Impact of Vertical Mergers on Food Industry Profitability:
An Empirical Evaluation

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Abstract

Vertical integration is an important business strategy among firms in the U.S. food industries. Our objective is to test one of the perceived benefits of vertical integration – improved profitability of the integrated firm. Findings show that increased vertical mergers in food industries would lower profits.

Key words: vertical integration, mergers, market performance, industry profitability

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1.   Introduction

With increased trade liberalization, rapidly changing consumer demand and a regulatory environment, the need for a more closely coordinated marketing system is becoming increasingly more important. Such increased coordination allows firms along the marketing chain to be more responsive to the changing market environments. The constant pressure to meet customer demands and the need to be competitive while staying profitable have provided added motivation to search for a more closely coordinated marketing system for most products today. Rooted in the concept of supply chain management, vertical integration is championed as the solution to such coordination problems. Essentially, there are two types of vertical integration: contract integration and ownership integration (or vertical mergers). Contract integration exists when a firm establishes a legal commitment that binds the producer to certain production and marketing practices. Contract integration requires that the producer (e.g., a farmer) sell the product to the integrated firm (e.g., a food manufacturer). Vertical merger exists when single ownership extends to two or more levels of the marketing system. A manufacturer selling its products through its own retailing outlet or a distributor of electricity owning its own power generating plants are examples of vertical mergers.

It is commonly argued that increased vertical integration has resulted in improved, consistently high quality, uniform products for consumers. It is also argued that increased vertical integration has resulted in lowering prices by both the unmerged input supplier and the vertically integrated firm (McAfee, 1999). Theoretical literature has shown that under certain conditions, vertical integration will increase economic efficiency in terms of output and price and also increase profit for the integrated firm, i.e., a win-win situation (Greenhut and Ohta, 1979). More generally, this strand of literature contends that vertical integration or coordination will create efficiencies by reducing the transaction costs associated with the market exchange (Williamson, 1974 and later years; Klein, Crawford and Alchian, 1978; Perry, 1989). Other most commonly argued benefits of vertical integration include the reduction of risk (Buzzell, 1983; Porter, 1985), the ability (of integrated firms) to innovate and to differentiate (Porter, Perry), increased efficiency in the exchange of information and organizational structures (Porter), and improved market positions of the integrated firm (Perry).

Although there are many expected benefits of vertical integration, the existing empirical literature seems to have focused mostly on issues related to transaction cost, foreclosures, and the determinants of vertical integration (e.g., Monteverde and Teece, 1982; MacDonald, 1985; Anderson and Coughlan, 1987; Caves and

Bradburd, 1988; Rosengren and Meehan, 1994; Davies and Morris, 1995; Waterman and Weiss, 1996). The empirical literature on an important aspect of vertical integration, i.e., its effect on price, output and profit, is surprisingly limited. Among the existing studies, McBride (1983) found that vertical integration negatively impacted post-integration prices. Findings by Ghemawat and Caves (1986) show that vertical integration may have created exit barriers for the integrated firm and may have a harmful price-increasing effect. Martin's study (1986) shows that vertical integration's effect on profitability is ambiguous. Simply put, the empirical literature has largely failed to provide evidence on the effect of vertical integration on price, output and profit (Suominen, 1992). Azzzam and Pagoulatos (1999) conclude that there are serious gaps in the vertical integration literature and the limited empirical work that has been done in this area makes generalization difficult to achieve. The main purpose of this study, thus, is to empirically examine the effect of vertical integration on the integrated firm's profitability. More specifically, we examine the impact of vertical mergers, i.e., vertical ownership integration, on the profitability of U.S. food manufacturers/processors.

Vertical integration, in one form or another, is an integral part of both the agricultural and food manufacturing sectors in the United States. As the U.S. food system has become more and more consumer driven, the importance of vertical integration has also become more important because it allows both farmers and food processors to manage and customize their production according to market needs. The poultry industry has been largely integrated since the early 1960s, while vertical integration has been spreading rapidly since early 1980s into other food industries. Most conspicuous among these are the meat packing and the prepared meat (including pork) industries, processed dairy industries, processed fruits and vegetables industries, bread and bakeries industries, etc. For instance, the meat packing and prepared meat industries not only are dominated by a very few large processors (e.g., ConAgra), but also purchases on the open market in these industries are replaced by vertical integration of some type. In 1998, approximately 40 percent of hog sales to packers were coordinated by contracts and integrated operations compared with 11 percent in 1993 and only three percent in 1980 (Martinez, 1999). Such emerging trends are likely to affect the structural linkages connecting the production agriculture and the food manufacturing industries.

