Presence of Check-Off Programs and Industry Concentration in the Food Manufacturing Sector

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ABSTRACT
The authors examine industry concentration for the U.S. food manufacturing sector. This study is the first to examine whether particular subsectors within the food manufacturing industry, which operate in the presence of industry-funded check-off programs such as marketing orders, are more or less concentrated than industries without such research and marketing programs. The authors find evidence to the hypothesis that industries with demand-enhancing check-off programs have lower concentration relative to industries without these programs. [JEL Classifications: L11, L5, D29, D49] © 2012 Wiley Periodicals, Inc.

1. INTRODUCTION
The food manufacturing industry in the United States consists of approximately 22,000 companies. Profitability of these individual companies depends on both efficient production and processing as well as demand stimulation. These latter activities include expenditures on advertising and nonadvertising promotion, differentiated product positioning, value-added attributes, and new product development. Because of agricultural policies extending back to the 1930s, the food sector is somewhat unique in the United States in that the roles of product creation, advertising, and publicity are private decisions of an individual firm. As part of U.S. farm policy, these decisions are made by industry representatives seeking to enhance demand for all firms in an industry. Because of the governmental backing of these industry programs, whether such industry decisions affect industry structure is an intriguing question. In a purely theoretical study, Crespi and Marette (2009) show that “industry-funded, demand-enhancing activities, like the research and development of new, better, and healthier commodities or generic commodity promotion, matter not only for the quality of goods in the marketplace and firm profitability, but also for influencing industry market structure” (p. 399).

In referring to demand-enhancing activities, Crespi and Marette (2009) present a case for check-off programs having such a role. The Federal check-off programs known as marketing orders were authorized by the Agricultural Marketing Agreement Act of 1937. The so-called stand-alone check-off programs for specific commodities (beef, pork, and cotton, for example) were authorized by various statutes in subsequent years (often the terms marketing orders and check-offs are used interchangeably though there is a legal distinction). All the statutes are generally providing specific purposes for check-offs, which have included (Neff & Platto 1995, p. 2) (a) creating orderly marketing conditions to achieve parity prices to farmers, (b) protecting consumer interest by gradually moving prices toward parity and disallowing actions intended to maintain prices above parity, (c) promoting an orderly flow of the supply of each commodity to market throughout its normal marketing season to avoid unreasonable fluctuations in supplies and prices, and/or (d) conducting production research, marketing research, and development projects; setting container and pack requirements; establishing minimum

1See Crespi (2003) for the legal distinction. In this article, we use the term check-off to refer to all mandatory, industry-funded marketing programs.
standards of quality and maturity; and maintaining grading and inspection requirements. The last activity is the emphasis of this current study.

Crespi and Marette (2009) employ an analytical model with subsequent simulation exercises to show that the existence of check-off programs can dampen a dominant firm’s ability to exclude a rival through setting a high sunk cost. Furthermore, they contend that this procompetitive effect is predicated on both the size of the program and how the check-off actually affects perceived demand. In all, their theoretical arguments indicate that check-offs can have a procompetitive effect as agricultural industries increasingly become concentrated.

The purpose of this study is to examine whether particular subsectors within the food manufacturing industry, which operate in the presence of check-offs, are less concentrated than industries without such research and marketing programs. Individual industry characteristics such as sunk and variable costs and advertising expenditures are known to be correlated with concentration (the interested reader is referred to the discussion of the empirical studies and the theory for this relationship in Sutton, 1996). Thus, controlling for the myriad of factors influencing industry concentration will be necessary for examining the relative impacts of check-offs on an industry’s structure, in doing so, even with the aggregated nature of the data used, the first test of the hypothesis put forward in the 2009 study, is provided.

2. BACKGROUND AND PREVIOUS RESEARCH

Check-offs may regulate commodity quantity and quality, container and pack standards, and the conduct of research and market programs (Neff & Platto 1995). The U.S. Department of Agriculture’s (USDA) stance on governing check-offs has been one of developing and maintaining markets rather than controlling markets. Limited regulatory burdens have allowed check-offs to be established and in many cases flourish. Check-offs have aided food product producers by providing an environment for producers to jointly solve marketing problems that cannot be solved individually. These agreements are legal instruments, enforced by the USDA, which ensures an appropriate balance between the interests of producers looking for fair prices and consumers who expect an adequate quality supplied at reasonable prices.

