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Productivity and Efficiency Impacts of Human Resources Practices in Food Retailing

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I. Introduction

The retail food industry has undergone significant changes since the 1980s as supermarkets responded to increased competition from alternative retail formats and changes in consumer shopping habits. Competition from warehouse clubs, mass merchandisers, supercenters, and convenience stores has intensified, forcing supermarkets to reevaluate many of the ways in which they conducted their business operations. A significant problem in food retailing has emerged in human resource management and hiring practices. Progressive Grocer (2003) noted that while food retailing has long prided itself on being a people business, the recent track record "tells a different story--one of a sector that seems bent on perpetuating a vicious cycle of focusing on today's operating efficiencies at the expense of tomorrow's front-line work force."

Human resource (HR) managers in retailing recognize the relationship between business performance and the firm's human resources strategy and benefits policies. Retail employers and trade associations conduct detailed surveys of employment and hiring trends to identify and benchmark best practices in training, compensation, benefits, recruiting and the controlling costs of turnover. The biannual Survey of Unit Level Employment Practices (SULEP) is featured on food industry websites offering updated information for store managers, operators and human resource professionals in the food industry. Industry consultants emphasize the importance of a linkage between business strategy and HR strategy in designing compensation and flexible benefits plan for employees.

Recent changes in the retail food industry have increased interest in studying how human resource practices impact performance. Multi-establishment chains in the industry have

traditionally operated with hierarchical and centralized human resources practices while single unit establishments have the leeway to pursue a variety of alternative staffing and management practices. Declining unionization, increased use of part-time workers, and technological changes have altered the retail food labor market at the same time that traditional food retailers have encountered increasing competition from non-traditional food sellers. Major food retailers have been forced to adapt quickly in order to survive, with many making changes in marketing, pricing, and service strategies. Some food retailers have focused on customer service and expanded the labor- and training-intensive services they offer, including more prepared food items, bakeries and other services. Such strategies suggest that understanding the link between human resource practices and performance is important as supermarket managers face increased competition from discount retailers like Wal-Mart.

The primary objective of this paper is to identify the impact of human resource policies on productivity and technical efficiency in food retailing establishments. A stochastic frontier analysis based on a performance measure used by food retailers is related to store level human resource practices. Data for the study are from the Supermarket Panel, which gathers detailed information on store characteristics, operations, and performance. The normal-gamma stochastic frontier model provides a flexible parameterization of the inefficiency distribution in the stochastic frontier. Discussion of the implications for evaluating store performance along with directions for future research conclude the paper.

The Supermarket Panel used in the analysis features detailed information on human resources management practices at the store level. Ichniowski and Shaw (2003) highlight the value of "insider econometrics" to identify empirically the economic impact of human resource

management practices. Black and Lynch (2001) emphasize the value of focusing on HR practices associated with specific production processes (here, food retailing) to reduce problems due to heterogeneity in production and external market events. Synergies between a set of HR practices and their impacts on productivity can be readily investigated using establishment-level data. However, little research is currently available to guide retailers on HR practices that most effectively stimulate productivity and efficiency at the store level.

In the retail environment we focus on gross margins (value added) to evaluate performance, providing a contrast to the sales per employee measure which is frequently used in the analysis of productivity trends. Foster, Haltiwanger, and Krizan (2006) measure establishment-level labor productivity in retailing using real gross output or nominal sales deflated by four-digit industry deflators and total hours for the labor input (total hours). The value added measure we propose closely aligns with the objectives of the retail chain and is readily linked to financial metrics that are evaluated by store managers, retail executives, and industry analysts.