Although the economic concerns regarding the impact of continued industrialization and vertical integration in the U.S. agricultural and food manufacturing sectors have been growing, we are surprised to find that in agricultural economics literature, the Frank (1990) and Frank and Henderson (1992) studies were the only studies to make any attempt to empirically measure the degree of vertical integration in the U.S. food manufacturing industries. Unlike the Frank and Henderson's study, other existing studies of vertical integration in the U.S. food industries are mostly descriptive and focus on issues such as the motivation behind vertical integration, efficiencies of alternative vertical structures, i.e., contractual vs. ownership integration, or the impact

of vertical integration in terms of farm-retail price spreads (e.g., Kinnucan and Nelson, 1993; Azzam, 1996; Martinez).

In Frank and Henderson's last sentence, they wished for more knowledge on how vertical coordination hampers or enhances profitability and economic welfare. That statement sums up the principal objective of this study and its contribution to the literature. Since vertical integration may have both costly and beneficial impacts on competition or market performance, depending on the kind of vertical relationship, we limit our focus to ownership integration, i.e., vertical mergers, only. Thus, we empirically examine how ownership integration impacts profitability in the U.S. food industries. With that general objective in mind, we break down this paper into two specific objectives: to empirically measure the degree of vertical integration in the U.S. food manufacturing industries, and to analyze the impact of vertical integration on the profitability of these industries. The next section describes how to measure vertical mergers and industry profitability, followed by the development of a model to examine the impact of vertical integration on profitability in Section 3. Section 4 describes the data. Results are presented and discussed in Section 5, followed by conclusions in Section 6.

2. Measurement of Vertical Mergers and Profitability

2.1 Measuring Vertical Mergers

While the debate over the impact of vertical integration continues, the literature on empirical measurement of vertical integration is limited in general. This, according to Hay and Morris (1991, p. 345), is mainly because "difficulties of measurement are no doubt one reason for the lack of systematic study of vertical integration." Similarly, according to Caves and Bradburd (p. 265) "... devising measures of vertical integration that are meaningful and comparable among industries has proved difficult." Such measuring difficulties obviously pose serious problems in attempts to analyze the impact of vertical mergers in the U.S. food industries (or in any other markets). Adelman's (1955) value added to sales ratio is considered the seminal work on empirical measurement of vertical integration and is one of the most widely used measures of vertical integration. This type of measurement, however, was unable to distinguish whether the integration was intra-industry or inter-industry (Davies and Morris). Similarly, vertical integration measurements based on census data on establishments (e.g., Tucker and Wilder, 1977) or enterprises (e.g., Levy, 1985) either only measures vertical integration taking place within the plant or enterprise, or are sensitive to multiplant backward integration by the firm (Caves and Bradburd).

More recent attempts at measuring vertical ownership integration rely on national input-output (I-O) tables, a trend started by Maddigan (1981) with her "vertical industry connection index" for a given firm.

Maddigan's index was based on the extent of technological relatedness, as revealed by I-O tables, among the set of industries within which the firm operates. Davies and Morris argue that her index ignores the magnitude of the firm's operations in those industries, e.g., an orange juice manufacturer with some form of vertical backward integration into production of oranges (say, either ownership or contract of orange orchards) would record the same value, whether its orange producers supply 1 percent or 100 percent of its fresh orange needs.

As mentioned earlier, among agricultural economics literature, only Frank and Frank and Henderson provide an empirical measurement of vertical integration in the U.S. food manufacturing industries. In addition to creating an inter-industry index of vertical coordination (they use the term 'vertical coordination' to incorporate both ownership and contract integrations), another objective of both of these studies was examining the effect of transaction costs on U.S. food manufacturing industries' vertical integration. However, Frank and Henderson's index of vertical integration was similar to Maddigan's and thus, suffered from similar shortcomings, i.e., sensitive to the stage in the vertical chain at which the firm operates. In addition, their vertical coordination index ignored intra-firm vertical linkages.

The vertical merger index presented here is based on the methodologies proposed by Caves and Bradburd and Davies and Morris. The index is based on the simple notion that integration is revealed by larger internal flows of output (within the firm) at the expense of market transactions. MacDonald is largely credited for successfully implementing this notion in terms of the proportions of shipments from manufacturing industries that are made to affiliated units (which may include manufacturing establishments, sales offices, wholesale, and retail establishments). Using national I-O tables and other public domain data (explained later), we construct a forward vertical merger index where a food manufacturing firm in industry j is the integrated firm owning its own wholesale and/or retail outlets as well as owning food manufacturing firms in another food manufacturing industry k ($j \neq k$). Such measurement reflects integration between business units in a given industry and those in industries downstream from it, thereby offering the potential for testing the impact of such integration on the performance of markets in which these integrated firms exist. Note that such a measurement will miss any integrated enterprises that operate in vertically-related industries but do not actually transfer intermediate products between their units (Caves and Bradburd).