There exists an extensive body of empirical literature with respect to check-offs. These include Ippolito and Masson (1978), Dardis and Bedore (1990), Zheng and Kaiser (2009), and Chouinard, Davis, LaFrance, and Perloff, (2010) on milk; French (1982) on fruits and vegetables; Thompson and Lyon (1989) and Powers (1992) on oranges; Williams, Capps, and Palma (2007) on grapefruit and oranges; French and Nuckton (1991) on raisins; Williams (1999) on soybeans; Murray et al. (2001) on cotton; Crespi and Chacon-Cascante (2004) on almonds; and Ward and Lambert (1993), Ward (1999), and Davis (2005) on beef. A few of these studies evaluated the extent of the effects of check-offs on market power accruing to program participants. Findings suggest that that the market power exerted by these legal cartels is significantly less than would be expected from a profit-maximizing cartel. Extensions of this literature evaluated the distribution and redistribution of check-off programs’ generated surpluses in the presence of market power along the supply chain. Specific studies include Richards, Kagan, Mischen, and Adu-Asamoah (1996) on lemons, and Kawaguchi, Suzuki, and Kaiser (1997) on milk.

Another line of literature examined the benefits and costs of check-off programs, especially advertising and promotion. An assumption implicitly underlying much of this work is a competitive market structure; however, a few researchers have examined how marketing by one program affects firms in a competing program (Alston, Freebairn, & James 2001; Crespi & James 2007; Kinnucan, Xiao, & Hsia 1996). What is thus far missing is an empirical study examining whether particular subsectors within the manufacturing industry, which operate in the presence of check-offs, are more or less concentrated than industries without such industry-sponsored market enhancement programs.

A few conceptual issues must be addressed initially. The structure of check-offs for industries within the food manufacturing sector is similar but does differ in check-off fee, minimum participation rate, and the allocation of funds across advertising, research, and other activities.
All check-off fees are on a per unit sold basis and the assessments are gathered at the first handler level and remitted to the appropriate marketing board. Given that the structure is similar across industries and only the standardized characteristics within the check-off vary, we are able to compare general check-off program effects across industries.

The analytical model by Crespi and Marette (2009) finds that once market power reaches the point where economic profits, garnered in part by check-off stimulated demand, allow the strategic use of sunk costs to exclude a rival, the strategic interplay among firms in an industry becomes complicated. Furthermore, the existence of a regulatory body that can elicit funds from industry players to fund these check-off programs can importantly influence these programs. In all, industry-funded demand-enhancing activities are not only expected to affect the quality of goods in the marketplace and firm profitability, but also to influence industry market structure.

For the basis of this study, market concentration will be measured using the Herfindahl-Hirschman Index (HHI). The HHI measures market concentration as a function of the individual firms’ market shares and is calculated as follows:

\[
HHI = \sum_{i=1}^{N} s_i^2
\]

where \(s_i\) is the market share of the \(i\)th firm and \(N\) is the total number of firms. In practice, the shares are measured in percentage terms as opposed to decimal terms. Of the various measures employed to measure market concentration, the HHI reflects more fully the information in the concentration, that is, reflects the combined influence of both unequal firm sizes and the concentration of activity in a few large firms (Pepall, Richards, & Norman 2008).

3. DATA

The analysis of the effect of check-offs on industry concentration in the food manufacturing industries is conducted using U.S. Economic Census data for 1997, 2002, and 2007. The specific series used are the Detailed Statistics by Industry and the Share of Value of Shipments Accounted for by the 4, 8, 20, & 50 Largest Companies. The food manufacturing industries subject to the analysis are taken to the sixth digit (e.g., Food Mfg [311], Grain & Oilseed Milling [3112], Starch & Vegetable Fats & Oils Mfg [31122], Soybean Processing [311222]).

