The Changing Structure of the U.S. Flour Milling Industry

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Abstract *What causes the structural changes, in terms of number and size of flour mills, in the U S flour milling industry, and will the U S wheat flour supply be adequate in the year 2000? Simulation results indicate that rising disposable income and declining wheat prices are the primary reasons for changes in the size distribution of larger flour mills, while automation in production and higher disposable income are important factors for smaller mills This study also projects that domestic wheat flour supply will be sufficient to meet increasing domestic demand by the year 2000, even though the number of U S wheat flour mills is projected to decline to 160 from the current 203*

Keywords *Markov chains multinomial logit analysis, flour mills, hazard function, year 2000*

The U S milling industry has experienced considerable structural change during the past two decades Between 1973 and 1987, the number of plants milling hard-, soft-, and whole-wheat flour steadily declined to 211 from 279 The number of mills with daily capacity under 1,000 hundredweight (cwt) declined from 125 to 63 during the same period, while flour mills with daily capacity over 10,000 cwt increased from 24 to 42 At the same time, wheat flour production increased substantially from 255 million cwt to a record high 338 million cwt

U S flour mills were typically built near wheat-producing areas prior to the 1950's when costs of shipping flour did not differ from that of shipping wheat Since then, flour mills were more commonly built at metropolitan centers as the cost of shipping flour exceeded that of shipping wheat Most companies built flour mills near population centers in the 1980's

What are the causes of structural changes in the U S milling industry? Economists often have hypothesized that a major cause for expansion in size is to achieve economic efficiency in input use (*1, 9, 21*) [1] Under this assumption, expansion of size economies continues as long as additional investment reduces longrun average costs, indicating increasing returns to size Others argue that expansion of size economies results from external pressures, such as changes in consumer behavior, wages, and disposable income (*2*) Under this assumption, the longrun average cost curve is L-shaped, meaning that efficiency is constant over a broad range of output, and therefore, small mills compete effectively with larger mills Consequently, the industry is not characterized by a concentration of larger mills at any particular output level Some economists believe that domestic farm policies have significant impact on expansion of size economies (*6*), since these policies influence structural change in the U S milling industry

Government subsidies to wheat producers include input subsidies, export subsidies, and price and income support policies associated with acreage reduction and/or conservation programs Since members of the General Agreement on Tariffs and Trade (GATT) are currently negotiating for trade liberalization, the potential effects on domestic wheat flour supply should be examined

This article investigates the causes of structural changes in terms of number and size of flour mills in the U S flour milling industry Assumptions associated with stationary and nonstationary transition probabilities are tested by employing the Markov process and a multinomial logit model We also assess the effects on structural changes within the milling industry due to technology changes, increases in domestic consumption due to changes in consumer taste and rise in disposable income, and domestic grain policies Finally, we project the number of mills for each size category and wheat flour supply to the year 2000 under various scenarios, including trade liberalization in the world wheat market

A Markov Chain Analysis

The Markov chain model associated with stationary transition probabilities has been widely used to evaluate changes in the size distribution of firms (*1, 8, 14, 15, 24*) This model assumes that the observed movement of firms among specific size classes over specific time periods will continue until the industry reaches an equilibrium size distribution of firms Therefore, expansion of size economies will continue as long as the additional investment will reduce longrun average cost, which coincides with increasing returns to size (*4, 16*)

To estimate meaningful transition probabilities, the maximum likelihood method can be used when time-ordered data that reflect intertemporal changes of firms over size categories are available In some cases, however, when time-ordered movements of individual firms among size categories are not available, transition probabilities can be estimated with the probability-constrained quadratic programming (QP)

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[1]Italicized numbers in parentheses cite sources listed in the References section at the end of this article

model, the probability-constrained minimum absolute deviation (MAD) model (*15*), or the probability-constrained minimization of median absolute deviation (MOMAD) model (*13*) Since the probability-constrained MOMAD model is considered to be superior to the probability-constrained QP model in estimating transition probabilities with limited aggregate time series data, and easier to use than the probability-constrained MAD model, the probability-constrained MOMAD model is used in this article

