad (5)$$

In (5), the first square bracketed term summarizes how changes in input-output ratios affect costs, while the second square bracketed term summarizes how changes in input prices affect costs. We take changes in the average input-output ratios to be principally the result of technological change and we proxy this technological change by the initial level of concentration and by the change in concentration. The initial level of concentration is included because of the Schumpeterian argument that innovation and therefore technological change is greater when there are large firms operating in concentrated markets. This is for the usual reasons: larger firms are better able to finance research projects and are better able, because they have some element of market control, to appropriate the returns from innovation. The square of the initial concentration level is also included to explore the possibility that the additional contribution of concentration to technological change may diminish with higher concentration and may even decline beyond some concentration level. Demsetz (1995), for

example, argues that the competitive rivalry needed to spur innovation may be highest in oligopoly. Too many firms, or concentration that is too low, makes profitable innovation difficult, while too few firms, or concentration that is too high, reduces the rivalrous pressure to innovate and the number of independent innovators.

The change in concentration is included because of the point made by Peltzman (1977) that changes in concentration are indirect evidence of cost reducing technological change. Specifically, concentration changes when an innovating firm lowers cost, consequently gaining market share and thereby further lowering industry cost. Peltzman also postulated that any change in concentration, either positive or negative, could indicate underlying technological change. Normally, following Schumpeter, one might expect larger firms to be leading innovators and therefore increases in concentration to be more strongly related to technological change. But if smaller firms innovate, or if they are able to imitate, with a lag, leading firms past innovations, then decreases in concentration could be associated with above average technological advance. Consequently changes in concentration will be separated into increasing and decreasing categories.

Accordingly, after converting dAVC/AVC to logarithmic differences, the estimating form is:

$$\Delta LnAVC_{it} = \beta_0 + (\beta_1 P\Delta CR_{it} + \beta_2 N\Delta CR_{it} + \beta_3 ICR_{it} + \beta_4 ICRSQ) + (\beta_5 \Delta LnPOM_{it} + \beta_6 \Delta LnPOE_{it}$$
$$+ \beta_7 \Delta LnW_{it}) + \beta_8 \Delta LnQ_{it} + \sum_t b_t D_t + v_{it}$$
(6)

In (6) $P=1$ when concentration increases, zero otherwise, while $N=1$ when concentration decreases, zero otherwise. Also included in (6) is a variable representing the changes in the log of real output. This is included since there may be more opportunities to lower cost by innovation and exploitation of economies of scale in high growth industries. As in the price equation, year dummies are added to control for economy-wide cyclical and secular effects.

Given the two equations to be estimated, (3) and (6), their joint consideration makes it possible to determine the effect of an increase in concentration on the growth in prices by evaluating

$$\frac{d\Delta LnP}{d\Delta CR} = (\alpha_1 + \alpha_2 * ICR) + \alpha_3 \frac{d\Delta LnAVC}{d\Delta CR},$$

which is, $\qquad \frac{d\Delta LnP}{d\Delta CR} = (\alpha_1 + \alpha_2 * ICR) + \alpha_3 * \beta_1.$ \hfill (7)

In (7), the bracketed term on the right-hand side $(\alpha_1 + \alpha_2 * ICR)$ is the market power effect of concentration on price, measuring the effect of concentration on price holding costs constant, while the second term $(\alpha_3 * \beta_1)$ is the efficiency effect of concentration on price. We expect the market power term positively effects price, the efficiency term negatively effects price, with the net effect depending on which is larger.

