U.S. Chain Restaurant Efficiency

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The growth of corporate food service firms and the resulting competition places increasing pressures on available resources and their efficient usage. This analysis measures efficiencies for U.S. chain restaurants and determines associations between managerial and operational characteristics. Using a ray-homothetic production function, frontiers were estimated for large and small restaurant chains. Technical and scale efficiencies were then derived for the firms. Finally, a Tobit analysis measured associations between technical efficiencies and firm characteristics. Results showed differences based on firm size, but factors such as experience, service format, unit size, and menu were strongly associated with efficiency, perhaps offsetting some firm size effects.

The food service industry is one of the most competitive of any market in the US. In 1955 twenty-five percent of the food dollar was spent away from home – in 1993 that figure jumped to forty-four percent. From 1993 to 1996 this industry experienced one of its strongest continuous growth periods. For the first time, industry sales penetrated the $300 billion threshold. Also in 1996, sales in both the fast-food and the full service segments topped the $100 billion mark – an increase of nearly $15 billion over previous year (*Chain Store Guide,* 1995).

Despite overall industry growth, the makeup of the market is changing. The industry is seeing a shift from independently owned firms to large-scale corporate firms (Tannenbaum, 1996). From September 1995 to June 1996, corporate firm growth steadily out paced that of independent restaurants. The growth of corporate firms and their market competitiveness places additional pressure on the available limited resources, such as labor and capital and the importance of their efficient usage.

Consequently, the industry is actively competing for resources and revenue. This competition suggests the importance of efficiency among chain restaurants in their use of these limited resources. West and Olsen (1990) determined that one strategic factor was common to high-performance restaurants – factor focused efficiency. The essence of which is to focus on and react to changes in the operating environment, while at the same time maintaining operational efficiency. This research is directed toward a better understanding of the factors affecting the efficiency of chain restaurants within the U.S. market.

Given the competitive atmosphere in which chain restaurants operate, it is imperative for firm decision-makers to be able to gauge the performance of their firm. Efficiency measures can provide information on the individual firm's utilization of technology, allocation of available resources, and return to scale. The purpose of this analysis is to measure efficiencies for U.S. chain restaurant firms and to determine associations between managerial and operational characteristics and efficiency. This analysis only deals with one part of the performance equation which is efficiency or "doing things right." The other important component is effectiveness or "doing the right things." Effectiveness can override some efficiency shortcomings, but it is still imperative for these firms to strive for the appropriate efficiency levels.

Data

Financial data for thirty-six US chain restaurants listed in the SEC filings (SIC#5812) were compiled for the study. Financial data from the 1993-1995 annual reports were used for efficiency analysis. Output was measured in terms of gross revenue rather than physical terms. Labor Expense (L), Cost of Goods Sold (C), Operating Expense (O), and Cost of Capital (K) represent the production inputs. Operating expenses include administrative costs, repair and maintenance, and several other miscellaneous expenditures. Cost of capital is defined as annual cost of depreciation and interest expense.

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Table 1. Descriptive Statistics for Financial Variables.

Variable ($)	Mean	Standard Deviation	Minimum Value	Maximum Value
SMALL				
Revenue (Y)	38,689,000	29,641,220	3,190,000	96,151,000
Cost of Goods (C)	10,824,350	8,290,910	181,000	30,072,000
Labor (L)	12,030,630	9,349,850	285,000	31,435,000
Operating (O)	10,982,280	7,856,050	856,000	27,930,000
Capital (K)	1,800,780	1,778,670	25,000	7,732,000
LARGE				
Revenue (Y)	331,763,170	275,283,870	101,620,000	1,213,000,000
Cost of Goods (C)	105,401,290	89,953,220	19,737,000	378,000,000
Labor (L)	102,522,830	99,308,740	3,122,000	439,000,000
Operating (O)	81,132,950	65,464,590	22,526,000	284,000,000
Capital (K)	11,696,880	10,900,660	602,000	40,000,000

In order to compensate for variations in their associated production functions, the database was divided into two groups: *LARGE* companies with annual revenues exceeding $100 million and *SMALL* companies with annual revenue less than $100 million. This results in two separate samples with 42 observations for the *LARGE* database and 54 for the *SMALL*.