Flour mills are grouped into four size classes based on the size of daily active capacity in hundredweight Intervals used to define the four classes consist of $0 \leq S_1 < 1{,}000$, $1{,}000 \leq S_2 < 5{,}000$, $5{,}000 \leq S_3 < 10{,}000$, and $S_4 \geq 10{,}000$ Under this selection of size classification, the exit of flour milling is treated in a manner analogous to the merging of independent operations (*1*) Indeed, within the past two decades, the ownership of most flour milling companies has changed mainly through acquisitions (*9*)

The transition matrix for the U S flour milling industry is estimated with data covering 1973-87 Proportion data for each size class are obtained from the *Milling Directory Buyer's Guide* (*20*) The results obtained are

$$M = \begin{array}{c} \\ \end{array}\begin{array}{ccccc} & S_1 & S_2 & S_3 & S_4 \end{array}$$

$$M = \left[\begin{array}{ccccc} S_1 & 9767 & 0099 & 0134 & 0000 \\ S_2 & 0 & 8113 & 1590 & 0297 \\ S_3 & 0 & 2011 & 7905 & 0084 \\ S_4 & 0 & 0274 & 0 & 9726 \end{array}\right] \qquad (1)$$

The estimated transition matrix (1) provides some useful information about the dynamic nature of size economies The probabilities on the diagonal in matrix 1 indicate that most flour mills in size classes S_1 and S_4 are likely to remain at the same size from one period to another However, approximately 20 percent of flour mills in class S_2 will likely increase daily capacity, while 20 percent of flour mills in class S_3 will likely decrease their daily capacity

To project the proportions of mill sizes in year t, let W(0) be the initial row vector of proportions and W(t) be the proportion vector at time t The conditional expectation of W(t) is given by

$$W(t) = W(t-1)*M = W(0)*M^t, \qquad (2)$$

where M is the transition matrix Equation 2 is used to project the proportions for mill sizes to year 2000 Table 1 indicates that the proportion for the size class S_1 will decline from 0 25 to 0 19, and the proportion for the size S_4 will increase from 0 22 to 0 26, while the proportions for the sizes S_2 and S_3 will remain unchanged Since the number of mills is expected to decline even more in the near future, this increase in proportion for the size S_4 may not generate enough supply of wheat flour to meet demand

A Multinomial Logit Analysis

One of the most demanding assumptions of the Markov chain model is that once the process of structural change has been established, the same process of change will continue until it reaches an equilibrium size distribution of firms This stationary assumption of transition probabilities may not be attainable in some cases The expansion of size economies may result from changes in exogenous variables, such as technology, wages, and consumer taste Indeed, growing health concerns have contributed to the increase in per-capita wheat flour consumption by 13 percent during the period 1973-87, while population has grown by more than 15 percent (*9*) Even though real wages in the U S milling industry have been stable, total production worker hours have declined by 25 percent during the study period More surprising, even though there have been structural changes among different size classes, no strong evidence exists of intrastructural changes in each size class (table 2) These exogenous changes may suggest that transition probabilities are nonstationary In this section, the multinomial logit model developed by Parks (*22*) is modified and then applied to estimate selection probabilities of size categories

Following McFadden (*17*), and Domencich and McFadden (*7*), the selection probability of the ith size category can be written as

$$P_i = \exp(D_i) \;/\; \sum_{j=1}^{m} \exp(D_j), \quad i = 1,2, \qquad ,m, \qquad (3)$$

Table 1—Projected proportions of mill sizes with a Markov process

	Mill size			
Year	S_1	S_2	S_3	S_4
1990	0 2454	0 2900	0 2473	0 2173
1991	2396	2934	2449	2221
1992	2340	2958	2434	2268
1993	2286	2974	2426	2314
1994	2233	2987	2421	2359
1995	2181	2997	2419	2403
1996	2130	3005	2418	2447
1997	2080	3013	2418	2447
1998	2032	3019	2418	2531
1999	1984	3025	2419	2572
2000	1938	3031	2420	2611