The index of vertical mergers presented and used in this study shares properties with both Caves and Bradburd and Davies and Morris measures, albeit with modifications. Adopting these measures to create a forward vertical mergers index is an attempt to avoid the shortcomings of both MacDonald and Maddigan's measures and Frank's measures. Consequently, some of the features of the vertical integration index presented here are as follows: (i) it is based on the explicit theoretical notion of what constitutes vertical integration and shows whether the index measures inter- or intra-industry integration, (ii) this index can be mechanically estimated

from easily available public domain data and does not require any subjective assessment of firm or industry definition, and (iii) although we present only the analysis at the industry level, this index can be estimated at both firm and industry levels.

2.2   A working definition

The Coase-Williamson paradigm of theoretical vertical integration literature dictates that the essence of vertical integration is the decision by the individual firm on whether to organize exchanges internally (within the firm) or externally (in the marketplace). According to Davies and Morris, any sensible measure of vertical mergers, thus, should reflect the magnitude of intra-firm flows of output relative to external sales. However, it is difficult, if not impossible, to obtain information on the internal and market exchange of firms (Perry). Therefore, we present a theoretically cruder, but more practical working definition of a vertical merger index. This working definition takes both intra-firm and inter-industry flows into consideration.

In an industry comprised of N firms and R industries, a *forward vertical merger* of industry j is measured by the proportion of industry sales accounted for by the intra-firm flows of output from firms in the industry to their plants in other industries, i.e.,

where FVI_j is the index of forward vertical integration of industry j, b_{jk}^i is the "sales or destination coefficient"

$$FVI_j = \sum_{j \neq k}^{R} \sum_{i=1}^{N} b_{jk}^i N_{jk}. \tag{1}$$

or the fraction of j's output sold to its own i^{th} firm in industry k, i.e., $b_{jk}^i = X_{jk}^i / X_j$, where X_{jk}^i is the flow of output within firm i from its plants in industry j to its plants in industry k, and X_j is the total sales of industry j. The intra-firm flows between industry j and k are weighted by the proportion of j's firms in industry k, or $N_{jk} = NC_{jk} / T_j$, where NC_{jk} is the number of companies active in both j and k, and T_j is the total number of companies active in j. If there are no intra-firm flows between industry j and k, then $FVI_j = 0$ indicating a lack of vertical integration. Thus, the value of the forward vertical integration will lie between [0,1] or $0 \leq FVI_j \leq 1$. The data necessary to estimate equation (1) is described in Section 4.

The emphasis of the vertical merger measure on the proportion of firms integrated is responsive to the transaction-cost model, which focuses on the firm's decisions to integrate. This measure, however, does not represent intra-firm and/or inter-industry flows that are not integration related, e.g., administrative transfer between industries. While we acknowledge the limitations set by the high level of aggregation in I-O tables (or even in other census data), this type of aggregation problem is common to the measurement of integration.

2.3   Measuring Food Industry Profitability

It is much easier to define profit than to measure it empirically. Economic profit simply means the surplus of revenue over cost, including the opportunity cost of capital. The perils of measuring economic profit have been discussed in depth in Scherer and Ross (Ch. 11, 1990). While the use of some form of rate of return (e.g., return on equity or Tobin's q ratio) is common in the financial literature, such profitability measures have a serious drawback. They usually reflect the operations of whole companies/corporations and the user must somehow mesh the company-specific profit data with industry-specific structural variables (Scherer and Ross, p. 418). Another source of profitability data is the Internal Revenue Service's *Statistics of Income: Corporation Income Tax Returns*. Because large companies are usually very diversified and the IRS uses the primary industry method to classify companies, vast amounts of "contaminating" activity are loaded into the primary industry totals along with correctly classified primary industry profits, sales, and assets (Scherer and Ross, p. 418).