Firm characteristics and market decision criteria were gathered from the *Directory of Chain Restaurant Operators* (1993-1995). Firm characteristics specified include the age of the firm, trade area, number of operating units and mode of operation (e.g., corporate owned vs. franchise). Marketing decision criteria were menu type (e.g., taco vs. burger) and service type (e.g., fast food vs. full service dining). These variables were used in order to examine possible associations between operational and marketing variables with efficiency.

Table 2. Cost Share of Total Inputs.

Variable ($)	Mean	Min Value	Max Value
SMALL			
Cost of Goods (C′)	.302	.167	.412
Labor (L′)	.327	.198	.442
Operating (O′)	.319	.093	.572
Capital (K′)	.053	.001	.121
LARGE			
Cost of Goods (C′)	.333	.130	.470
Labor (L′)	.319	.017	.425
Operating (O′)	.303	.134	.655
Capital (K′)	.046	.001	.125

Descriptive Statistics for Model Observations

Descriptive statistics for the financial data are provided in Table 1. For the database as a whole (*LARGE* and *SMALL*), the gross revenue varied widely from $3.19 million to $1.2 billion. As shown in Table 2, there was considerable variation in the cost share for the various inputs (labor, cost of goods sold, operating expenses, and cost of capital). This variation shows that no predominant industry norm exists for input mixture. Smaller firms did seem to allocate a larger percent of their expenditures to labor and operating costs while larger firms allocated more resources towards the purchase of raw materials (cost of goods).

Descriptive statistics for firm characteristics are presented in Tables 3 and 4. Firms in the *SMALL* category, ranged from 3 to 70 years with a mean age of 25. An average firm operated 129 units, of which 63% were company owned with a per unit revenue of just under $1 million. The areas of operation were concentrated in the South and West. The menu was predominantly table-service with a focus on Mexican and Italian fares.

In the *LARGE* category, the companies range in age from 1 to 75 years with an average of 28 years. On average, the sample firms operated 456 units, of which 63% were company owned, with an annual unit revenue of just under $1.2 million. The operation areas were distributed throughout the U.S. with a slightly higher concentration in the West. The firms focused on table-service menus with burger and Italian fare.

In comparison of the two samples, there appears to be some interesting observations. First, both samples' mean ages are approximately the same. For these samples, a mature firm is not indicative of its classification as a high revenue operation. Both samples show that 63% of the units are company owned. Looking at the four identified geographic regions in the U.S., it appears the *SMALL* sample firms are capitalizing on the restaurant boom in the South (Food Retailing Review, 1994). Currently, over one-third of their units are operated in the South and this area appears to be the focus of industry growth. The *LARGE* sample maintains a larger fraction of its units within the West but the South does account for the second largest concentration.

Table 3. Descriptive Variable Statistics for SMALL Firms – Second Stage.

Variable	Mean	Min	Max
SMALL			
UNITS (#)	129.00	5.00	1500.00
AGE (YR)	25.00	3.00	70.00
FRANCH (%)	.37	0.00	1.00
COOWN (%)	.63	0.00	1.00
REVUNT ($M)	964.00	45.00	3526.00
EAST (%)	.23	0.00	1.00
SOUTH (%)	.33	0.00	1.00
MWEST (%)	.19	0.00	.50
WEST (%)	.25	0.00	1.00
TBLSERV (%)	.59	0.00	1.00
FFOOD (%)	.41	0.00	1.00
STKSEAF (%)	.30	0.00	1.00
BURGER (%)	.15	0.00	1.00
PIZZA (%)	.05	0.00	1.00
MEX (%)	.30	0.00	1.00
ITAL (%)	.20	0.00	1.00

Table 4. Descriptive Variable Statistics for Large Firms – Second Stage.