Table 2—Daily active average milling capacity of a flour mill (1977-89)

	Mill size			
Variable	Size 1	Size 2	Size 3	Size 4
Mean (cwt)	997 15	2,604 35	6,734 53	14,376 31
Standard deviation	23 62	66 38	118 66	247 64
Variation of coefficient	0237	0255	0176	0172

where D_j is the estimated utility function U_j such that $U_j = D_j + \epsilon_j$, and all ϵ_j are independently and identically distributed with a Weibull distribution. The normalized multinomial logit model is written as

$$P_i = \exp(d_i) \;/\; [1 + \sum_{j=2}^{m} \exp(d_j)], \quad i = 2,3, \ldots, m, \qquad (4)$$

$$P_1 = [1 + \sum_{j=2}^{m} \exp(d_j)]^{1},$$

where $P_i/P_1 = \exp(D_i - D_1) = \exp(d_i)$.

The natural logarithm of the odds of choosing the ith size mill over the size class 1 in year t is written as

$$\ln (P_{it}/P_{1t}) = b_{i0} + b_{i1} X_{1t} + b_{i2} X_{2t} + \ldots + b_{ik} X_{kt} + v_{it} \qquad (5)$$

$$i = 2,3, \ldots, m, \; t = 1,2, \ldots, T$$

Since the selection probabilities P_{it} are unknown and are replaced by the observed relative frequencies p_{it}, Parks introduced an additional error term u_{it} such that equation 5 is now expressed as

$$\ln (p_{it}/p_{1t}) = b_{i0} + b_{i1} X_{1t} + \ldots + b_{ik} X_{kt} + v_{it} + u_{it}, \qquad (6)$$

$$i = 2,3, \ldots, m, \; t = 1,2, \ldots, T,$$

where $E(v_{it}) = 0$, $E(u_{it}) = 0$,

$E(v_{it},v_{jt}) = \sigma_{ij}$ for all i and j

$= 0$ otherwise, and

$E(u_{it},u_{jt}) = \Omega$

$$= 1/n_t \begin{bmatrix} 1/P_{1t}+1/P_{2t} & 1/P_{1t} & \cdots & 1/P_{1t} \\ 1/P_{1t} & 1/P_{1t}+1/P_{3t} & \cdots & 1/P_{1t} \\ \vdots & & \ddots & \vdots \\ 1/P_{1t} & 1/P_{1t} & \cdots & 1/P_{1t}+1/P_{mt} \end{bmatrix}$$

Zellner and Lee showed that the joint estimation procedure produces more efficient estimators than do single-equation techniques (*27*). The joint multinomial logit equations associated with equation 6 can be written in compact notation as

$$Y = X\beta + e, \qquad (7)$$

where Y is an (mx1)T vector, β is an (mxk)x1 vector such that $\beta = (\beta_1', \beta_2', \ldots, \beta_m')'$, $e_t = v_t + u_t$, $X = (X_1', X_2', \ldots, X_T')'$, where

$$X_t = \begin{bmatrix} X_{1t} & & & \\ & X_{2t} & & \\ & & \ddots & \\ & & & X_{mt} \end{bmatrix},$$

and x_{it} is a (lxk) vector of explanatory variables.

The Parks-modified multinomial logit (MML) estimator is given by $b_{MML} = (X'V^{-1}X)^{-1} X'V^{-1}Y$, and the coefficient covariance matrix is estimated by $(X'V^{-1}X)$, where V is a block diagonal matrix with $(\Omega_t + \Sigma)$ in the tth block, $t = 1,2, \ldots, T$, and $\Sigma = \frac{1}{T}[S - \lambda \sum_{t=1}^{T} \Omega_t]$, where S is a covariance matrix obtained from applying ordinary least squares to equation system 5. To explore explanatory variables in estimation of the selection probabilities, the price input-output model is given by (*19*)

$$P(i)^*D(i) = \sum_{j}^{n} w_{ij} + Y_i \quad \text{for } i = 1, 2, \ldots, n, \qquad (8)$$

where D(i) is total production for sector i, P(i) is price per unit of D(i), w_{ij} is dollar value of inputs bought by the jth production sector, and Y_i is the dollar value of final demand for sector i output. Equation 8 can be rewritten as equation 9 by dividing both sides of equation 8 by P(i).