The above equations relate the price and cost history of an industry to changes in concentration, while adjusting for other relevant factors. This approach follows the work of Peltzman (1977), who for 165 industries related changes in unit cost and changes in prices to changes in concentration from 1947 to 1967 and found increases in concentration reduced unit

cost and prices. Concerning food processing, variants of this approach have been applied by Gisser (1982), Kelton (1992) and Gopinath et al. (2003). Gisser related total factor productivity growth from 1963 to 1972 to changes in concentration and initial 1963 concentration levels for 44 food processing industries. He found higher productivity growth for both larger increases and decreases in concentration, but found the initial concentration level, represented only by a linear term in CR4, insignificant. While Gisser focused on efficiency effects, Kelton, in contrast, focused on market power effects by relating, for 48 food processing industries, for the periods 1977 to 1982 and 1958 to 1992, changes in prices to changes in concentration, changes in unit cost, and changes in shipments. She found changes in concentration had a significant effect on prices at the ten percent level. Gopinath et al. also concentrated on efficiency effects by relating total factor productivity growth to changes in CR4, changes in CR4 squared, and other control variables for a panel of 36 food industries for the 1964 to 1992 period. They concluded that the positive effect of changes in CR4 declined as CR4 changes were larger and, in fact, became negative when CR4 changed by more than 24 percent over the period.[2]

Sample, Data and Estimation Procedure

The sample employed covers annual observations for 35 four-digit industries whose definition did not change substantially over the period 1963 to 1992.[3] All data, except for the four firm concentration ratio, are drawn from the NBER Manufacturing Industry Database

---

[2] As pointed out by the authors the results have to be treated carefully since the t-statistic on the squared change in concentration is only 1.645.

[3] The 35 industries' four-digit 1972 SIC codes are: 2011, 2013, 2021, 2022, 2023, 2024, 2026, 2032, 2033, 2034, 2035, 2037, 2041, 2043, 2046, 2051, 2052, 2061, 2062, 2063, 2074, 2075, 2076, 2077, 2079, 2082, 2083, 2084, 2085, 2086, 2087, 2091, 2092, 2095, 2097.

(downloadable at nber.org). The four firm concentration ratio for the years 1963, 1967, 1972, 1977, 1982, 1987, 1992 is from the Census of Manufacturing. Concentration levels for non-census years are obtained by linear interpolation between adjacent census years. Industry prices are represented by the NBER's price deflator for shipments (equals 1 in 1987). Average variable cost is measured as nominal variable cost per unit of real output. Nominal variable costs are the sum of payroll and material costs, including energy. Real output is value of shipments, measured as value added plus cost of materials, divided by the shipments price deflator. Input prices are represented by NBER's price index for materials (excluding energy), NBER's price index for energy, and payroll per employee. The capital-output ratio is NBER's measure of real gross capital stock divided by real output.

Since most of the variables are measured as changes over a period of time, there is a problem of determining the appropriate time span. Because concentration changes slowly, too short differencing, such as one year or two year differencing, could be dominated by measurement error. To fully explore the possibilities, samples based on first differences of five, ten and twenty years were chosen.[4] For five-year differences, this means the first observation is in 1968, with annual observations thereafter. For ten-year differences, the sample starts in 1973, and for twenty-year differences the sample starts in 1983. The price and cost equations were treated as a system and jointly estimated. To account for the likely joint determination of average cost, prices and output growth, three stage least squares were used.[5]

---

[4] Regressions for one year first differences produced largely insignificant results. For three year first differences the coefficients for the concentration variables, both levels and changes, become significant at the 10 percent level.
[5] In fact the results were similar with least squares and seemingly unrelated regression estimation.

Results

In presenting the regression results, we start with the price equation results for the five, ten and twenty year periods. These are shown in Table 1. Following this, we present the results for the accompanying cost equations in Table 2. In Table 3 the results from the price equations and cost equations are brought together in order to evaluate the overall impact of changes in concentration on output prices.