Variable	Mean	Min	Max
LARGE			
UNITS (#)	456.00	75.00	1751.00
AGE (YR)	28.00	1.00	75.00
FRANCH (%)	.37	0.00	1.00
COOWN (%)	.63	.06	1.00
REVUNT ($M)	1194.00	191.00	3770.00
EAST (%)	.13	0.00	1.00
SOUTH (%)	.28	0.00	1.00
MWEST (%)	.26	0.00	.50
WEST (%)	.33	0.00	1.00
TBLSERV (%)	.60	0.00	1.00
FFOOD (%)	.40	0.00	1.00
STKSEAF (%)	.19	0.00	1.00
BURGER (%)	.22	0.00	1.00
PIZZA (%)	.13	0.00	1.00
MEX (%)	.13	0.00	1.00
ITAL (%)	.33	0.00	1.00

For both groups, approximately 40% of the firms were fast food operations. The *SMALL* sample had a larger focus on ethnic foods, such as Mexican and Italian, while the *LARGE* sample menu was comprised of a mixture of Italian and traditional burger fare. The major difference between the two groups was found in the number of units in operation, with a mean of 456 for the Large in comparison to 129 for the Small.

Methodology

In order to determine efficiency measures, a production function must first be estimated to determine the relationship between output and input. For this analysis, output and inputs were only available in revenue and cost terms respectively. This estimation provides the necessary elements for measuring how efficiently the firms employed the resources. The second stage then estimates the association between certain operational and managerial variables with the estimated efficiency level.

Stage One

Previous studies of firm behavior have used a ray-homothetic function (RHF) developed by Fäere (Thomsen and Eidman, 1997; Andre, 1996; Byrne, 1996; Grabowski and Belbase, 1986) for estimation of the frontier production function. A desirable characteristic of this procedure is that it allows return to scale to vary with both output level and input mix. In addition, this function permits the calculation of optimal scale (i.e., output level at which returns to scale is unity) for each firm in an industry. Both notions yield information about whether the optimal level of operation is being utilized. The resulting production function frontier for this analysis based on the previous work of Fäere is:

$$Y = \ln\theta + \alpha_1 C'\ln C + \alpha_2 L'\ln L + \alpha_3 O'\ln O + \alpha_4 K'\ln K \quad (1)$$

where Y denotes the firm revenue, X' represents the respective budget shares for cost of goods sold (C), labor expense (L), operating expenses (O), and capital expenses (K), respectively.

The next step is to use these results to arrive at the technical efficiency measure. Pure technical inefficiency occurs when the firm is producing the maximum level of output, given the existing technology and input combination. Inefficiency represents an inability upon the part of the firm to solve certain technical problems in the production process and results in lost output for both the firm and society (Aly, 1987). In order to determine the extent to which a firm is technically efficient, a technical efficient index was estimated as:

$$(2)\quad PTEI_i = \frac{Y_i}{\hat{Y}_i}$$

where *PTEI* is the estimated pure technical efficiency index for the i^{th} firm, Y_i is the actual firm revenue and $\hat{Y}_I$ is the firm's technically efficient output determined by the constructed production function frontier given the firm's current level of inputs.

Actual measurement of $\hat{Y}$ for each firm is obtained by inserting the input values of the firm into equation (1) (Grabowski and Belbase (1986) and Fäere and Yoon (1985):

$$(3)\quad \hat{Y}_i = \ln\theta + \hat{\alpha}_1 C_i{}' \ln C_i + \hat{\alpha}_2 L_i{}' \ln L_i + \hat{\alpha}_3 O_i{}' \ln O_i + \hat{\alpha}_4 K_i{}' \ln K_i .$$

In addition to pure technical inefficiency measurement, the RHF allows for estimation of scale inefficiency. A firm is considered to be scale inefficient when it is not operating at constant returns to scale. This may not represent an inability to optimize on the part of the firm. The market may not be competitive or price distortions may occur. In these situations, it may be optimal (in terms of maximizing profit, revenue, or some other activity) for the firm to operate at non-constant returns to scale (Aly, 1987). Thus operating at non-constant returns to scale may be socially inefficient, but not necessarily inefficient from the individual firm's point of view.

In order to determine the extent to which a firm is scale efficient, a scale efficient output index was estimated as:

$$(4)\quad SEI_i = \frac{\hat{Y}_i}{Y_i^o}$$

where *SEI* is the scale efficiency index for the i^{th} firm, $\hat{Y}_i$ is the firm's technically efficient output shown in equation (3), and Y_i^o the firms' scale efficient level of output for the given level of inputs if the firm were operating at constant returns to scale.