$$D(i) = \sum_{j}^{n} w_{ij}/P(i) + Y_i/P(i), \quad \text{for } i = 1, 2, \ldots, n \qquad (9)$$

Equation 9 implies that total production of each sector can be explained with variables such as the ratio of input value to output price and the ratio of disposable income to output price. By inserting equation 9 into equation 3, the estimated model therefore includes independent variables for W*H/P and Y*N/P, where W is the hourly wage of production workers, H is total worker hours in millions of production workers, Y is disposable per capita income, N is population in millions, and P is the price of wheat flour per 100 pounds. Data for W and H are obtained from the *Census of Manufactures*, P is from (*9*), and Y and N are from the *Statistical Abstract of the United States*.

Table 3 shows the results of applying Parks's modified multinomial logit model. The coefficients of the estimated multinomial logit equation are not readily interpretable because the dependent variables are choice probabilities. Results show that the production workers' wage variable is statistically insignificant for the selection probability P_3 for size class S_3, while all other variables are very significant for all selection probabilities. The value of R^2 is 0.96, indicating that the structural changes of the U.S. milling industry

Table 3—Estimates of the log odds of sizes S_2, S_3, and S_4 relative to S_1

Item	Dependent variable	Explanatory variables[1]		
		Constant	W*H/P	Y*N/P
b_{MML}	$\ln(P_2/P_1)$	−0 37804	−0 04371	0 00430
		(13284)	(01299)	(00076)
	$\ln(P_3/P_1)$	− 84638	− 02076	00316
		(14536)	(01413)	(00083)
	$\ln(P_4/P_1)$	−1 62791	− 04508	00695
		(18846)	(01763)	(00099)

R^2 = 96

$$S = \begin{bmatrix} 002070 & -000923 & 000711 \\ -000923 & 004031 & 003165 \\ 000711 & 003165 & 011623 \end{bmatrix} \quad \hat{\Sigma} = \begin{bmatrix} 001010 & -001357 & 000277 \\ -001357 & 002807 & 002731 \\ 000277 & 002731 & 009975 \end{bmatrix}$$

λ = 016586

[1]Estimated standard errors are in parentheses

may be properly explained by variables W*H/P and Y*N/P However, the reliability of estimates obtained from the Markov chain process should be compared with a multinomial logit analysis to project the size distribution of the U S milling industry

Simulation with Historical Data

Simulation with historical data is a simple way of verifying the reliability of estimated selection probabilities We combined Theil's U-coefficient with historical data to investigate the effectiveness and accuracy of the selection probabilities estimated with the Markov chain process and the multinomial logit analysis (*3*, *26*) The U-coefficient is given by

$$U = \{\Sigma(P_i - A_i)^2/N\}^{1/2}/\{[\Sigma(A_i)^2/N]^{1/2} + [\Sigma(P_i)^2/N]^{1/2}\}, \quad (10)$$

where P_i is a simulated value, A_i is an actual value, and N is the number of observations Theil's U-coefficient lies between zero and 1 If the U-coefficient is equal to zero, the simulated results are perfect, and if U equals 1, there is no relationship between the simulated and the actual values (*3*) Table 4 shows the U-coefficients for the selection probabilities Results indicate that both models perform reasonably well, but the multinomial logit model displays better predictive efficiency than the Markov process model Therefore, the modified multinomial logit model is the logical choice to investigate how explanatory variables affect the selection probabilities

Table 4—Theil's U-coefficients for selection probabilities

Item	Selection probabilities			
	P_1	P_2	P_3	P_4
Markov model	0 03984	0 02221	0 02594	0 03854
Multinomial logit model	01247	02051	02617	04447