To determine which industry is likely to be (directly) impacted by an industry-sponsored marketing program, we developed the following guidelines while examining both the nature of the individual check-off programs and the definitions of the North American Industry Classification System (NAICS) industry classifications in the Census of Manufactures (Census). First, the check-off had to be active in all 3 years of the Census. Second, the check-off had to be national in scale. Third, the check-off had to be active in marketing products directly to consumers (that is we did not consider an order if it was marketing a product specifically as an input to the processing sector but not to consumers, e.g., whey protein). Fourth, the order had to market product in one of the food industries in the Census categories. If one combines the 11 dairy orders into one order, then at the time of this writing there are currently 51 U.S. federal check-offs and stand-alone check-off programs that can partake in generic advertising, promotion, and/or development of new consumer products.

We examined all 51 of these programs and narrowed the list to 15 programs as impacting directly the manufacturing sectors in the analysis. The main reason for excluding an order was that many of the 51 orders that use promotion, advertising, or research and development cover only fresh food (e.g., cherries, citrus, avocados, apricots, grapes, onions, peaches, potatoes, nectarines, tomatoes—just to name a few). Fresh products such as these are not classified as manufacturing under the Census and so are excluded from this study based on our fourth rule, though it would be interesting and worthwhile to reexamine these industries if one could find the requisite industry data like that provided by the Census. Dried fruits and processed nuts, on the other hand, are marketed by their industry boards in both their fresh product
and processed product forms and are included because the *Census* includes categories for these industries. We also excluded other commodity promotion programs that have only state authorization and operate exclusively within the boundaries of the authorizing state because we wanted our analysis to coincide with the national statistics gathered by the *Census*, although doing so may underrepresent the impacted industries. The orders and programs that met our requirements are Marketing Order 981: California Almonds; Marketing Order 929: Cranberries; Marketing Order 987: California Dates; Marketing Order 982: Oregon and Washington Hazelnuts; Marketing Order 983: California Pistachios; Marketing Order 993: California Dried Prunes; Marketing Order 924: Washington-Oregon Prunes; Marketing Order 989: California Raisins; Marketing Order 984 California Walnuts; Dairy Federal Milk Marketing Orders (currently there are 11 federal marketing orders); Beef Promotion and Research Program; Dairy Producer Check-off Program; Fluid Milk Processor Promotion Program; Peanut Promotion Research and Information Order, and the Pork Promotion and Research Program.

It is worth noting that check-offs are initiated at the farm (producer) level as a means for enhancing producer profits although the marketing is at the consumer level. Although tying some of the check-offs to the food manufacturing sector can easily be argued (i.e., fluid milk, soybean) others might be more ad hoc because there is obviously aggregation issues (i.e., meat processed from carcasses) in the food manufacturing data collected by the U.S. Census Bureau. However, this point can be easily reasoned away. Recall that demand enhancements (i.e., advertising, value-added activities) affect consumer demand, and hence, affect all the intermediate derived demands back to the producer. As such, it is appropriate to look at what happens at the manufacturing level unless one thinks that, for example, the “beef, it’s what’s for dinner” demand shift is somehow appropriated entirely by the cow–calf producer without helping packers. Given the availability of the data, looking at the food manufacturing sector to see if the demand enhancement makes the food manufacturing sectors more or less concentrated addresses the merits of the testable hypothesis laid out in the theory although future research should also undertake this examination at the intermediate levels. In Table 1, the manufacturing industries used in the analysis are listed; the asterisks indicate which industries are impacted directly by check-offs.