The firm's scale efficient level of output, Y_i^o, was developed using a procedure developed by Grabowski and Belbase (1986) to measure the output lost as a result of not operating at constant returns to scale. For this, a multiplicative factor, λ, has to be determined in order to calculate potential output. Multiplying the inputs in equation (3) by λ, a constant, and setting it equal to the optimal level of output for firm I, Y^* can be defined as:

$$(5)\quad Y_i^* = \ln\theta + \hat{\alpha}_1 C_i{}' \ln(C_i * \lambda) + \hat{\alpha}_2 L_i{}' \ln(L_i * \lambda) + \hat{\alpha}_3 O_i{}' \ln(O_i * \lambda) + \hat{\alpha}_4 K_i{}' \ln(K_i * \lambda).$$

Therefore, λ would be the number by which the inputs need to be multiplied if the optimal level of output were to be produced by the i^{th} firm. Solving for $\ln\lambda$ gives,

$$(6)\quad \ln\lambda = \frac{Y_i^* - \hat{Y}_i}{\hat{\alpha}_1 C_i{}' + \hat{\alpha}_2 L_i{}' + \hat{\alpha}_3 O_i{}' + \hat{\alpha}_4 K_i{}'}.$$

It can then be shown that optimal output for firm I can be written as:

$$(7)\quad Y_i^* = \hat{\alpha}_1 C_i{}' + \hat{\alpha}_2 L_i{}' + \hat{\alpha}_3 O_i{}' + \hat{\alpha}_4 K_i{}'.$$

Substituting equation (7) into the denominator of equation (6) gives:

$$(8)\quad \ln\lambda = 1 - \frac{\hat{Y}_i}{Y_i^*}.$$

$$(9)\quad \lambda = \exp\left(1 - \frac{\hat{Y}_i}{Y_i^*}\right)$$

If decreasing returns to scale exist, then $0<\lambda<1$; while if there is increasing returns to scale $\lambda>1$. In the case of increasing returns to scale, λ-1 represents the percentage by which all inputs need to increase to allow firm I to produce at optimal scale. In addition, $(\lambda-1)/\lambda$ represents the percentage by which inputs would need to be decreased for a movement from optimal to potential output. Therefore, the potential output can be estimated by:

$$(10)\quad Y_i^o = Y_i^* - \left(\frac{\lambda - 1}{\lambda}\right) Y_i^*$$

where Y_i^o is the potential output and Y_i^* is the optimal output. In the case of decreasing returns to scale, (1-λ)/λ represents the percentage by which all inputs need to increase to allow firm *I* to produce potential output since potential output will be greater than the optimal output, and it is defined by:

(11) $$Y_i^o = Y_i^* + \left(\frac{1-\lambda}{\lambda}\right) Y_i^*.$$

Inserting this solution into equation (4) allows calculation of SEI.

Stage Two

The estimated indices and the production function frontier provide information as to the efficiency of the firm. The purpose of the second stage is to ascertain any associations between the technical efficiency and firm characteristics which serve as a proxy for factors that may impact the effectiveness of the firm (Andre, 1996; Byrne and Escaleras, 1996).

Since the estimated *PTEI* index will not exceed one, a limited dependent variable estimation procedure is needed for this step (Thomsen and Eidman, 1997; Byrne and Escaleras, 1997). A Tobit model is well-suited for this estimation type because the procedure accounts for censoring of the estimated index (Chavas and Alibe, 1993). For all *n* observations, the log-likelihood function is given as (Kmenta, 1986):

(12)

$$L_j \sum_{i-1}^{n} \left\{ (1 - Z_i) \log F\left(\frac{-\alpha - \beta_i X_i}{\sigma}\right) + Z_i \left[-\frac{1}{2} \log(2\pi\sigma^2) - \frac{1}{P2\sigma^2}(Y_i - \alpha - \beta_i X_i)^2 \right] \right\}$$

where j = small or large firms;

$Z_i = 1$ if PTEI > 0;
$Z_i = 0$ if PTEI =0, and

$\beta_0 + \beta_1 UNITS + \beta_2 AGE + \beta_3 COOWN + \beta_4 REVUNT + \beta_i X_i = \beta_5 SOUTH + \beta_6 MIDW + \beta_7 WEST + \beta_8 FFOOD + \beta_9 PIZZA + \beta_{10} MEX + \beta_{11} ITA.$

The base group represents firms operating in the EAST, with a table service format, and a steak/seafood menu offering.