The estimated multinomial logit equations in table 3 can be presented as follows

$$\ln(P_i/P_1) = a_i + b_i{*}(W{*}H/P) + c_i{*}(Y{*}N/P),$$
$$\text{where } i = 2,3,4 \quad (11)$$

The second term of the right-hand side of the equation, b_i*(W*H/P), represents the worker hour elasticity of the selection probabilities, and the third term, c_i*(Y*N/P), represents the aggregate disposable income elasticity of the selection probabilities The wheat flour price elasticity of the selection probabilities is represented by the negative sum of the worker hour and aggregate disposable income elasticity or, equivalently, by $[a_i - \ln(P_i/P_1)]$

Elasticities are evaluated at the mean values The estimated production worker hour elasticities of the selection probabilities [−0 9283, −0 4409, −0 9574] are for the size classes S_2, S_3, and S_4, respectively These results indicate that the selection probabilities for the size classes S_2 and S_4 increase proportionately to the reduction of production worker hours resulting from the mechanization in wheat flour processing However, the selection probability for the size class S_3 is expected to increase by half of the proportional reduction of production worker hours The estimated aggregate disposable income elasticities of the selection probabilities are [0 9347, 0 6869, 1 5107] and the wheat flour price elasticities [−0 0064, −0 2460, −0 5533] are for the size classes S_2, S_3, and S_4, respectively The selection probabilities are very sensitive to changes in disposable income, while they are less sensitive to changes in wheat flour price

Wheat flour price has declined by 53 percent from 1973 to 1987, while disposable income has risen by 32 percent Exploring the causes of structural changes in the U S milling industry means using the total differentiation of equation 11

$$dP_i = P_i{*}\{(b_i{*}W/P){*}dH + (c_i/P){*}d(Y{*}N)$$

$$- [(b_i*W*H + c_i*Y*N)/P^2]*(\delta P/\delta P_w)*\delta P_w\}, \quad (12)$$

where P_w is wheat price (cost) to produce 100 pounds of flour [2]

Table 5 reveals changes in selection probabilities due to changes in production worker hours, aggregate disposable income, and wheat price An increase in disposable income and a decrease in production worker hours have equally influenced the selection of the second size category, $1,000 \leq S_2 < 5,000$ (table 5) However, the selections of the third size category, $5,000 \leq S_3 < 10,000$, and the fourth size category, $S_4 \geq 10,000$, have been influenced more by increases in disposable income and decreases in wheat price Decreased production worker hours contributed only 25 percent of the changes in size categories S_3 and S_4, while increased disposable income and decreased wheat price each account for approximately 37 percent of the changes in size classes S_3 and S_4 These findings contradict previous studies that indicate the cause for expansion in size economies is to achieve economic efficiency in input use

Wheat is one of the most protected crops in the United States The government provides input subsidies, export subsidies, and price and income support policies associated with acreage reduction and/or conservation programs As a result of government grain programs, per unit wheat costs for millers to produce 100 pounds of flour have declined by more than 70 percent from $7 16 (1967 dollars) in 1974 to $2 10 in 1988 (*9*) However, policymakers are discussing plans to phase out subsidies for grain producers, and members of GATT are negotiating for trade liberalization The declining trend in wheat prices is expected to be affected by the removal of farm programs

Projecting the Number of Mills with a Hazard Function

Structural changes within the U S flour milling industry consist of both size distribution and the changing number of mills In cases where a transition matrix is made up of the conditions representing entry and exit of firms, the number of firms can be projected with the conditional expected value equation (*3*) For other cases, a simple regression method has been used to project mill numbers (*8*, *23*) Even though this approach is simple to use, its specification suffers from the lack of a theoretical foundation

Another approach is based on the so-called "reliability theory" (*10*, *11*, *18*) Time to failure, or life length, T, is defined as a continuous random variable following a Weibull probability density function

$$f(t) = (\alpha\beta)t^{\beta-1} * \exp(-\alpha t^{\beta}), \quad \text{where } t > 0, \quad (13)$$

and a cumulative distribution function given by

$$F(t) = 1 - \exp(-\alpha t^{\beta}), \quad (14)$$

where α and β are parameters Following Meyer, the Weibull distribution may be the most appropriate function for a failure law whenever an industry comprises a number of firms, and failure is essentially due to the most severely flawed firm among many flawed firms in the industry