Crespi and Marette (2009) posited that costs were important factors in determining the impact of the demand-enhancing programs on concentration and empirical tests should control for such factors. Following Sutton (1996) we use proxies for three common industry variables that have been found to be related to the HHI in previous industry studies: sunk cost, variable cost, and advertising. Sunk costs (*Sunk*) are calculated by dividing industry-level, gross book value of depreciable assets by the total value of shipments by industry. Variable costs (*Variable*) are calculated in a similar fashion by dividing annual payroll by the total value of shipments by industry. Advertising expenditures (*Advertise*) are calculated by dividing advertising and promotional services by the total value of shipments by industry. Advertising and promotional services account for payments made to other companies for these services that were paid directly by the establishment. Although many of the check-offs under consideration in this analysis also engage in industry-wide, generic advertising, these expenditures are paid as assessments to the various marketing boards by the first handlers of the commodity and are thus not collected as part of the *Census of Manufactures* Survey on advertising expenditures by manufacturing firms. In other words, the variable *Advertise* is not inclusive of generic marketing programs but does include payments by the manufacturing firms for printing, media coverage, and other services and materials; hence, *Advertise* is likely to be a rough proxy for true advertising expenditures. To capture the effect of any demand-enhancing marketing program on an industry's HHI, we include a binary variable for the presence of a check-off (*Checkoff*) in the industry. Although it would be beneficial to have these data in terms of total expenditures by each marketing program in each industry, these data are considered proprietary by the marketing boards and are not readily available for each of the check-offs examined, though attempts were made to obtain these.
We were able to create an unbalanced panel of 44 industries, totaling 129 observations, for our analysis from the Census of Manufactures Survey. In Table 2, the statistics for the variables used in the study are provided.

4. ECONOMETRIC MODEL

A simple econometric model is applied to estimate the impact of various industry structural characteristics and market factors on the HHI. The underlying assumption in the development of this model is that the HHI can be distinguished by various characteristics. The fundamentals of such models have been used on numerous occasions; in our case we follow the review of

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2The Census of Manufactures Survey contained 51, 47, and 47 food manufacturing industries in 1997, 2002, and 2007, respectively. Confectionery Mfg from Purchased Chocolate - Retail Chocolate (3113301), Confectionery Mfg from Purchased Chocolate - Commercial Chocolate (3113302), Nonchocolate Confectionery Mfg - Retail Nonchocolate (3113401), and Nonchocolate Confectionery Mfg - Commercial Nonchocolate (3113402) were eliminated from the 1997 data because these industries were not reported in the 2002 or 2007 survey. Herfindahl-Hirschman indices for Cane Sugar Refining (311312), Other Snack Food Mfg (311919), and Flavoring Syrup & Concentrate Mfg (311930) were withheld from the survey data to avoid disclosing data for individual companies; therefore, these industries were removed from the data used for analysis. Three industries were missing advertising expenditures. In 1997, Retail Bakeries (311811) advertising expenditures were withheld because the estimate did not meet publication standards. In 2002, Specialty Canning (311422) and Ice Cream & Frozen Desert Mfg (311520) advertising expenditures were withheld to avoid disclosing data for individual companies. Thus, we have an unbalanced panel of 44 food manufacturing industries (less three industries removed due to withheld advertising expenditures) and three time periods (i.e., 44 * 3 = 132 - 3 = 129).
TABLE 2. Variable Statistics

<table>
<thead>
<tr>
<th>Variable</th>
<th>1997</th>
<th>2002</th>
<th>2007</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>M</td>
<td>Mdn</td>
<td>SD</td>
</tr>
<tr>
<td>Dependent variables:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>HHI</td>
<td>956.670</td>
<td>699.600</td>
<td>669.528</td>
</tr>
<tr>
<td>CR4</td>
<td>46.800</td>
<td>43.700</td>
<td>18.455</td>
</tr>
<tr>
<td>Independent variables:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sunk</td>
<td>0.329</td>
<td>0.312</td>
<td>0.156</td>
</tr>
<tr>
<td>Variable</td>
<td>0.095</td>
<td>0.099</td>
<td>0.043</td>
</tr>
<tr>
<td>Advertise</td>
<td>0.003</td>
<td>0.002</td>
<td>0.004</td>
</tr>
<tr>
<td>Checkoff</td>
<td>0.233</td>
<td>0.000</td>
<td>0.427</td>
</tr>
</tbody>
</table>

Note: HHI = Herfindahl-Hirschman Index; CR4 = measure of the percent value of shipments of the top four firms in each industry

the literature and the analysis of markets as laid out in Sutton (1996). The specification can be written as:

\[
HHI_i = a_0 + \sum_{j=1}^{J} \beta_j IC_{ij} + \epsilon_i \tag{2}
\]

where \(HHI_i\) is the HHI for the \(i^{th}\) industry (time subscripts \([t]\) on each variable are omitted for convenience), the intercept is represented as \(a_0\) with \(\epsilon_i\) as white noise error term, \(IC\) is the \(j^{th}\) industry structure characteristic of the \(i^{th}\) industry and \(\beta_j\) is the parameter associated with the \(j^{th}\) industry structure characteristic. Although Equation 2 represents the general specification of the model, we estimated several variants based on Equation 2. In particular, we report estimations using both the level and natural logarithms of continuous variables. In addition to the HHI, we also used an additional measure of concentration as a dependent variable, CR4 (measuring the percent value of shipments of the top four firms in each industry).

