

Economic Analysis of the Changing Structure of the U.S. Flour Milling Industry

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ABSTRACT

This article presents a decomposed Poisson regression model based on count data that evaluates structural changes in size, number of plants in each size class, and the concentration level of market power in the U.S. flour milling industry, simultaneously. Empirical results indicate that the effects of a changing wage rate and corporate bond rate on both the size distribution and the number of flour mills are significant, but in opposite directions. Furthermore, a test for price leadership reveals that the U.S. flour milling industry has an oligopolistic market structure. [Econ-Lit citations: D430, L110, Q120] © 2001 John Wiley & Sons, Inc.

1. INTRODUCTION

The U.S. milling industry has experienced considerable structural change in location, size, number of plants in each size class, and in the concentration of market power during the last three decades. Between 1973 and 1990, the number of plants milling wheat-flour steadily declined to 208 from 279. Since then, the decrease in the number of mills has been sluggish, reaching 201 in 1998. During this same period, the number of the smallest size-class flour mills with daily capacity under 1,000 hundredweight (cwt) declined from 125 to 34, while the largest size-class flour mills with daily capacity over 10,000 cwt increased from 24 to 61. At the same time, wheat-flour production increased substantially from 255 million cwt to 404 million cwt.

U.S. flour mills were typically built near wheat-producing areas when costs of shipping flour did not differ from that of shipping wheat. Following railroad deregulation in the early 1980s, the advent of unit-train technology in wheat shipments lowered the cost of shipping wheat relative to the cost of shipping flour and mill feeds (Wilson, 1995). Since then, flour mills were more commonly built at or near metropolitan centers.

Another important change in the U.S. milling industry is the increased concentration of market power in geographically dispersed markets, seemingly shifting from monopolistic markets to oligopoly markets. In the early 1970s, the market share for family-owned mills

or those owned by local elevator companies accounted for more than 70%, while the remaining market was shared by vertically integrated food processors (such as Pillsbury, Nabisco, General Mills, and International Multi-Foods) and multi-unit flour millers (such as ConAgra, Cargill, Archer Daniels Midland [ADM]). By 1992, market share for the four largest multi-unit flour millers accounted for more than 70%, where Cargill dominates in California, ADM in the Midwest and Pacific Northwest, and ConAgra in the East (Wilson, 1995).

This increase in market concentration may indicate the occurrence of changes in market structure in the U.S. milling industry from perfect competition or monopolistic competition to oligopolistic competition. Both economies of scale in plant size and capital requirements would seem to have contributed to erecting barriers to entry (Wilson, 1995). Significantly increased market power in a geographically divided regional market, however, when accompanied by entry barriers, could enhance both prices and firm profits beyond that which would occur under a perfectly competitive market. Consequently, policymakers and regulatory agencies are concerned about the exercise of market power in geographically dispersed commodity markets (U.S. General Accounting Office, 1990).

Structural changes within the U.S. flour milling industry consist of a changing size distribution, a changing number of milling operations, and a changing level of market concentration. However, existing studies examining transition probabilities associated with a Markov process (Chan, 1981; Farris & Padberg, 1964; Garcia, Offutt, & Sonka, 1987) and a multinomial logit analysis (Adelaja, Nayga, & Farooq, 1999; Kim, Lin, & Leath, 1991) provide only information about a changing size distribution. Meanwhile, both a simple regression model (Farris & Padberg, 1964; Reining, 1989) and a conditional expected-value equation (Chan, 1981) have been used to estimate the changing number of firms within an industry. Using linear regression with count variables, however, would result in inefficient, inconsistent, and biased estimators. Since the size distribution, the changing number of flour mills in each size class, and the changing level of production concentration occur simultaneously, thereby defining the process of market structural changes within the U.S. flour milling industry, it would be more efficient to evaluate these structural characteristics simultaneously.

The objective of this paper is to evaluate the structural changes in the U.S. flour milling industry in response to changes in exogenous economic variables. To achieve this goal, Section 2 presents a decomposed Poisson regression model (PRM) for the U.S. flour milling industry which can be used to simultaneously evaluate the industry's size distribution, the changing number of mills in each size class, and the changing concentration level of market power. Furthermore, Section 2 demonstrates how the decomposed PRM can be used to test price leadership in oligopoly. In Section 3, the model is applied to the U.S. flour milling industry with data covering the time period 1973–1998. Concluding remarks are offered in Section 4.