First for the price equation results, recall that the concentration variables show the impact of concentration on prices, holding average variable cost constant, i.e. the coefficients represent the market power effect of concentration only. Unexpectedly, the coefficient of ΔCR is negative and statistically significant at five percent level when the differencing period is five years or ten years, and remains negative, although less significant, for the 20 year period. However, the coefficient of the interaction term of initial concentration level and the concentration change is significantly positive at the one percent level for the five-year and ten-year differences, although again less significant for the 20 year period. This implies that the impact of concentration changes increases with the concentration level. Consequently, when holding average variable cost constant, evaluating the market power effect requires evaluating both the coefficients. To illustrate, for the five-year results, $\frac{\partial \Delta LnP}{\partial \Delta CR} = 0.548\, ICR - 0.239$. This implies as long as $ICR > .44$, ($\frac{0.239}{0.548}$), increases in concentration will increase price. For the ten and 20 year periods the critical concentration levels are .44 and .52. The implications are that the market power effect of concentration works in more concentrated industries but not in less concentrated industries.

The other variable in the price equations that is a bit surprising is the growth in the capital-output ratio. We had expected it to have a positive sign but, instead, its coefficient is negative and significant. One explanation may be that since the capital stock is a measure of productive capacity, increases in the capital-output ratio may be picking up increases in industry capacity which will lower prices.[6]

How do changes in concentration and initial concentration levels relate to changes in average costs? The results in Table 2 indicate that disruptions in the size distribution that produce changes in concentration are associated with favourable cost consequences. For the five year period, the significantly negative coefficient, at the one percent level, for increases in concentration indicates industries with larger increases in concentration have lower increases in costs, ceteris paribus, while the significantly positive coefficient for decreases in concentration indicates industries with larger decreases in concentration also have lower increases in costs. However for the ten and twenty year intervals, while the results remain strong for increasing concentration industries they largely dissolve for decreasing concentration industries.[7]

Looking at starting levels of concentration, there is support for the proposition of an optimal concentration level. The coefficient on concentration is positive while the coefficient on concentration squared is negative, both significant at the one percent level, across all three time intervals. This means that the growth in costs is lower as concentration increases, but this effect diminishes as concentration increases and eventually turns over. For the 5 year time interval, the

---

[6] Other studies have found problems with the capital-output ratio when there is a time-series element. For example Domowitz, Hubbard and Peterson (1986) for 284 industries found the capital-output ratio had a positive effect on price-cost margins in cross-section regressions but a negative effect when fixed effects (time-demeaned data) regressions were employed.

[7] Since the sample periods were shorter for the ten and twenty year interval regressions, differences among the regressions might result from coverage of different periods. This appears not to be the case. For example, when we repeated the regressions for five year first differences for the same sample as twenty year first differences the results were similar to the results for five year differences reported in the text.

turn-over occurs when the four firm concentration ratio is .54, while for the ten and twenty

year periods the turn-over occurs at .53.[8]

Looking at other variables in the cost equation, the growth in output variable is always

negative and strongly significant. This suggests that higher growth facilitates cost improvements

either by making it easier to exploit economies of scale or to pursue cost-reducing innovations.

The input price variables are all appropriately signed with, not surprisingly for food processing

industries, the price index for materials and supplies clearly the most important.[9]

Our next step is to bring the price and cost equations together by evaluating the

components in equation 7 with the estimated coefficients from the regression results.

Accordingly, in Table 3 the market power, efficiency and total consequences of a one percentage

point increase in CR4 on the growth in prices are presented for alternative initial levels of CR4,

ranging from zero to one, and for each of the time periods. The results for the cost effect on

prices are the most straightforward. A negative cost effect is present in every case, is always

significant at the one percent level, and becomes larger as the time period lengthens.[10] The

increase in the cost effect with longer time periods is due primarily to the increase in the effect of

changes in concentration on cost in the cost equation. However once the difference in years is

accounted for, the per year cost effects are about the same. For the five year period, a one

---

[8] If the squared concentration term is dropped the coefficient on concentration is negative, significant at the five percent level, and smaller (in the five year period the coefficient is only .05).
[9] Rather than look at how average variable cost changes over time we could also look at how productivity changes in these industries using a five-factor productivity index from the NBER data set. Accordingly five, ten year and twenty year differences in the log of this productivity index were used as a dependent variable in a specification identical to the cost equation specifications except that input price indices did not have to be included as control variables. The results were very similar to those obtained in the cost equation specification. All the coefficients were of approximately the same magnitude and statistical significance with, because the equation is a productivity rather than a cost equation, opposite signs. The average variable cost form we use makes it easier to talk about price and cost consequences and does not presume constant returns to scale. which is an assumption needed to construct the productivity index.
[10] The standard errors are computed using Stata's non-linear test command.