The more units a firm operates, the greater its overall production level should be as efficiency is usually assumed to increase with the size of operation. Through the reduction in average cost per unit that occurs as firm size is increased, the firm will be able to optimize its efficient capacity. *UNITS*, representing the number of units the firm operates, is hypothesized to be positively associated with efficiency.

Years of operation (*AGE*) would be expected to have a positive association with efficiency as a firm moves along the learning curve. An older firm should have the experience necessary to find the right input mix.

Within the restaurant industry, firms can be company owned or franchised. Firms which operate company-owned units are involved in and dictate all aspects of the decision making process for the units. The firm sets objectives and goals for the daily operation of each unit as well as providing structured employee training and development, centralized purchasing and distribution, and marketing and promotion throughout the regions of operation. Also, these firms assume all financial liability for the unit operation. Company owned firms can possibly realize economies of size benefits as well as maintain an appropriate scale of operation.

Franchising is an integral part of the industry. Firms with franchised units act as limited overseers of the operation. Through legal contracts, the firm leases the use of its brand name and characteristics of unit operation to individuals in return for a percent of revenue. With these contracts, the firm attempts to preset standards of unit operation for the franchisee. Not only does franchising draw financing for rapid expansion, but it also is a method to allow for a faster increase of in-store and field level infrastructure (Lombardi, 1996). However this does come at a cost in terms of decreased overall control of operations. It is the actual contracted franchisee who is responsible for the day-to-day operation of the units. Firms who franchise their units benefit from lower operation costs (administration, training, purchasing, etc.) and limited financial liability. Still, they may not be able to effectively capitalize on the potential consistency that could be attained by the firm operating as a single entity. *COOWN* represents the percentage of total units which are company owned and operated and it is hypothesized the proportion of company owned units is positively associated with efficiency.

Sexton and Iskow (1988) state that insufficient business volume (i.e. generated revenue per unit) is one of the most important causes of technical inefficiency. Restaurant facilities, especially those built within the last 10 years, are designed to operate at a particular rate to efficiently produce a given volume of sales. If units deliver less than their optimal volume, then the firm as a whole is operating beneath its efficient capacity. The ability for management to construct and maintain an appropriate scale of operation at the unit level is critical for the overall success of the firm. *REVUNIT* will represent the average revenue generated per unit and is hypothesized to be positively associated with efficiency.

The area or geographical region of operation for a firm may play an important part in their overall operation efficiency. The firm must determine whether operation in a region will deliver an appropriate volume of sales given their operation style. *SOUTH, MWEST,* and *WEST* represent the percentage of total units which are operated within the South, Midwest, and West geographic regions, respectively. Assuming that there exists a higher population density, larger employee base, larger customer base, and higher accessibility in the East, then the other regions would be expected to have a lower association with efficiency in comparison. Since the technical index is a ratio, costs of doing business should not be an important factor if the relationship between revenue and costs are assumed to be proportional between regions.

Restaurant service can be one of two types: fast food or table service. Fast food operations build revenue through a large customer count driven by perceived convenience, speed of service, and low or value pricing (*Food Retailing Review,* 1994). The facilities are designed for low-cost construction with minimal space requirements and are conducive to minimal staffing needs. These units focus on achieving optimal revenue generation through cost minimization and achieve efficient capacity through high volume.

Full service operations generate revenue through a perceived value in the quality of food and service provided, for an overall unique dining experience (*Food Retailing Review*). Full service facilities also incur higher costs associated with location, size, and interior decor. There usually exists specialized employee needs along with increased labor costs. Optimal revenue is generated by high menu prices. Effective management of costs is an important factor in operational efficiency. *FFOOD* will represent whether the firm's primary service style is fast food and is hypothesized that fast food service is positively associated with efficiency.

The type of menu fare offered by a firm plays an important part in their operational efficiency. Each menu item implies specific associated costs for distribution and storage, production, shrinkage, labor, training, and equipment. Simple menu

Table 5. Parameter Estimates of the Ray-Homothetic Production Function.