2. A DECOMPOSED POISSON REGRESSION MODEL FOR STRUCTURAL CHANGE

Daily milling capacity varies widely, ranging from less than 200 cwt to more than 10,000 cwt. However, the U.S. milling industry grouped mills into only two size groups: the first group consists of mills with daily milling capacity greater than or equal to 10,000 cwt, and the second group includes mills with a daily milling capacity less than 10,000 cwt

TABLE 1. Size Class Statistics for U.S. Wheat-Flour Milling, 1973–98

	Size classes for flour milling ^a (daily active milling capacity [cwt])			
	S ₁	S ₂	S ₃	S ₄
Mean (cwt)	300	2,665	6,717	14,643
Standard deviation	21	112	379	660
Coefficient of variation	0.0704	0.0421	0.0564	0.0451

^aSize classes: $0 \leq S_1 < 1,000$ cwt, $1,000$ cwt $\leq S_2 < 5,000$ cwt, $5,000$ cwt $\leq S_3 < 10,000$ cwt, and $S_4 \geq 10,000$ cwt.

(Milling & Baking News, 2000). Since a significant number of mills have a daily milling capacity less than 10,000 cwt, we regrouped the U.S. wheat-flour milling industry into four size classes based on the size of daily active milling capacity. The four mill size classes include $0 \leq S_1 < 1,000$ cwt; $1,000$ cwt $\leq S_2 < 5,000$ cwt; $5,000$ cwt $\leq S_3 < 10,000$ cwt; and $S_4 \geq 10,000$ cwt. The estimated coefficients of variation presented in Table 1 support the conclusion that while structural changes likely occur among the different size classes, no evidence exists of intrastructural changes within each size class.

Several different forces contribute to structural changes occurring in the U.S. milling industry. Increased demand for grain products in high-fiber diets by health-conscious consumers, economies of scale, and technological changes in wheat-flour milling create economic forces that lead to consolidation into larger milling plants. Changes in the hourly wages of production workers in the milling industry and changes in corporate bond rates send market signals that lead to changing milling technology and to changes in economies of scale. Per capita wheat-flour consumption has been steadily increasing from a record low 110 pounds in 1972 to nearly 150 pounds in 1997 (Vocke, 2000). Wheat-flour prices and the popularity of high-fiber diets likely play an important role in explaining the increased consumer demand for wheat-flour. For example, the United States Department of Agriculture's Food Guide Pyramid lists the Bread, Cereal, Rice, and Pasta Group as its basic group, from which it recommends 6–11 servings per day. Meanwhile, the time variable provides a reasonable proxy to explain technological changes in the U.S. milling industry. Therefore, from among many other variables, we model structural changes in the U.S. milling industry using three explanatory variables: the hourly wages of production workers in the milling industry and the corporate bond rates (both normalized with the unit price of wheat-flour), and the ratio of the per capita wheat-flour consumption to the time variable, to explain the effects of both the increasing consumer demand for wheat-flour and technological changes. Using the ratio of per capita wheat-flour consumption to time has the added effect of avoiding potential multicollinearity problems between these two highly correlated explanatory variables.

The PRM is one of a few models that deal with characteristics of count variables. To model structural changes in the U.S. milling industry, first let $N_{ij}(k)$ be the i th observation of the j th size class for flour mills owned by the k th group (such as the four dominant milling firms as a group, and the remaining mills grouped separately). Then, let $D_i(l)$ be a dummy variable associated with the l th size class, and $D_i(h)$ be a dummy variable associated with the h th ownership group. A decomposed PRM that reflects both structural

changes in the size-class distribution and the total number of flour mills of the j th size class owned by the k th ownership group is then represented as:

$$\begin{aligned} \mu_{ij}(k) &= E[N_{ij}(k)|(w_i/p_i), (r_i/p_i)] \\ &= \exp \left[\alpha_0 + \sum_{\ell=1}^m \beta(\ell) D_i(\ell)(w_i/p_i) + \sum_{\ell=1}^m \gamma(\ell) D_i(\ell)(r_i/p_i) + \sum_{\ell=1}^{m-1} \delta(\ell) D_i(\ell) \right. \\ &\quad \left. + \zeta(C/T) + \sum_{h=1}^{n-1} \theta(h) D_i(h) \right], \quad j = 1, 2, \dots, m; k = 1, 2, \dots, n \end{aligned} \quad (1)$$

where $\alpha, \beta, \gamma, \delta, \zeta,$ and θ are parameters, w represents the hourly wage of production workers in the flour mill industry (\$/hr), r represents corporate bond rates, p represents a unit price of wheat-flour (\$/cwt), C represents per capita wheat-flour consumption (lbs), T is the time variable representing technological changes, while

$$D_i(\ell) = \begin{cases} 1 & \text{if } \ell = j \\ 0 & \text{otherwise, and} \end{cases}$$

$$D_i(h) = \begin{cases} 1 & \text{if } h = k \\ 0 & \text{otherwise.} \end{cases}$$