percentage point increase in CR4 would reduce costs by .498 percent, while the average increase in CR4, for those industries with increasing concentration, of 5.1 percentage points would reduce average costs by 2.54 percent (-.498*5.1). For the twenty year period the equivalent numbers are a reduction in costs of .968 percent and 11.3 percent (-.968 times the average increase in concentration of 11.6), which are numbers just over four times larger than the five year figures.[11]

In contrast, a positive market power effect shows up only when concentration exceeds .5 and is significantly positive only for the five and ten year periods. One explanation for the relatively weak effects may be that market power effects are most likely when a critical threshold in concentration is exceeded, so that for many industries in the sample the changes in concentration are not enough to take the industry past a critical concentration level and thus move it from a non-cooperative to a cooperative solution. [12] Combining the weak market power effects and strong cost effects produces an overall effect on prices that is everywhere negative, and almost always significantly different from zero. On average, increasing concentration has produced consumer-friendly price effects in the food processing industries.

Conclusion

As we observed in the introduction, much of the interest in the food industries has been prompted by the unusually large increases in average concentration, increases not observed in the

---

[11] CR4 increased for 58 percent of industries over the five year observations of first differences. 62 percent over ten years and 68 percent over 20 years. For increasing CR4 industries the average increase was 5.1, 8 and 11.6 percentage points for 5, 10 and 20 years respectively. For decreasing CR4 industries the average decrease was 3.2, 5.3 and 6.2 percentage points respectively.

[12] There is a critical concentration literature that says that recognition of interdependence among firms requires a certain minimum level of concentration. See p. 422-423 Scherer and Ross (1990) for a review.

rest of manufacturing. Our work suggests that these increases have on balance been beneficial, that is the efficiency consequences of increased concentration have outweighed the market power consequences. We did this by concentrating directly on the price and cost histories of the food industries and fitting price and cost equations to these histories. However, as we also noted in the introduction, other recent studies, in particular Lopez et al. (2002) and Lopez and Liron-Espana (2003), employing the techniques of the new empirical industrial organization (NEIO), find the effects of concentration to be, on average, price increasing. A key factor behind their results is that they often find constant returns to scale, or even diseconomies of scale, for industries in their sample, meaning that the cost consequences of increases in concentration are either absent or even negative.[13] For example, of the 32 industries in Lopez et al., nine had significant diseconomies (at the ten percent level) and another six had point estimates indicating diseconomies. Given diseconomies, one would expect a survivor-like adjustment process whereby smaller lower cost firms expand at the expense of larger higher cost firms, thus producing lower concentration. But in fact most food industries experienced concentration increases during the sample period. The joint occurrence of diseconomies and rising concentration implies, implausibly, an adjustment process where high cost firms are taking over the industry.[14]

---

[13]A key step in these papers, introduced by Azzam (1997), is to specify a Generalized Leontief Cost Function which produces, when aggregated from the firm to the industry level, a result where increases in concentration (the Herfindahl index) reduce industry average costs if there are economies of scale, and increase average costs if there are diseconomies of scale. With this innovation they can seperate the market power and efficiency effects of concentration. Previously most NEIO studies routinely specified constant returns to scale cost functions, thereby automatically eliminating any efficiency effect due to rising concentration.

[14]The malt beverages industry is a good example of the problem since the estimated cost function indicates significant diseconomies while CR4 increased from 52 to 90 over the sample period. In fact, a leading industrial organization textbook, Carleton and Perloff (2004), uses this industry to illustrate how the survivor technique concludes there must be economies of scale since larger plants are increasing their share of output. We tracked CR4 for seven of the nine industries with significant diseconomies and found that the average CR4 increased by 6.6 percentage points from 1972 to 1992.