II. Modeling Efficiency in Food Retailing

Stochastic production frontier models, summarized comprehensively in Kumbhakar and Lovell (2000), allow both for technical inefficiency and random shocks that are uncontrolled by decision makers and managers. Stochastic frontier analysis assumes a composite error term consisting of two random variables. The first element in the composite error, v_i, is a symmetric noise term reflecting random noise which influences store decisions and can take on both positive and negative values. The asymmetric inefficiency error term, u_i, accounts for technical

and managerial constraints and assumes only nonnegative values. A typical specification for a stochastic frontier model is

$$\ln y_i \ = \ \ln f(x_i, \ z_i) \ + \ v_i \ - \ u_i \qquad (1)$$

where y_i represents the observed output measure for the ith establishment, $f(x_i, z_i)$ is the deterministic frontier with inputs x and operational measures denoted by z_i. The v_i are mean zero i.i.d. random variables which are assumed to be independent of u_i and the explanatory variables while following a normal distribution with mean 0 and variance σ_v^2. Technical inefficiency is represented by the one-sided error term, u_i, that follows a half-normal distribution with mean μ and variance σ_u^2. Technical inefficiency is represented by the nonnegative random variable u_i with a continuous density, $f(u \mid \theta)$, where θ is a vector of parameters. The formulation of the inefficiency distribution is based on a gamma distribution from Greene (2003):

$$f(u) \ = \ \theta^P / \Gamma(P) \exp(-\theta u) u^{P-1} \quad . \qquad (2)$$

The normal-gamma stochastic frontier model provides a more flexible parameterization of the inefficiency distribution in the stochastic frontier model than either of the usual alternatives such as normal-half normal or normal-exponential.

Technical efficiency is estimated as $TE_i = \exp(-\hat{u}_I)$, which has a value between 0 and 1, with 1 indicating an efficient food retailing establishment. Only the difference between the random error terms $\epsilon_i = v_i - u_i$ can be observed, requiring a derivation to extract technical efficiency u_i from ϵ_i. Kumbhakar and Lovell (2000) discuss methods to obtain estimates of technical efficiency for each producer by deriving $\hat{u}_I$ from the conditional distribution $E(u_i \mid \epsilon_i)$.

Empirical Model of Supermarket Operations

The Supermarket Panel is an annual, nation-wide survey of supermarkets that collects data on store characteristics, operating practices, and performance. The Panel was established in 1998 by The Food Industry Center (TFIC) at the University of Minnesota as a basis for ongoing study of the supermarket industry. Surveys were designed and tested in store visits to food retailing establishments. The surveys are mailed directly to store managers each January. In close consultation with supermarket managers the survey information is used to prepare confidential customized benchmark reports comparing the performance of the manager's store to a peer group of stores similar in size and format. Based on field visits scores for six key management areas – supply chain, human resources, food handling, environmental practices, quality assurance, and service offerings – were identified as critical components that managers and store department heads would find useful in evaluating and benchmarking their performance. Refinements of the model and a comparison of our results with existing industry data along with checks on the interpretation of store performance metrics were obtained by meeting with a leading food retailing consulting firm, Willard Bishop Consulting.

The Panel is unique because the unit of analysis is the individual store. In contrast, findings presented in the *Annual Report of the Grocery Industry* published by *Progressive Grocer* and the Food Marketing Institute's annual *SPEAKS* report are based on company-level responses for representative stores. Data collection procedures for the 2002 Supermarket panel, sampled from nearly 32,000 supermarkets in the U.S., are described in detail by King, Jacobson, and Seltzer (2002) and the variables for the model are presented in table 1.

A translog production function for the food retailing establishment is based on value added as the output measure along with measures of the operational and environmental constraints facing the supermarket. Store performance depends on store size (SSize), the hiring of full-time labor (FTHrs) and part-time labor hours (PTHrs) along with store-level organizational and operational factors (z_q) that influence performance so that the model is written:

$$\ln(\text{ValAdd}) = \alpha_0 + \alpha_1 \ln(\text{SSize}) + \alpha_2 \ln(\text{FTHrs}) + \alpha_3 \ln(\text{PTHrs}) + \sum_q \delta_q \ln z_q$$

$$+ k(\text{SSize, FTHrs, PTHrs}) + \sum_q \delta_q \ln z_q + \sum_q \sum_i \gamma_{qi} \ln z_q \ln x_i + \nu - u \qquad (3)$$

The second-order terms in the translog production frontier in equation 3 are represented by k(SSize, FTHrs, PTHRs) with estimated coefficients of β_{mn}. Operational characteristics of the store and workplace (the z vector) are discussed below.