Because of the potential for capturing panel effects, i.e., time effects, fixed effects, and random effects estimation was considered. Fixed effects were tested by the (incremental) \(F\) test. Random effects were examined by the Lagrange multiplier test (Breusch & Pagan 1980). The \(F\) test failed to reject the null hypothesis that the time effects are zero. Similarly, the Lagrange multiplier test failed to reject the null hypothesis that the time series error variances are zero. Failure to reject the null hypothesis in both cases, suggests a pooled ordinary least squares (OLS) regression is favored. Poolability was tested by estimating time-by-time OLS regressions. We failed to reject the null hypothesis of poolability across time. Therefore, the HHI (or CR4) was estimated with pooled OLS as

\[
HHI_{it} = \alpha + \beta_1 SunkCost_{it} + \beta_2 VariableCost_{it} + \beta_3 Advertising Expenditures_{it} + \beta_4 Checkoff_{it} + \epsilon_{it} \tag{3}
\]

where \(i\) refers to an individual industry and \(t\) is one of the 3 years reported in the Census.

The data utilized in this study have observations from each industry over time. As a result, the errors in the econometric model are potentially heteroskedastic and/or serially correlated. A likelihood-ratio test failed to confirm the presence of panel-level heteroskedasticity. Furthermore, using Wooldridge’s (2002) test for serial correlation in panel-data models, we failed to reject the null hypothesis of no first-order autocorrelation. The test results for panel-level heteroskedasticity and serial correlation further provide evidence that Equation 3 is the appropriate specification.

5. RESULTS

Regression results are presented in Table 3. Theory provides little guidance on the correct functional form for the equations to be estimated. Therefore, two models are presented for
TABLE 3. Econometric Results

<table>
<thead>
<tr>
<th>Variable</th>
<th>Model 1 HHI Levels</th>
<th>Model 2 HHI Logs</th>
<th>Model 3 CR4 Levels</th>
<th>Model 4 CR4 Logs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intercept</td>
<td>1308.126 (0.000)</td>
<td>4.635 (0.000)</td>
<td>58.334 (0.000)</td>
<td>2.632 (0.000)</td>
</tr>
<tr>
<td>Sunk</td>
<td>837.992 (0.007)</td>
<td>0.491 (0.006)</td>
<td>31.516 (0.000)</td>
<td>0.296 (0.001)</td>
</tr>
<tr>
<td>Variable</td>
<td>−6354.490 (0.000)</td>
<td>−1.116 (0.000)</td>
<td>−216.724 (0.000)</td>
<td>−0.618 (0.000)</td>
</tr>
<tr>
<td>Advertise</td>
<td>17658.140 (0.057)</td>
<td>0.021 (0.711)</td>
<td>313.198 (0.170)</td>
<td>−0.001 (0.965)</td>
</tr>
<tr>
<td>Checkoff</td>
<td>−390.078 (0.007)</td>
<td>−0.520 (0.007)</td>
<td>−10.142 (0.005)</td>
<td>−0.269 (0.007)</td>
</tr>
</tbody>
</table>

Adj $R^2$ 0.238 0.304 0.380 0.359

Note: $P$ values are reported in parentheses. HHI = Herfindahl-Hirschman Index; CR4 = measure of the percent value of shipments of the top four firms in each industry.

Each concentration measure (HHI and CR4), one estimated with continuous variables in levels (referred to as the levels model) and one with log transformations of the continuous variables (referred to as the logs model). Overall, both models fit the data well, and presentation of both models provides readers an indication of robustness across functional forms. Results were relatively insensitive to specification of the variables in levels or logs. Coefficients represent marginal effects, i.e., differences in the levels model, and percentage differences in the logs model.