This type of contamination problem is greatly reduced in the U.S. Census Bureau's *Census of Manufacturers* and *Annual Survey of Manufacturers* (Scherer and Ross, p. 418). From the data available in these two publications, it is possible to compute an industry average price-cost margin, i.e., $price - cost\ margin = (total\ sales - total\ cost) / total\ sales$, to represent a measure of net industry profitability. Although this profit rate index is a weak measure of industry profitability, it is the closest approximation to industry profitability given the drawbacks of other measures. Despite the controversy regarding the use of such a price-cost margin index to measure market power, here we use this index as a measure of profitability, *not* market power.

$$\Pi = \frac{S + \Delta I - (W + M + K)}{(S + \Delta I)} \qquad (2)$$

Using the industry profitability measure of Domowitz, Hubbard, and Peterson (1986), we define net industry profitability as follows: where Π is net industry profit, S is dollar sales, ΔI is the change in inventories, W and M are the cost of labor and materials, and K is the imputed cost of capital.

3.   Impact of Vertical Integration on Industry Profitability

Ideally we would like to employ a research procedure that extracts vertical integration as one of the explanatory variables from the profit maximizing conditions of firms in an industry. However, we share the judgement of other researchers that this approach is a dead end in deriving such a relationship. From a more practical view point, we model the impact of vertical integration on industry profitability using a structure-performance paradigm mirroring

widely acceptable models. Using some form of price-cost margin index, economists since Bain have been trying to identify the factors or variables that influence economic performance and examine the links between these factors and market performance. These studies have been severely criticized in the literature which is a subject matter beyond the scope of this paper, for using price-cost margin to represent market power instead of what it actually represents, i.e., industry profits. Although our model mirrors these studies, we are examining the effect of vertical mergers on industry profitability, not market power, as well as the direction and magnitude such effects.

We present an industry-level empirical model of profitability in which industry profitability, Π, is the dependent variable. Among the explanatory variables, our target is the vertical mergers variable (FVI_j) and how it impacts Π while controlling for various industry characteristics (e.g., productivity, competition) that mirrors those used in the previous studies. From earlier discussions, we have learned that vertical integration or vertical mergers impact industry profitability. If vertical integration contributes to the creation of differential advantage or efficiency (e.g., cost savings due to integration) to enhance the profitability of the integrated firm, then we would expect a positive and significant impact of vertical mergers on industry profitability. To control for efficiency across sample industries, we use a relative productivity index defined as value added per worker (RP). If increased profitability is due to efficiency, whether due to vertical mergers or otherwise, we would expect RP to have a positive and significant impact on industry profitability.

We expect the four-firm market concentration ($CR4$) to have a positive and significant impact on industry profitability, indicating the ability of a few firms in highly concentrated industries to influence the terms of trade, i.e., price, and increase profits. National concentration ratios may understate actual concentration when markets are regional or local, e.g., ice cream and frozen desserts (SIC 2024), fluid milk (SIC 2026), bread and bakery (SIC 2051), etc. We use a regional industry dummy variable (REG, where REG =1 for industries that are regional in nature) to control for this understatement, and we expect a positive sign.

Those industries with barriers to entry, even for the short-run, will enjoy higher profits than those without such barriers. To represent the difference across industries in entry conditions, we include an index of product differentiation in terms of advertising intensity ($ADVT$) defined as advertising-to-sales ratio, research and development intensity (RnD) defined as research and development expenditure to sales ratio, and capital intensity defined as capital-to-sales ratio ($KINT$). While both $ADVT$ and $KINT$ may help create entry barriers which will help sustain profitability (i.e., positive and significant relationships with Π), there is no *a priori* belief on the innovation and invention index, RnD, because of its paradoxical impact on market performance.

To control for differences across industries in demand conditions we use the domestic demand or absorption rate as one of the explanatory variables. This domestic demand rate (*DOMDEM*) is defined as

follows: $DOMDEM = (SALES - EXPORT + IMPORT) / SALES$. We expect *DOMDEM* to have a positive and significant impact on industry profitability. Although we have included imports in the *DOMDEM* variable, we wanted to isolate the effect of import competition on domestic producers' profitability. Therefore, we introduce an import competition variable defined as the import-to-sales ratio (*IMPORT*) as one of the explanatory variables. While high domestic demand may have a positive and significant impact on profitability, we expect a negative and significant impact of competition from foreign firms on the profitability of domestic firms. Esposito and Esposito (1971) used a similar reasoning to examine the impact of import competition on market performance.

Based on our discussion above, our main hypothesis takes the following estimable form,

$$\Pi = \beta_0 + \beta_1 FVI + \beta_2 CR4 + \beta_3 REG + \beta_4 RP + \beta_5 RnD + \beta_6 ADVT \\ + \beta_7 KINT + \beta_8 DOMDEM + \beta_9 IMPORT + u, \tag{3}$$

where u is an error term.