The output measure for the retail store is weekly gross margin, defined as weekly sales minus the cost of goods sold. Baily and Solow (2001) suggested that value-added generated by retailers is the best measure of retailing output. They note that the value-added measure of output reflects the amount of retail services that are provided, such as the variety of merchandise provided, convenience of store location, availability of checkout and food department personnel, along with the availability of in-store services.

Results from summary income statements of conventional supermarkets confirm a close relationship between value-added measures and labor productivity at the store level. The Food Marketing Institute (2000) reported that the most profitable food retailers invested a higher percentage of expenses in personnel compared to lower performing supermarkets, even though

overall expenses for the top performers were lower than those for the least profitable stores. Payroll as a percentage of total expenses was at 47.5% for the most profitable stores and 41.9% for the least profitable stores. High performing stores use managerial skills and operational methods to control overall expenses more effectively and to maintain high gross margins.

The two inputs considered in this analysis are store selling area and weekly labor hours. Store selling area is a rough measure of the capital used in a retail operation. Store energy costs and other major capital inputs, such as refrigeration equipment and lighting, shelving and display cases, and front-end checkout equipment are highly correlated with store selling area.

The impact of workforce composition on retail performance is measured by the store's use of full-time and part-time workers. The labor inputs are full-time labor hours and part-time labor hours. Oi (1992) noted that reliance on part-time workers is an indicator of the skill mix of the retail work force. Increases in the use of part-time employees are driven partly by larger store sizes and larger stores must pay higher wages because their employees supply more work effort. Larger stores must hire more clerks and these employees are more productive because they waste less time in waiting for customers. Higher wages are paid to more productive employees, leading Oi (1992) to conclude that productivity gains associated with sales volumes in food retailing are relatively greater for part-time employees. The empirical model allows us to evaluate the relative impact of full-time and part-time employees on store performance as measured by value added.

An index of human resource practices is the key measure used in the study and is defined for each food retailing establishment based on data from the Supermarket Panel survey. An index of human resource practices (HRIndex) at each food retailing establishment is defined from the Supermarket Panel. The HR index consists of three components related to training and workforce

characteristics along with two measures of the benefits and incentives offered to full-time and part-time employees.

A number of studies demonstrate that particular human resource practices are complementary and contribute to improving firm performance, with the leading studies summarized in Zwick (2004). The "high performance work systems" mentioned in labor literature include employee involvement programs such as self-managed work teams, incentive programs along with profit sharing and other human resource practices incorporating formal training programs. Ichniowski, Shaw, and Prennushi (1997) find that innovative employment practices tend to be complements and that human resource policies are important determinants of productivity. Bingley and Westergaard-Nielsen (2001) demonstrated that personnel policy, defined as wage level and growth along with worker turnover, has a strong relation to firm economic performance, measured as value added minus total wage costs. Building on this literature, we identify a set of HR practices which are predominant in food retailing.

The HR index includes information on (1) training hours for new hires in cashiers and other positions (NwEmpTrn), (2) hours of training for store managers, grocery department managers, and scanning coordinators (KyEmpTrn), and (3) the relative proportion of full-time to part-time employees hired at the store (FtPtRati). Managers report the hours of training in classroom settings or one-on-one supervision given to new hires in cashier positions and elsewhere in the store during the first week and during the first 26 weeks of employment. Information on the number of training hours in the past 12 months for key employees such as the store manager, grocery department manager, and pricing coordinator are also available.

The HR index also relies on information about the compensation package of benefits and incentives offered to full-time or part-time employees (IBComp). The benefits include individual health insurance, family health insurance, disability insurance, a company funded pension, and a 401(k) plan. The menu of incentives indicate whether the firm offers an annual bonus, uses individual performance incentive pay, provides incentive pay based on product or category performance, or has an employee stock ownership plan. The index, constructed as a count of the number of benefits and incentives provided, is consistent with empirical work on benefits offerings by firms based on dichotomous indicators for whether or not firms provide benefits (Brown and Medoff, 2003). We consulted with U.S. Census Bureau economists who have examined the link between fringe benefits choices and firm performance using integrated data on firms, their employees, and their benefits offerings from the Census Bureau's Longitudinal Employer-Household Dynamics Program (Decressin et al. 2007). Mok and Yeung (2005) use a stochastic frontier model to examine the effect of employee motivation, which is influenced by bonus incentives and flexibility in employment, on the technical efficiency of foreign-financed manufacturing firms in southern China.