We think a reason for these problematic results is how technological change, which should be a prime driving force behind concentration change, is handled in NEIO studies.[15] Typically technological change is represented by a time trend. In Lopez et al. this means, as the authors point out, that technological change can only affect the intercept of the average and marginal cost curves, meaning that technological change impacts symmetrically on all firms and that the cost levels of firms relative to one another does not change over time. But changes in concentration surely occur, in part, because technological change is adopted by firms unevenly; that is there are firm-specific innovations not immediately available to all firms. In summary, when technological change applies equally to all firms there are fewer reasons for concentration to change, but if concentration does change, this is indirect evidence of technological change that is firm specific and therefore not appropriately modelled by a time trend. One could conclude this means technological change should be modelled in a more sophisticated manner in the cost function. However when the data is annual industry level data and the systems being estimated are non-linear, incorporating more complicated technological specifications and detecting them reliably is very difficult.

While we think that NEIO approaches have not been able to deal successfully with technological change, particularly technological change for only a sub-set of firms which is at the heart of changes in concentration, their advantage is that they do produce market power and efficiency predictions for specific industries. In contrast one of the problems with the approach we use is it produces only a prediction about the net effect of concentration across a sample of industries. Therefore while we conclude that efficiency effects from rising concentration have, on average, dominated market power effects, this does not by itself imply that antitrust

---

[15]Sexton also alludes to the problems of adequately incorporating technological change in NEIO models.

monitoring of increasing concentration is not required since for some individual industries the

opposite is always possible.

REFERENCES

Azzam, A., "Measuring Market Power and Cost–Efficiency Effects of Industrial Concentration", *Journal of Industrial Economics*, 45 (1997): 377-386.

Carleton, D. and J. Perloff, *Modern Industrial Organization, fourth edition*, (Boston: Addision-Wesley, 2004).

Demsetz, H., *The Economics of the Business Firm: Seven Critical Essays*, (New York: Cambridge University Press, 1995).

Dickson, V., "Conjectural Variation Elasticities and Concentration", *Economics Letters*, 7 (1981):281-85.

Domowitz, I., R. Hubbard, and B. Peterson, "Business Cycles and the Relationship between Concentration and Price-cost Margins," *Rand Journal of Economics*, 17 (1986): 1-17.

Gisser, M., "Welfare Implications of Oligopoly in U.S. Food Manufacturing," *American Journal of Agricultural Economics*, 64 (1982):616-24.

Gisser, M., "Dynamic Gains and Static Losses in Oligopoly: Evidence from the Beer Industry," *Economic Inquiry*, 37 (1999): 554-75.

Gopinath, M., D. Pick, and Y. Li, "Concentration and Innovation in the U.S. Food Industries," *Journal of Agriculture & Food Industrial Organization*, 1 (2003): article 15..

Kelton, C., "Price Changes from 1958-1982", in D. Audretsch and J. Siegfried ed., *Empirical Studies in Industrial Organization*, (The Netherlands: Kluwer Academic Publishers,1992), 97-115.

Levin, R.C., W.M. Cohen, and D.C. Mowery, "R&D Appropriability, Opportunity and Market Structure: New Evidence on Some Schumpeterian Hypotheses", *American Economic Review*, 75 (1985):20-24.

Lopez, R., A. Azzam and C. Lirón-España, " Market Power and/or Efficiency: A Structural Approach", *Review of Industrial Organization*, 20 (2002): 115-126.

Lopez, R. and C. Lirón-España, " Social Welfare and the Market Power-Efficiency Tradeoff in the U.S. Food Processing: A Note", *Journal of Agriculture & Food Industrial Organization*, 1 (2003), Article 5.

National Bureau of Economic Research. *Manufacturing Industry Data Base, 1958-96*, Cambridge, MA (http://www.nber.org/data/).

Peltzman, S., " The Gains and Losses from Industrial Concentration," *Journal of Law and Economics*, 20 (1977): 229-263.