Given that the collected data encompass widely disparate industries, it is important to note that the models estimated do explain a notable percentage of the variation in average industry concentration with adjusted $R^2$ values ranging from 0.24 to 0.38 in the four models estimated. This is not necessarily surprising, on reflection, given that three of the variables ($Sunk$, $Variable$, and $Advertise$) were specifically chosen as they have been found to correlate well with concentration in previous studies. The patterns are consistent with sunk costs and advertising showing positive correlation with both HHI and CR4 and variable cost showing negative correlation. $Sunk$ and $Variable$ show statistically significant effects on the concentration measures across all specifications, whereas the variable $Advertise$ shows only significant correlation in the HHI-dependent model where all variables are measured in levels. The specification does not have any appreciable effect on the pattern of the correlations across models. Overall, we would conclude that these four specifications are revealing the same correlations.

The specific hypothesis of interest in this article, however, is whether the addition of the dummy variable indicating the presence of an agricultural check-off significantly impacts the concentration in a food industry. Looking at Models 2 and 4, the presence of a check-off is correlated with an average decline in the HHI by 52% and an average decline in the CR4 by 27%. Models 1 and 3 show nearly the same percentage change on the average HHI and CR4 from the presence of a check-off. Indeed, in all four models, the coefficient on $Checkoff$ is negative.

\[3\] Box-Cox regressions suggest a logs functional form is more appropriate for the HHI model, but the levels functional form is more appropriate for the CR4 model. However, the difference in “fit” is slight. Both models are presented given the small advantage in statistical sense for picking one model over the other. Some readers may prefer interpreting results in terms of differences and some in terms of percentage differences. All models and test statistics discussed in this article are available upon request.

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and statistically significant at the 1% hypothesis level indicating the presence of a check-off is correlated with a less-concentrated industry as predicated by theory.  

6. CONCLUSION

The purpose of this analysis is to test the hypothesis put forward by Crespi and Marette (2009) that the presence of an industry-sponsored, demand-enhancing program such as a marketing order or other check-off program for promotion and advertising or other related demand marketing can have a procompetitive impact on an industry. The question is of importance as markets in food and agriculture become more and more concentrated. Under the present leadership, the U.S. Departments of Justice and Agriculture, for example, have chosen to make the regulation of anticompetitive behavior of firms in agriculture a focus of both departments (see, for example, U.S. Department of Justice, 2010). Government-sanctioned check-off programs for such things as generic advertising have never been promoted on their procompetitive impacts, so testing for the presence or absence of such impacts is of importance for agricultural policy. Although there is debate as to the link between competition and concentration, the results show that when market concentration is examined, the presence of such a marketing program is correlated with significantly lower levels of industry concentration, which is consistent with theory. Future analyses should consider alternative theories, such as whether less-concentrated industries are more likely to have check-off programs and the impacts of check-offs on concentration at the farm and other levels of the marketing chain, as well as the use of various measures of check-off variables, such as the actual dollar amount of expenditure. Nonetheless, as a test of one particular hypothesis with implications for agricultural policy, our empirical model provides fodder for the discussion of the benefits of check-offs that extend beyond the rate-of-return measures typically examined in the literature.

REFERENCES


4 A reviewer correctly points out that failing to refute a null hypothesis (here, Crespi and Marette’s hypothesis that generic advertising can cause lower industry concentration) is not the same as proving it nor does it mean that competing hypotheses have been refuted. We agree. The reviewer posits that the existence of free ridership due to the presence of branded advertising would also be consistent with both low concentration and the existence of a check-off program. The correlation of the private advertising and check-off variables in our data revealed almost no correlation ($r = 0.007$), however. Further, though intriguing, as far as we know, no such alternative theory currently exists. Consider, for example, that a hypothesis that positive firm-level advertising externalities is a necessary condition for generic advertising would arise under a Bertrand framework with only two firms producing a homogeneous good just as it would arise under a Cournot framework with many firms producing a homogeneous product. As such, free-ridership, on its own, is not a necessary condition for low concentration. Of course, future research should consider alternative theories and future empirical tests must distinguish among them to be useful. We thank the reviewer for asking us to make this point clear.
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