4. The Data

We focus our study on the U.S. food manufacturing industries at the 4-digit SIC (standard industrial classification) level. All data used in this study are obtained from public domain sources. We use data on "Distribution of Sales by Class of Customer" (published every 10 years) from *1987 Census of Manufacturers*: *Subject Series*, from which one could calculate the proportions of each industry's sales destined for affiliated units of its constituent firms, i.e. the "sales or destination coefficient" in equation (1). For example, in 1987 shipments to other establishments of the same company for the meat packing plants (SIC 2011) included $3,130.5 million or 7.5934 percent to wholesale establishments (including sales offices), $145 million or 0.3517 percent to retail stores and outlets, $1414.3 million or 3.4305 percent to other manufacturing establishments, and $113.5 million or 0.2753 percent to other nonmanufacturing establishments. That is, the destination coefficient for SIC 2011 is 0.1165. Similar computations were carried out for the other industries with data adjusted for 1992.

Data needed to compute the industry profitability index, i.e., equation (2), were obtained from the *1992 Census of Manufacturers: Industry Series*. Nominal capital stock data available at the National Bureau of Economic Research's (NBER) productivity data base (www.nber.org) was used to compute the cost of capital for the sample industries, assuming a 4 percent depreciation rate. The most time consuming computation involved determining the proportion of j's firms in industry k, or N_{jk}, in equation (1). The accuracy of the value of N_{jk} is obviously limited by the accuracy of our data source, the *Ward's Business Directory of U.S. Private and Public Companies* (Gale Group, 2000). Taking errors of commission and omission together, we believe that the

numerator of N_{jk} is understated while the denominator may be either over- or understated. Based on available data, we were not able to compute N_{jk} for the following industries: SIC 2043, 2062, 2068, 2076, 2085, and 2097. These six industries were dropped from further analysis. Thus, the sample contained 43 food manufacturing industries (table 1).

Explanatory variables in equation (3) were constructed using *1992 Census of Manufacturers* data on industry concentration ($CONC$) and value added per production employee (RP). Capital stock data from NBER was used to construct $KINT$. Trade (import and export) data needed to compute the domestic absorption or demand variable ($DOMDEM$) and the import competition variable ($IMPORT$) were obtained from the NBER trade data bank (April 2000) and verified with trade data available (now discontinued) from U.S. foreign trade highlights publications courtesy of International Trade Administration, Department of Commerce (April 2000). Data on both RnD and $ADVT$ were provided by Professor Rigoberto Lopez of the University of Connecticut (adjusted to 1992). Appendix tables 1 and 2 show descriptive statistics and the correlation matrix of variables in equation (3).

5.   Results and Discussions

5.1   Food Manufacturer's Vertical Integration

In the case of forward vertical mergers, the FVI_j index (column 4, table 1) shows the proportion of industry sales accounted for by the intra-firm flows of output from firms in the industry to their plants in other industries, including wholesaling, retailing, manufacturing, and nonmanufacturing industries. That is, as shown in equation (1), we were able to compute a reliable index of ownership integration of an industry (j) because the FVI_j index included sales of industry j's output sold to its own i^{th} firm in the industry k ($j \neq k$). Results in Table 1 show that among the 43 sample industries, forward vertical ownership integration was the highest (0.1138) in the soft drinks industry (SIC 2086) and the lowest (0.0015) in the flour and other grain mill products (SIC 2041) in 1992. This means that the soft drinks industry was 11.38 percent integrated upstream, or that the soft drinks industry owned 11.38 percent of its upstream markets. On average, the degree of forward vertical ownership integration in the U.S. food industry was 0.0331 or 3.31 percent. Given a possible maximum of 1.00 (or 100 percent), results in Table 1 show that the degree of forward vertical mergers in individual food industries, as well as in the sector in general, was quite low.

>>>> table 1 about here>>>>>

Comparing these findings to those of Frank and Henderson, we note several key differences. One is that

Frank and Henderson's definition of vertical relationship (they used the term "vertical coordination" or VC) was broader in scope as they included several vertical governance structures, including ownership integration. A major difference between their study and this study is that the former defined the food manufacturing industries as the *upstream* industries from the U.S. farm sector, e.g., Frank and Henderson's VC index values ranged from zero for industries that procure virtually no input from the U.S. farms (e.g., coffee roasters) to nearly one for the industries which had high incidence of production management contracts (e.g., poultry slaughtering and processing). Their VC index captured all types of vertical relationships while this study *only* captures vertical ownership integration or vertical mergers. Other key differences include the use of different computational procedures (e.g., Frank and Henderson relied on a Maddigan-type index, which we avoided here due to reasons discussed elsewhere) and the use of different kinds of data. For example, while Frank and Henderson relied on 1982 Input-Output data, we use industry sales data, which clearly identify the proportion of each industry's sales destined for its own companies in other industries. Moreover, the principal goal of the Frank and Henderson study was to examine the effect of transaction costs on vertical coordination in the U.S. food manufacturing industries, while the main objective here is to examine the impact of forward vertical ownership integration on industry profitability. The bottom line is, while this study and Frank's study may share some common ideas, the two studies are clearly different in their objectives, procedures, and contribution to the literature.