Variable	Parameter Coefficient	Standard Error	T-Statistic
SMALL			
Intercept	-223402	20238.5	-11.038
Cost of Goods (C′)	25456	4135.6	6.155
Labor (L′)	31342	3964.6	7.905
Operating (O′)	29586	3108.4	9.518
Capital (K′)	39120	9031.5	4.331
LARGE			
Intercept	-3902652	234910.7	-16.613
Cost of Goods (C′)	326959	21254.4	15.383
Labor (L′)	426452	25558.8	16.685
Operating (O′)	368549	25254.8	14.593
Capital (K′)	536312	63026.4	8.509

SMALL Sample Size = 53 F-statistic = 52.944 Adj. R-sq. = .7968
LARGE Sample Size = 41 F-statistic = 96.939 Adj. R-sq. = .9035

offerings, such as those that focus on specific offerings, allow for the development of specialized production processes, increased uniformity throughout the organization, and less facility variation. A diversified menu increases operational decisions and reduces specialization in the production process. As menu items availability increases so does the concerns for procurement and storage, facility design, and employee competency. *Pizza*, *Mex*, and *Ital* represent whether a firm's primary menu fare is specialized or ethnic in composition while traditional firms comprise the base group. It is hypothesized that specialized menus would be positively associated with efficiency.

Empirical Results

Stage One

The estimated coefficients for the ray-homothetic production function model are provided in Table 5. For SMALL and LARGE, the coefficients are significant at the 0.01 level with respective adjusted R-square values of .7968 and .9035. Heteroscedasticity was not significant as indicated by the Harvey and Breusch-Pagan tests (Kmenta, 1986). In addition, as set forth by Belsley, Kuh, and Welsch, multicollinearity diagnostics suggested no degrading problems between capital, labor, production and overhead costs.

The marginal effect is the change in revenue due to a change in the explanatory variables. The marginal effect of cost of goods on gross revenue for firm *I* would be:

(13)

$$ME_i = \alpha_1(\ln C_i)\frac{L_i + O_i + K_i}{(C_i + L_i + O_i + K_i)^2} + \alpha_I \frac{1}{C_i + L_i + O_i + K_i}$$

Marginal effects at the sample means for the stage one variables are provided in Table 6. Marginal effects are somewhat similar among the variables within each size category which would be expected if the market is in equilibrium. The marginal effects of the *LARGE* operations appear to be about twice the amount as for the *SMALL* operations (Table 6).

Table 6. Marginal Effects of Input on Revenue.

	SMALL	LARGE
Cost of Goods Sold	4.40	8.12
Labor Expense	5.23	10.40
Operating Expense	5.08	10.29
Cost of Capital	5.28	10.33

One goal was to analyze the association between firm size and technical efficiency. In order to accomplish this, firm size was based on gross revenue and was divided as follows:

SMALL –

1)<\$20M; 2)>\$20M but <\$50M; 3)>\$50M.

LARGE –

1)>\$100M but <\$150M; 2)>\$150M but <\$300M; 3)>\$300M.

Within the two size categories, larger firms tend to be more efficient than smaller ones (Table 7). For instance, *SMALL* operations in the lower level have an estimated *PTEI* of only 0.27 while the higher revenue level has a *PTEI* of 0.81. The mean scale efficiency of 0.40 shows that the smaller firm produce only 40 percent of potential output while the larger firm produced 90 percent of their scale efficient output.

From this information in Table 7, an association between size of a firm and their returns to scale can be identified. For both *SMALL* and *LARGE*, firms with larger gross revenues operate at decreasing returns to scale, while smaller firms in terms of gross revenue operate at increasing returns to scale. Therefore, it appears that firms operating at increasing returns to scale (lower gross revenue) are more technical and scale inefficient than those operating at decreasing returns to scale (higher gross revenue).

Stage Two

Regression results for the Tobit models are provided in Tables 8 and 9. Statistically significant variable signs were consistent with the *a priori* hypotheses with the exceptions of *PIZZA (LARGE)* and *MIDWEST (SMALL)*. The negative sign associated with the *PIZZA* coefficient indicates that those large firms specializing in pizza menus do not have the same positive association with specialization and efficiency as the other specialized offering firms. One explanation might

Table 7. Mean Efficiency and Returns to Scale Results by Gross Revenue.