It is recognized that the PRM has a very restrictive theoretical characteristic, that is, its conditional mean should equal its conditional variance. However, researchers can often encounter an overdispersion problem, with some count variables having a variance greater than the mean, which leads to inefficient estimators. Correcting for this overdispersion problem leads to the use of the decomposed negative binomial regression model (NBRM) by replacing the mean $\mu_{ij}(k)$ in equation (1) with the random variable $\tilde{u}_{ij}(k)$, such that:

$$\begin{aligned} \tilde{u}_{ij}(k) &= \exp \left[a_0 + \sum_{\ell=1}^m b(\ell) D_i(\ell)(w_i/p_i) + \sum_{\ell=1}^m c(\ell) D_i(\ell)(r_i/p_i) + \sum_{\ell=1}^{m-1} d(\ell) D_i(\ell) \right. \\ &\quad \left. + e(C/T) + \sum_{h=1}^{n-1} f(h) D_i(h) + \epsilon_{ij}(k) \right], \\ &\quad j = 1, 2, \dots, m; k = 1, 2, \dots, n \end{aligned} \quad (2)$$

where $a, b, c, d, e,$ and f are parameters, ϵ is a disturbance term, and all other variables are the same as presented in equation (1).

The NBRM allows for the conditional variance to exceed the conditional mean. However, the NBRM has its own problem in application. Its Hessian matrix is more complex, and therefore, use of a SAS procedure: PROC GENMOD to estimate a NBRM often results in a non-negative definite Hessian matrix. Hellerstein (1995) proposed the use of a Quasi-Newton algorithm, which is a member of a family of variable metric algorithms (Avriel, 1976). The Quasi-Newton algorithm is also complex. Since we are only interested in the expected value of the count variable, rather than the distribution of the count

variable—and the estimates from the PRM are unbiased and consistent—even though inefficient (Gourieroux, Monfort, and Trognon, 1984; Long, 1997), we use the decomposed PRM from equation (1) for economic analysis.

Given the joint relationship between size class, number of flour mills, and concentration of market power, as wage rates increase, milling firms would achieve greater economic efficiency through consolidation and elimination of duplicate operations by shifting from labor-intensive to capital-intensive production processes. Since larger mills are considered to have a more capital-intensive operation than smaller mills, the number of larger-size mills would increase, while the number of smaller-size mills would decline as wage rates increase. Therefore, the parameter $\beta(l)$ associated with smaller-size mills is expected to be negative, while it is likely to be positive for larger-size mills. Similarly, rising corporate bond rates would increase capital costs, so that milling firms would shift to a labor-intensive production process from a capital-intensive production process. Since smaller mills are generally considered to involve more labor-intensive operations than larger mills, the parameter $\gamma(l)$ is expected to be positive for smaller-size mills, while it would be negative for larger-size mills.

Wage rate, corporate bond rate, and wheat-flour price elasticities for the number of mills in each size class are represented in equations (3) through (5), respectively.

$$\eta_{(w)j} = [\partial N_j / \partial w][w / N_j] = \beta(j)[w/p] \cong 0, \quad j = 1, 2, \dots, m \tag{3}$$

$$\eta_{(r)j} = [\partial N_j / \partial r][r / N_j] = \gamma(j)[r/p] \cong 0, \quad j = 1, 2, \dots, m \tag{4}$$

$$\eta_{(p)j} = [\partial N_j / \partial p][p / N_j] = -[\beta(j)(w/p) + \gamma(j)(r/p)] \cong 0, \quad j = 1, 2, \dots, m. \tag{5}$$

Since the parameters associated with the normalized wage rate and corporate bond rate vary across the size of plants, the wage rate and corporate bond rate elasticities presented in equations (3) and (4) would also vary across the size of plants. The elasticity of wage rate would be negative for the smaller-size mills, while it would be positive for large-size mills. Similarly, the elasticity of corporate bond rate would be positive for small-size mills, while it would be negative for large-sized mills. For equation (5), the flour price elasticity for the number of mills equals a negative sum of wage and corporate bond rate elasticities.