5.2   *Impact of Vertical Mergers on Industry Profitability*

Using equation (3) we examined the impact of vertical mergers on industry profitability using 43 U.S. food manufacturing industries as our sample. Descriptive statistics of the regression variables in equation (3) are presented in appendix table 1, while a correlation matrix of these variables is presented in appendix table 2. The correlation matrix shows that the industry profitability index is negatively correlated with the vertical merger index and the regional concentration dummy, and positively correlated with the rest of the explanatory variables. The correlation matrix also fails to show any serious multicollinearity problem among the explanatory variables. Only the advertising intensity and relative productivity variables show a higher level of positive correlation (0.726). The estimated model (equation 3) is corrected for heteroskedasticity by using prescribed procedures in SHAZAM.

>>> table 2 about here>>>>>

Regression results are presented in Table 2. Beta-coefficients [1] were computed for each explanatory

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[1]   Beta coefficients show which variables contribute most to the regression by taking into account the effect of a typical or "equally likely" change in variables. The beta coefficients were calculated by multiplying the estimated coefficients by the standard deviation of each regressor and dividing by the standard deviation of the dependent variable.

variable to determine their relative contributions in explaining profitability in the U.S. food industries. Although this study used cross-sectional data, the model performed very well given the relatively high value of the squared correlation coefficient between the observed and the predicted values. The most striking feature of the results in Table 2 is that the arguments put forward in the construction of the market performance model, i.e., equation (3), were well substantiated. Results show that six out of eight variables (excluding the regional market concentration variable (*REG*) and the import competition variable (*IMPORT*)) were statistically significant and almost all of them kept their expected signs. [2]

In terms of the effects of the market structure variables on U.S. food industry's profitability, it was found that vertical mergers (integration) had adversely impacted the profitability of the sample industries. More specifically, a unit increase in vertical mergers decreased the profitability of the sample industries by almost the same magnitude. We argued earlier that in order to have a positive and significant impact on profitability, vertical mergers must contribute to the creation of differential advantage or efficiency to the integrated firm. Given our results, it can be argued that forward vertical mergers failed to create or contribute to the creation of differential advantage or efficiency of the integrated firms in U.S. food manufacturing industries. In addition, our results also imply that although the current level of vertical integration in the U.S. food manufacturing industries may be low, any further increase in such activities would lead to a further decline in net profitability of this sector.

As predicted, market concentration (*CR4*) positively and significantly increased profitability of the sample industries. A positive and significant productivity index (*RP*) signals an increase in profitability due to an increase in productivity, i.e., increased performance. Although this finding supports the well-known Demsetz hypothesis, note that increased productivity may have created some kind of entry barriers, thereby allowing existing firms to reap higher profits. Table 2 shows that innovations and inventions in the form of higher research and development (*RnD*) will improve industry profitability. Results in Table 2 shows that those industries with high advertising intensity (*ADVT*) would have a higher profit rate. Although advertising potentially has salutary (e.g., raising consumer awareness) and detrimental effects (e.g., creating entry barriers), high profitability is more likely to arise from creation and maintenance of brand loyalty among consumers and thereby shut off potential entrants into the market.

The capital intensity (*KINT*) variable was negative and significant indicating that capital intensive

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[2] Removing either of these two variables from the estimated model did not have much effect on either the estimated coefficients or the goodness-of-fit statistic. However, when both of these variables were removed from the estimated model, the goodness-of-fit statistics decreased to 0.491 while the direction and the magnitudes of the estimated coefficients did not change much. Given such an outcome, we decided to keep both of these variables in the reported model. We also tested an alternative model with a variable representing interaction between market concentration (CR4) and vertical mergers (FVI) to examine their joint impact on industry profitability. However, this interactive term was statistically not significant and therefore, was not included in the final model.

industries were more likely to incur loss than those that are not capital intensive. This finding rejects the idea that highly capital intensive industries are more profitable because such industries create entry barriers by requiring higher capital for entry. Our results also show that higher domestic absorption or demand (*DOMDEM*) would significantly increase industry profitability. This finding, along with that of the positive and significant impact of advertising on profitability, shows the importance of marketing strategies that aim at expanding domestic consumer demand. Although import competition (*IMPORT*) did not have any statistically significant impact on food industry profitability, the estimated coefficient shows the expected negative sign, i.e., import competition adversely affects the profitability of domestic firms.