The reliability of the industry at time t is defined as $R(t) = Pr(T > t) = 1 - F(t)$, which explains the probability that flour mills are still operating at time t The hazard function (or failure rate) is defined as $Z(t) = f(t)/R(t)$, which simply represents a conditional probability or a transition probability that firms fail in period t given that they have survived through period t–1 The hazard function, Z(t), is increasing in t for $\beta>1$, constant for $\beta=1$, and decreasing for $\beta<1$ The hazard function corresponding to the exponential distribution is a special case of the Weibull distribution with $\beta=1$ It should be noted that there is a mathematically equivalent specification in terms of a probability distribution for any specification in terms of a hazard function (*11*)

The estimated nonlinear cumulative Weibull distribution function is

$$F(t) = 1 - \exp[- 020309380 * t^{1\ 044398130}], \ R^2 = \ 99,$$
$$(0034121389) \qquad (0766475454) \quad (15)$$

where numbers below coefficients are the estimated standard errors, and t = 0 for the year 1973 Using this cumulative distribution function, we estimated reliability and hazard functions to be

$$R(t) = \exp[- 020309380 * t^{1\ 044398130}], \quad \text{and}$$

$$Z(t) = \ 021211078 * t^{\ 04439813} \quad (16)$$

Results indicate that about four mills will annually merge with existing mills, bringing down the total to about 160 mills by the year 2000 (table 6)

Table 5—Proportional contributions of production worker hours, disposable income, and wheat price to changes in selection probabilities P_2, P_3, and P_4

Item	P_2	P_3	P_4
		Percent	
Production worker hours (H)	50 60	25 06	24 61
Disposable income (Y*V)	48 46	37 14	36 94
Wheat price (P_w)	94	37 80	38 45

[2]The estimated marketing margin equation is

$$P_f = \ 566047 + \ 876319*P_w, \ R^2 = \ 9953, \ D\ W \ = 1\ 801, \ n=15,$$
$$(071115) \quad (016740),$$

where P_f is wheat flour price per 100 pounds and P_w is wheat price the millers paid to produce 100 pounds of flour

Projecting the U.S. Wheat Flour Supply

To conduct simulation analysis using the estimated modified multinomial logit model, some assumptions are necessary for explanatory variables. Deflated aggregate disposable income grew 32 percent during 1973-87, and production worker hours declined by 25 percent during the same period. Therefore, our first scenario assumes that aggregate disposable income will increase by 2.5 percent annually and production worker hours will decline by 2 percent annually, while wheat price remains at the 1987 level (table 6).

Results indicate that the projected number of mills for the size classes S_1, S_2, and S_3 declines. However, the number of mills for the smallest size class, S_1, declines faster than for the other two classes. Even though the total number of mills declines over the period, the number of mills for the largest size class, S_4, is expected to increase. Given the trend of increasing per-capita wheat flour consumption, and an increasing population, expansion of the largest size mills would be necessary to meet increasing domestic demand for wheat flour.

Scenario 2 assumes that both aggregate disposable income and production worker hours mirror scenario 1, but wheat price is assumed to increase by 2 percent annually. Results indicate that the number of mills for the size classes S_1, S_2, and S_3 will decline, but at a slower rate than in scenario 1. The number of mills for the largest size category, S_4, will remain unchanged. As wheat flour price rises, consumer demand for wheat flour declines, offsetting the increase in per-capita wheat flour consumption and diminishing the incentive for structural adjustments.

Scenario 3 assumes that both aggregate disposable income and production worker hours match those in scenario 1, but wheat price is assumed to decrease by 2 percent annually. Our results show that the structural changes are similar to those for scenario 1, but occur at a faster rate. The number of mills for the size classes S_1, S_2, and S_3 would decline, while the number for the size class S_4 would increase at a faster rate to meet increased consumer demand.