The wheat-flour price elasticity of the number of mills also has an important role in explaining market structure. When geographically divided regional markets are dominated by one or a few large firms, the common assumption is that the dominant firm sets its output price to maximize its profits while allowing minor firms to sell all they can at that price. The dominant firm will set its output price along its consumer demand curve where its marginal cost equals its marginal revenue. Meanwhile, minor firms will behave as perfectly competitive firms by first regarding the demand curve for their output as a horizontal line at the prevailing market price set by the dominant firm, and then selling that amount at which their marginal cost equals the market price (Ferguson & Gould, 1975). That is, if the U.S. milling industry is characterized by price leadership in oligopoly, wheat-flour prices for the dominant firm would be observed along its consumer demand curve, while for minor firms, wheat-flour prices would be observed along the firms' marginal cost curves. Therefore, it is hypothesized that the flour price elasticity of the

number of mills for the dominant firm(s) would be negative and those for the minor firms would be positive.

To test for price leadership in oligopoly with the decomposed PRM, let the total daily milling capacity in each ownership group be represented by $A_j N_j(k)$, where A_j represents the average daily milling capacity of the j th-size mills. Since the coefficient of variation associated with the average daily milling capacity is very small for each mill size class (Table 1), it is assumed that the changes in the total daily milling capacity result exclusively from the changes in the number of mills in each size class. Differentiating the total daily milling capacity in each ownership group, $A_j N_j(k)$, with respect to the wheat-flour price variable results in the following:

$$\begin{aligned} [\partial(A_j N_j(k))/\partial p] &= -[A_j N_j(k)/p][\beta(j)(w/p) + \gamma(j)(r/p)] \\ &= [A_j N_j(k)/p]\eta_{(p)j} \cong 0, \quad j = 1, 2, \dots, m; k = 1, 2, \dots, n. \end{aligned} \quad (6)$$

Consequently, when the wheat-flour price elasticity of the number of mills for the dominant firm(s) is negative while those for the minor firms are positive, the U.S. flour milling industry would be characterized by price leadership in oligopoly.

3. ECONOMIC SIMULATION RESULTS

To estimate the parameters of the decomposed PRM presented in equation (1), the hourly wages of production workers in the flour mill industry were obtained from the Bureau of Labor Statistics, U.S. Department of Labor (1999). Wheat-flour price and per capita wheat-flour consumption data were obtained from *Wheat: Situation and Outlook Yearbook*, U.S. Department of Agriculture (1999). Corporate bond rates were obtained from the Economic Research Service, U.S. Department of Agriculture, and daily milling capacity data for flour mills were obtained from the industry source *Milling Directory: Buyer's Guide* (1973–1999). Since the information on ownership for each flour mill is not available at this time, $k = 1$ is assumed for each mill in equation (1). Research and development of wheat-flour milling machinery and techniques seemingly advanced more during the 1970s and 1980s than during the 1990s (Posner & Hibbs, 1997). Therefore, the time variable T is assigned as $T = 1$ for 1973, $T = 2$ for 1974, etc., rather than as $T = 73$ for 1973, $T = 74$ for 1974, etc.

The decomposed PRM in equation (1) is estimated using SAS GENMOD. Parameter estimates are presented in Table 2. The sign of all estimators is consistent with a priori expectations. The effects of explanatory variables on the number of mills for size class S_1 ($0 \leq S_1 < 1,000$ cwt) are almost as significant as the effects of the explanatory variables for size class S_4 ($S_4 > 10,000$ cwt), but in the opposite direction. These results may indicate that wheat-flour mills of size class S_1 involve more labor-intensive operations, while mills of size class S_4 involve more capital-intensive operations. Parameters associated with the mills of size class S_3 ($5,000$ cwt $\leq S_3 < 10,000$ cwt) are statistically insignificant. Since the number of mills of the size class S_3 has increased from 52 to 54 with minor fluctuations during the period of 1973 to 1998, it is not surprising that the parameters associated with the size class S_3 are statistically insignificant. The estimated parameter associated with the variable C/T is statistically insignificant. We tried several specifications for T . For all of the specifications, the estimated parameter was statistically insignificant and all other estimated parameters are basically unchanged.