Scherer, F. and D. Ross, *Industrial Structure and Economic Performance, third edition*, (Boston MA: Houghton Mifflin Company, 1990).

Sexton, R. J., "Industrialization and Consolidation in the U.S. Food Sector: Implications for Competition and Welfare." *American Journal of Agricultural Economics*, 82 (2000):1087-1104.

U.S. Department of Commerce, Bureau of the Census. *Concentration Ratios in Manufacturing*, Washington DC (http://www.census.gov/econ/www/mansum.html).

Whitley, J. "The Gains and Losses from Agricultural Concentration: A Critical Survey of the Literature." *Journal of Agricultural and Industrial Food Organization*, 1 (2003):article 6.

Table 1: Three stage least squares results for price equations

Dependant Variable: ΔLnP	Five-Year Differencing	Ten-Year Differencing	Twenty-Year Differencing
ΔCR	-.239** (.106)	-.255** (.101)	-.230* (.134)
$ICR * \Delta CR$	.548*** (.211)	.576*** (.211)	.444 (.300)
$\Delta LnKQ$	-.035** (.014)	-.041*** (.016)	-.094*** (.022)
$\Delta LnAVC$	1.058*** (.029)	1.132*** (.035)	1.153*** (.058)
Constant	.011 (.012)	-.045** (.022)	-.096 (.059)
Observations	875	700	350
R-sq	0.891	0.893	.790

Note: Levels of significance are * (10%), ** (5%) and *** (1%). Standard errors in parentheses.

Table 2 : Three stage least squares results for cost equations.

Dependant Variable: $\Delta LnAVC$	Five-Year Differencing	Ten-Year Differencing	Twenty-Year Differencing
$P\Delta CR$	-.470***	-.530***	-.839***
	(.106)	(.102)	(.128)
$N\Delta CR$	.507***	.191	-.141
	(.159)	(.167)	(.299)
ICR	-.459***	-.917***	-1.854***
	(.109)	(.165)	(.319)
$ICRSQ$	.437***	.863***	1.715***
	(.113)	(.174)	(.330)
ΔLnQ	-.275***	-.326***	-.384***
	(.033)	(.037)	(.041)
$\Delta LnPOM$	.595***	.559***	.498***
	(.034)	(.040)	(.066)
$\Delta LnPOE$	.125***	.137***	.189***
	(.041)	(.039)	(.055)
ΔLnW	.102	.418***	.594***
	(.065)	(.071)	(.093)
Constant	.161***	.199***	-.002
	(0.029)	(.062)	(.168)
Observations	875	700	350
R-sq	0.678	0.717	.219

Note : Levels of significance are * (10%), ** (5%) and *** (1%). Standard errors in parentheses.

Table 3: Price effects from one percentage point increase in concentration

	Initial CR	Market-power Effect $(\alpha_1 + \alpha_2 * ICR)$	Cost Efficiency Effect $\alpha_3 * \beta_1$	Total Effect $\dfrac{d\Delta LnP}{d\Delta CR}$
Five-year differences	.0	-.239%**	-.498%***	-.736%***
	.25	-.102%*	-.498%***	-.599%***
	.50	.035%	-.498%***	-.462%***
	.75	.172%**	-.498%***	-.325%***
	1.0	.309%**	-.498%***	-.188%
Ten-year differences	.0	-.255**	-.600%***	-.855%***
	.25	-.111%**	-.600%***	-.711%***
	.50	.033%	-.600%***	-.567%***
	.75	.177%**	-.600%***	-.423%***
	1.0	.321%**	-.600%***	-.279%*
Twenty-year differences	.0	-.230%*	-.968%***	-1.198%***
	.25	-.119%	-.968%***	-1.087%***
	.50	-.008%	-.968%***	-.976%***
	.75	.103%	-.968%***	-.864%***
	1.0	.214%	-.968%***	-.754%***

Note: Levels of significance are * (10%),**(5%) and ***(1%).