Since the daily active milling capacity of a flour mill in each size category remains stable (see table 2), daily wheat flour supply can be estimated by multiplying the number of mills by the daily average milling capacity of a flour mill in each size category. The average number of annual milling days (307 days) is then multiplied by the estimated total daily wheat flour supply to derive annual wheat flour supply. Under scenario 1 in table 7, wheat flour supply is expected to decline over the period with minor fluctuations, from 378.7 million cwt in 1990 to 375.7 million cwt in year 2000. Under scenario 2, wheat flour supply declines steadily from 382.8 million cwt in 1990 to 343.3 million cwt in year 2000, while it increases steadily under scenario 3 to 435.6 million cwt from 398.7 million cwt during the same period.

Wheat price can greatly affect the size distributions of the flour mill industry. As the government phases out producer subsidies, therefore, the structure of the U.S. milling industry may change significantly. Kim reported that the U.S. wheat price would not change, however, when major industrialized countries remove their producer subsidies (*12*). But, as shown in scenario 1, the expansion of the size distributions will continue due to automation in production and increased consumer demand. To determine if U.S. wheat flour supply under trade liberalization would be adequate, we assumed that a 1-percent annual growth rate in population during 1973-87 will continue to the year 2000. Under this assumption, population would climb to 277.4 million from 1987's 243.7 million. Therefore, per-capita wheat flour consumption in the year 2000 would be 136 pounds under scenario 1, 124 pounds under scenario 2, and 157 pounds under scenario 3.

Table 6—Estimated number of mills in each size category according to reliability theory

Year	Number of mills	Scenario 1[1]				Scenario 2[2]				Scenario 3[3]			
		S_1	S_2	S_3	S_4	S_1	S_2	S_3	S_4	S_1	S_2	S_3	S_4
1990	203	48	60	44	51	47	60	44	52	44	59	44	56
1991	198	44	59	43	52	44	59	43	52	40	58	42	58
1992	194	40	59	41	54	42	59	41	52	36	57	40	61
1993	189	37	58	39	55	39	58	40	52	32	56	38	63
1994	185	34	57	38	56	36	58	38	53	28	55	37	65
1995	180	31	56	37	56	34	57	37	52	25	53	35	67
1996	176	29	55	35	57	32	56	35	53	21	52	33	70
1997	172	26	54	34	58	29	56	34	53	19	50	31	72
1998	168	24	53	32	59	28	55	33	52	16	49	29	74
1999	164	21	52	31	60	26	54	32	52	14	47	27	76
2000	160	19	51	29	61	24	53	31	52	12	45	25	78

[1]Aggregate disposable income increases by 2.5 percent annually and production worker hours decrease by 2 percent annually while wheat price remains at the 1987 level.
[2]Aggregate disposable income and production worker hours mirror scenario 1, and wheat price rises by 2 percent annually.
[3]Aggregate disposable income and production worker hours mirror scenario 1, and wheat price falls by 2 percent annually.

Table 7—Projected wheat flour supply under different scenarios

Year	Scenario 1[1]	Scenario 2[2]	Scenario 3[3]
		Million hundredweight	
1990	378.7	382.8	398.7
1991	379.0	379.0	401.4
1992	382.5	374.3	408.5
1993	381.0	370.5	411.1
1994	381.7	369.8	415.9
1995	377.9	361.9	418.1
1996	376.7	360.8	425.1
1997	377.4	357.8	427.6
1998	376.2	350.2	430.6
1999	376.9	346.8	433.1
2000	375.7	343.3	435.6

[1]Aggregate disposable income increases by 2.5 percent annually, production worker hours decrease by 2 percent annually, and wheat price remains at the 1987 level

[2]Aggregate disposable income and production worker hours mirror scenario 1 and wheat price rises by 2 percent annually

[3]Aggregate disposable income and production worker hours mirror scenario 1 and wheat price falls by 2 percent annually

With per-capita wheat flour consumption at 128 pounds in 1987, wheat flour supply under all scenarios would be adequate to meet increasing consumer demand

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