TABLE 2. Parameter Estimates for a Decomposed Poisson Regression Model of the Number of Mills by Size Class for the U.S. Wheat-Flour Milling Industry

α (constant)	3.4541 (17.5424) ^a
Normalized wage variable (w/p)	
$\beta(1)$	-1.1969 (-11.5419)
$\beta(2)$	-0.2737 (-2.4725)
$\beta(3)$	-0.0622 (-0.5276)
$\beta(4)$	0.7242 (5.2669)
Normalized corporate bond rate (r/p)	
$\gamma(1)$	96.8746 (9.5502)
$\gamma(2)$	26.0905 (2.4200)
$\gamma(3)$	-9.2255 (-0.8046)
$\gamma(4)$	-48.6721 (-3.7448)
Per capita consumption/time (C/T)	0.0005 (0.7143)
Dummy variables	
$\delta(1)$	1.0043 (4.2919)
$\delta(2)$	0.6674 (2.7352)
$\delta(3)$	0.6703 (2.6705)
Log likelihood	18,932.1

^aEstimated z-values are in parentheses.

The estimated elasticities of wage rate, corporate bond rate, and wheat-flour price for the number of mills in each size class are presented in Table 3. The wheat-flour price elasticity for the size class S_4 is negative, and those for the size classes S_1 through S_3 are positive (even though the parameters associated with the size class S_3 are statistically insignificant). Since market share for the four largest multi-unit flour firms, each with a daily capacity greater than 10,000 cwt, accounted for more than 70% of total industry capacity, the negative wheat-flour price elasticity for the size class S_4 and the positive wheat-flour price elasticities for all other size classes may indicate that price leadership in oligopoly characterizes the U.S. flour milling industry.

During the period of 1973 to 1998, the wage rate and corporate bond rate have declined by 13% and 76%, respectively, while the total number of flour mills has declined by 78 mills. Using the estimated decomposed PRM in Table 2, we evaluate how the size distribution and number of mills change in response to increased costs defined by the following three economic scenarios. Scenario I simply assumes that the milling industry's wage

TABLE 3. Wage Rate, Corporate Bond Rate, and Wheat-Flour Price Elasticities for the Number of Flour Mills for Each Size Class (Measured at Mean Values)

Size class	η_w	η_r	η_p
S ₁	-1.1639	0.9712	0.1927
S ₂	-0.2662	0.2616	0.0046
S ₃	-0.0605	-0.0925	0.1530
S ₄	0.7042	-0.4880	-0.2162

rate for production workers increases by 20% from the 1998 level, and that all other variables remain unchanged. Scenario II assumes that the corporate bond rate increases by 20% and all other variables remain unchanged. Finally, Scenario III assumes that both the wage rate and corporate bond rate increase by 20% and all other variables remain unchanged. Estimated elasticities presented in Table 3 and the observed number of mills for each size class during 1998 are used for the economic simulation analysis. Results are presented in Table 4.

Results for Scenario I indicate that the number of flour mills for the smallest size class, S₁, declines as the wage rate rises, while those for the largest size class, S₄, would increase and the total number of flour mills would decline by three mills. Smaller firms merge or go out of business, and larger firms would consolidate and eliminate duplication

TABLE 4. Estimated Number of Flour Mills Under Three Different Economic Scenarios

Size	N(j) (1998)	$\Delta N(j)$ due to Δw	$\Delta N(j)$ due to Δr	Subtotal	Estimated N(j)
Scenario I ^a					
S ₁	34	-8		-8	26
S ₂	52	-3		-3	49
S ₃	54	-1		-1	53
S ₄	61	9		9	70
Total	201	-3		-3	198
Scenario II ^b					
S ₁	34		7	7	41
S ₂	52		3	3	55
S ₃	54		-1	-1	53
S ₄	61		-6	-6	55
Total	201		3	3	204
Scenario III ^c					
S ₁	34	-8	7	-1	33
S ₂	52	-3	3	0	52
S ₃	54	-1	-1	-2	52
S ₄	61	9	-6	3	64
Total	201	-3	3	0	201

^aScenario I assumes that wages increased by 20% and all other variables remain unchanged.

^bScenario II assumes that corporate bond rate increase by 20% and all other variables remains unchanged.