Finally, beta coefficients (table 2) show that domestic demand, advertising intensity, and investment in innovation and inventions were the three most important variables in explaining profitability in the U.S. food manufacturing sector. Overall, the results presented in this study accord reasonably well with previous inter-industry studies on industry profitability, and the results support the model presented in equation (3).

6.   Conclusions

Most of the existing studies on vertical integration focus on transaction-cost issues or foreclosure issues and avoid an important question: How does vertical integration affect profitability? We empirically examine that question in this study using 43 U.S. food manufacturing industries. We computed a vertical ownership integration, or vertical merger index, that captures both intra-firm and inter-industry forward ownership integration linkages for each of the sample industries. In general, we found that although a lot of merger activities have been going on in this sector since the early 1980s, the level of forward vertical mergers that currently exists was very low (less than 4 percent). However, we acknowledged data limitations in our study and how it may have led to underestimation of the vertical merger index.

Our main objective was to examine the impact of vertical mergers on profitability. Our results show that increased vertical mergers in the U.S. food manufacturing industries would lead to a lowering of profits. This is perhaps due to the failure of vertical mergers (integration) to create differential advantages, such as cost savings, for the integrated firm. This finding may attract more attention from food industry executives than from the U.S. anti-trust authorities, who generally do not pay attention to vertical mergers unless foreclosure becomes an issue.

In addition, the results of this study accord reasonably well with previous inter-industry research on industry profitability. For example, this study shows that increased market concentration significantly increases profitability. A similar assessment was made regarding higher domestic demand and increased advertising intensity. Additionally, those industries that invest in research and development and have a more productive labor force would also increase their profit significantly. Results show that increasing capital intensity as a strategy to

increase profit would have the opposite effect on profitability. Contrary to popular belief, the argument that capital intensive industries create entry barriers leading to higher profits was not supported by the findings. Although import competition had a negative impact on the profitability of domestic firms, such an effect was statistically insignificant.

Although there was a lack of clear linkages between the theoretical model of industry profitability and vertical integration, we followed a more practical approach commonly suggested in the literature and were able to provide an improved measure of vertical integration. However, there is a need for theoretical work regarding the linkage between various types of vertical integration and profitability. The future research agenda should include improving the index of vertical integration. Finally, we acknowledge that data inconvenience imposed some limitations in this study, as it did on all previous studies of this kind. To rectify this continued data problem, we recommend expanding the scope of data collected by government agencies.

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Table 1. Profitability and the Degree of Vertical Integration in the U.S. Food Manufacturing Industries, 1992 (N=43)

SIC code	Industry Description	Profitability Index	Forward Vertical Integration Index (FVI_f)
2011	Meat packing plants	0.0885	0.0159
2013	Sausages and other prepared meats	0.1731	0.0413
2015	Poultry slaughtering and processing	0.1496	0.0487
2021	Creamery butter	0.1016	0.1126
2022	Cheese, natural and processed	0.1953	0.0119
2023	Dry, condensed, and evaporated dairy products	0.3878	0.0104
2024	Ice cream and frozen desserts	0.2901	0.0519
2026	Fluid milk	0.1875	0.0878
2032	Canned Specialty	0.4580	0.0131
2033	Canned fruits and Vegetables	0.3638	0.0273
2034	Dehydrated Fruits, vegetables and soups	0.4178	0.0566
2035	Pickles, sauces and salad dressing	0.5023	0.0095
2037	Frozen fruits and vegetables	0.2636	0.0193
2038	Frozen specialties, n.e.c.	0.3930	0.0207
2041	Flour and other grain mill products	0.1925	0.0015
2044	Rice milling	0.2068	0.0253
2045	Prepared flour mixes and doughs	0.3596	0.0048
2046	Wet corn milling	0.4084	0.0075
2047	Dog and cat food	0.4656	0.0192
2048	Prepared feeds, n.e.c.	0.1387	0.0423
2051	Bread, cake, and related products	0.4070	0.0341
2052	Cookies and crackers	0.4913	0.0055
2053	Frozen bakery products, except bread	0.3770	0.0238
2061	Raw cane sugar	0.2629	0.0310
2063	Beet sugar	0.2528	0.0954
2064	Candy and other confectionary products and industry	0.4379	0.0134
2067	Chewing gum	0.3701	0.0068
2066	Chocolate and cocoa products	0.1533	0.0228
2074	Cottonseed oil mills	0.2179	0.0238
2075	Soybean oil mills	0.0981	0.0633
2077	Animal and marine fats and oils	0.2867	0.0134
2079	Edible fats and oils, n.e.c.	0.2328	0.0500
2082	Malt beverages	0.4960	0.0158
2083	Malt	0.2267	0.0234
2084	Wines, brandy, and brandy spirits	0.3859	0.0227
2086	Bottled and canned soft drinks	0.2913	0.1138
2087	Flavoring extracts and syrups, n.e.c.	0.7128	0.0431
2091	Canned and cured fish and seafoods	0.2357	0.0425
2092	Fresh or frozen prepared fish	0.2232	0.0089
2095	Roasted coffee	0.4547	0.0777
2096	Potato chips and similar snacks	0.4204	0.0234
2098	Macaroni and spaghetti	0.4914	0.0133
2099	Food preparations, n.e.c.	0.3668	0.0259