Gross Revenue ($)	N	Returns to Scale	Pure Technical Efficiency	Scale Efficiency	Overall Efficiency
SMALL					
<$20 M	20	2.91	.27	.40	.11
$20-$50 M	13	.94	.47	.69	.33
$50-$100 M	19	.38	.81	.90	.74
Overall	52	1.49	.52	.66	.40
LARGE					
$100-$150 M	12	3.31	.51	.21	.10
$150-$300 M	12	2.05	.57	.32	.17
$300 M-$1 B	16	.84	.68	.64	.45
Overall	40	1.95	.60	.42	.26

be that preparation and delivery time, in terms of higher labor cost, may outweigh the other benefits of specialization. Small Midwestern firms seem to have a higher association with efficiency than their counter parts in the East, suggesting that lower operational costs or customer preference differences may have outweighed the benefits of customer density and accessibility.

The smaller firm category was positively associated with efficiency for the number of units in operation, the average revenue per unit, and a Mexican based menu. For the larger firm category, higher levels of technical efficiency are associated with an increase in the number of units in operation, average unit revenue, and the percentage of corporate owned units. At a glance, the most efficient large operations tend to operate in the East and offer fast food service with a Mexican menu.

Table 8. Tobit Estimation Results for SMALL Firms (n=52).

Variable	Normalized Coefficient	Standard Error
Constant	-0.5042	0.7822
Units	0.2947	0.5958
Age	0.1530	0.1369
Co.-owned %	0.4469	0.6438
Revenue/unit	0.1075	0.3311
South	-0.7121	0.8182
Mid-west	2.7859	1.4215
West	-0.1082	0.7100
Fast Food	0.4291	0.4394
Pizza	-0.7326	0.8962
Mexican	1.5396	0.4523
Italian	0.6137	0.5579
Log Likelihood	24.3436	

Bold denotes significance at the 0.05 level

Table 9. Tobit Estimation Results for LARGE Firms (n=42).

Variable	Normalized Coefficient	Standard Error
Constant	9.4314	2.1721
Units	0.1974	0.9700
Age	-0.1433	0.1664
Co.-owned %	3.1789	1.0876
Revenue/unit	0.8177	0.3657
South	-4.3217	2.2659
Mid-west	-5.2114	2.6930
West	-5.9521	2.1466
Fast Food	1.1936	0.4678
Pizza	-1.7205	0.5702
Mexican	1.4200	0.5946
Italian	-0.3170	0.4326
Log Likelihood	45.0678	

Bold denotes significance at the 0.05 level

Summary and Implications

The food service industry generates in excess of $300 billion in sales. Two segments, fast-food and full service sales topping $100 billion in 1996. Within these segments, the growth of firms and the inherent market competitiveness places strong pressures on the available limited resources and the importance of their efficient usage. The objective of this project was to use technical efficiency as a measure of restaurant efficiency and to explain associations of this measure with certain operational and managerial variables.

The scores of pure technical efficiency were regressed against operational and managerial variables. The two data groups, small and large firms, were examined independently. The results show that an increase in the average revenue per unit is positively associated with efficiency for both the

SMALL and *LARGE* firms. Insufficient business volume is one of the most important causes of technical inefficiency.

For the *SMALL* firms, an increase in the number of units is associated with higher efficiency. Firms are able to reduce the average cost per unit as firm size is increased, enabling them to optimize their efficient capacity. For the *LARGE* firms, the number of units was not significantly associated with efficiency, implying that the firms within this category have reached the necessary size of operation and that further expansion alone is not necessarily correlated with a higher efficiency.

For the *SMALL* firms, older firms are more efficient than younger ones, suggesting that some type of learning curve exists where experience in the market place increases the effective use of resources. The *LARGE* firms gained higher levels of efficiency by their location. Firms with a large proportion or entirely located within the eastern region had higher efficiency levels.

SMALL firms were able to operate more efficiently with a fast food service format. Fast food and its associated characteristics of high volume, low transaction dollars, and cost minimization can provide lower revenue firms an efficient means of competing in the market.

These findings can help provide some insights into the competitive environment for the away-from-home food dollar. Clearly, production function differences exist between small and large firms, but this does not necessarily suggest that all industry participants must get large. Based on the differences, small firms are able to compete efficiently with their larger counterparts. Strategic planning for these smaller firms would allow proper determination of the mix for location, menu, unit size, and unit numbers to be competitive.

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