^cScenario III assumes that both the wage rate and corporate bond rate increased by 20% and all other variables remain unchanged.

of operations to reduce production costs. Therefore, even though the total number of flour mills would decline in response to an increase in the wage rate, the total wheat-flour milling capacity would still increase.

Scenario II assumes that corporate bond rate rises by 20%, while all other variables remain unchanged. As the corporate bond rate rises, firms would switch from capital-intensive to more labor-intensive operations. Consequently, the number of mills for the largest size class, S_4 , would decline, while those for the smaller size classes would increase. Therefore, even though the total number of flour mills would be expected to increase, the total wheat-flour milling capacity would decline.

Finally, Scenario III assumes that both the wage rate and corporate bond rate increase by 20%, while all other variables remain unchanged. The declining number of large mills due to a rising corporate bond rate would be offset by the increasing number of larger mills due to a rising wage rate. Similarly, the increasing number of mills for smaller size mills due to a rising corporate bond rate would be offset by the declining number of smaller mills due to a rising wage rate. As a result of these offsetting effects on the number of mills for each size class, the total effect of both a rising wage and corporate bond rate on the total number of flour mills is minimal. It should be noted, however, that even though the total number of flour mills remains unchanged, the number of larger-size mills would increase and the number of smaller-size mills would decline in response to both an increasing wage rate and corporate bond rate, so that the total wheat-flour milling capacity would increase.

The practical implication of these results tells us that the full impact on structural changes within the U.S. milling industry needs to account for the decomposed effects of changing economic variables. Given that both changing size distribution and the resulting change in number of flour mills in each size class occur simultaneously, evaluating either the size distribution or the changing number of flour mills in each size class, separately, more than likely would lead to misleading results. Furthermore, each economic variable affects flour mills differently for each size class, often in opposite directions, meaning that effective structural change analysis is best addressed by decomposing the effects of market parameter changes to isolate the full structural change effect. In addition, the results show that an increase in costs does not necessarily significantly reduce the number of flour mills in total, or by size class. Different cost increases occurring simultaneously may be offsetting in their impact on the structure of the U.S. milling industry.

4. CONCLUSIONS

First, this article presents a decomposed PRM based on count data to evaluate the size distribution, the number of U.S. flour mills for each of four milling-plant size classes, and the concentration level of market power in the U.S. flour milling industry. In addition, this article addresses how to use the decomposed PRM to test for price leadership in oligopoly, and uses simulation analysis to evaluate the effects of changing economic forces on the size distribution as well as the number of flour mills for each size class.

Empirical results indicate that both the wage rate and corporate bond rate explain the changing structure of the U.S. milling industry very well. The wage rate and corporate bond rate elasticities of the number of mills in each size class vary across the size of plant, but generally in opposite directions. The wage rate elasticity of the number of mills changes to positive from negative as the size of plant increases. However, the corporate bond rate elasticity changes to negative from positive as the size of plant increases.

Simulation analyses exhibit that an increase in wage rate leads to a reduction in the total number of flour mills, but increases the total daily milling capacity (Simulation I). Meanwhile, an increase in corporate bond rate leads to an increase in the total number of flour mills, but reduces the total daily milling capacity (Simulation II). Furthermore, simulation analyses also exhibit that the full effect of both a rising wage rate and corporate bond rate on the total number of flour mills is insignificant due to the offsetting effects of these economic factors on the number of mills for each size class (Simulation III). The declining number of larger mills resulting from a rising corporate bond rate would be offset by the increasing number of larger mills due to a rising wage rate. Similarly, the declining number of smaller mills due to a rising wage rate would be offset by the increasing number of smaller mills resulting from a rising corporate bond rate. As a result of these offsetting effects on the number of mills for each size class, change in the total number of flour mills is insignificant, but it increases the total daily milling capacity, even when the wage rate and corporate bond rate rise. The implication of simulation results is that the full impact on structural change within the U.S. flour milling industry needs to account for the decomposed effects of the changing economic variables.

Finally, since market share for the four largest multi-unit flour firms, each with a daily capacity greater than 10,000 cwt, accounted for more than 70% of total industry capacity, the decomposed PRM is used to test price leadership in oligopoly. The negative wheat-flour price elasticity for the largest size class, S_4 , and the positive wheat-flour price elasticities for all other smaller size classes, may indicate that price leadership in oligopoly characterizes the U.S. flour milling industry.

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