Industry Average		**0.3171**	**0.0331**
Maximum		**0.7128**	**0.1138**
Minimum		**0.0885**	**0.0015**
Standard deviation		**0.1372**	**0.0284**

Table 2: Regression Results (N=43)

Dependent variable: *Profitability*

Variable Name	Expected sign	Estimated Coefficient	Beta coefficient
CONSTANT	–	-0.621** (0.322)	–
Vertical Mergers *(FVI)*	positive/ negative	-0.914** (0.412)	0.1892
Market concentration *(CR4)*	positive	0.001** (0.0007)	0.1307
Location dummy *(REG)*	positive	0.022 (0.023)	0.0745
Productivity index *(RP)*	positive	0.120* (0.086)	0.1336
Research & Development index *(RnD)*	positive/ negative	0.148*** (0.060)	0.1972
Advertising intensity *(ADVT)*	positive	1.586** (0.774)	0.2115
Capital intensity *(KINT)*	positive	-3.767** (1.833)	0.1894
Domestic demand *(DOMDEM)*	positive	0.921*** (0.333)	0.2692
Import competition *(IMPORT)*	negative	-0.509 (0.322)	0.0946
Squared corr. coef. between observed and predicted		0.548	

Note: (i) standard errors in parenthesis, (ii) beta coefficients are in absolute terms, (iii) model was corrected for heteroskedasticity, (iv) *** = 99% level of confidence, ** = 95% level of confidence, and * = 10% level of confidence.

Appendix table 1: Descriptive statistics of model variables						
Variable	N	Mean	St. Dev.	Variance	Minimum	Maximum
PCM	43	0.3171	0.1372	0.0188	0.0885	0.7128
FVI	43	0.0331	0.0284	0.0008	0.0015	0.1138
CR4	43	47.9530	17.9340	321.6200	19.0000	90.0000
REG	43	0.3023	0.4647	0.2160	0.0000	1.0000
RP	43	0.1992	0.1527	0.0233	0.0385	0.9086
RND	43	0.3143	0.1828	0.0334	0.0001	0.7283
ADVT	43	0.0258	0.0183	0.0003	0.0035	0.1076
KINT	43	0.0148	0.0069	0.0000	0.0045	0.0329
DOMDEM	43	0.9931	0.0401	0.0016	0.9096	1.0455
IMPORT	43	0.0463	0.0255	0.0007	0.0130	0.0835

Appendix table 2: Correlation matrix of model variables (N=43)										
PCM	1.0000									
FVI	-0.2684	1.0000								
CR4	0.3891	-0.0944	1.0000							
REG	-0.1064	-0.0598	-0.2097	1.0000						
RP	0.6037	0.0536	0.4755	-0.2766	1.0000					
RND	0.5600	-0.0432	0.3026	-0.2463	0.5418	1.0000				
ADVT	0.6203	-0.1183	0.3058	-0.2520	0.7263	0.4092	1.0000			
KINT	0.0794	0.1198	0.3490	-0.0407	0.0099	0.0088	-0.0608	1.0000		

	PCM	FVI	CR4	REG	RP	RND	ADVT	KINT	DOMDEM	IMPORT
DOMDEM	0.4031	0.1146	0.1333	-0.1426	0.1624	0.2344	0.3027	0.0699	1.0000	
IMPORT	0.1659	0.0669	0.2899	-0.0389	0.1000	0.0027	0.1559	0.2972	0.4135	1.0000