A final component of the HR index measures the firm's policy of providing a uniform compensation package of benefits and incentives to both full-time and part-time employees alike (UnifComp). The variable is formed as a count measure of the number of benefits and incentives that are offered to both sets of employees. Researchers in organization theory have adopted equity theory as a fundamental model for understanding the motivation of workers in organizations. Katz (2000) noted that equity theory, developed by Stacey Adams and supported through decades of research, argues that workers assess the fairness of their rewards (earnings

and compensation) by comparing both their outcomes and their inputs with those received by

their co-workers. Zenger and Lazzarini (2004) emphasize employee concerns about fairness in

pay and compensation along with the propensity of employees to compare their pay and

compensation as factors which constrain the manager's ability to reward individual and group

performance.

Food retailers achieving high value added (above the sample mean) tend to adopt uniform

benefits packages as about 46 percent of these establishments provide 4 or more benefits equally

to full-time and part-time employees. For the stores with low performance on the value added

measure, 85 percent do not offer any of the same benefits to both types of employees.

To summarize, the HR index consists of five measures: new employee training

(NwEmpTrn), training of key employees department managers (KyEmpTrn), the relative

proportion of full-time to part-time employees (FtPtRati), benefits and incentives offered to full-

time and part-time employees (IBComp), and the uniformity of benefits and incentives provided

to employees (UnifComp). The measures capture different components of the human resource

strategies pursued by the food retailers as the bivariate correlations between the measures are

generally small and below 0.20. Each measure is standardized by subtracting its mean and

dividing by the standard error represented by:

$$STD(x) \; = \; \frac{x \; - \; \bar{x}}{s_x}$$

(4)

The combined measure of human resource practices for food retailing establishments is defined

following Bresnahan, Brynjolfsson, and Hitt (2002) as

$$HRIndex = STD\left[STD(NwEmpTrn) + STD(KyEmpTrn) + STD(FtPtRati)\right.$$
$$\left. + STD(IBComp) + STD(UnifComp)\right] \qquad \textbf{(5)}$$

A second store characteristic is the number of stores under common ownership which measures firm size. Membership in a larger group (GSize) may boost productivity through multistore economies in procurement and advertising and through centralization of some managerial functions. Hoppe (2002) commented on the empirical regularity that large firms tend to adopt new technology sooner than small firms as the larger firms expect a greater return from adoption. Food retailing chains may benefit from multiplant economies in the adoption and diffusion of technological innovations and generate savings in nonproduction costs such as transportation, distribution and inventory control while taking advantage of the economies of massed reserves along with information sharing between establishments.

A third organizational descriptor is a binary variable equal to zero if the store is wholesaler supplied and one if the store is part of a self-distributing group (SelfDist). Stores and distribution centers are under common ownership in self-distributing chains, facilitating coordination between these two segments of the retail supply chain and enhancing productivity gains. Stores in self-distributing groups, which account for about 37 percent of the sampled stores, report a value added figure that is over 2.5 times higher than that recorded by wholesaler supplied stores.

Stores in self-distributing groups also provide higher levels of benefits and incentives for both full-time and part-time workers. Self-distributing firms have benefits packages which are more likely to treat full-time and part-time employees equally as 49 percent of the firms offer

four of more of the same benefits to these employees. Wholesaler-supplied establishments typically treat full-time and part-time workers differently and about 43 percent do not provide any benefits that are shared by sets of employees.

Unionization is an organizational factor that may affect productivity if having a unionized workforce is associated with significant differences in worker skills and/or workforce stability. A binary variable equal to one if at least 25% of the workforce is covered by a collective bargaining agreement and zero otherwise is also included in the empirical model, resulting in about 24% of the stores identified as unionized. Unionized stores register high performance for the value added measure, with a dollar amount that is over 2 times higher than non-unionized stores.

Distribution service levels are closely related to store format, the fifth measure of store organization. King, Jacobson, and Seltzer (2002) report considerable variation in median store characteristics and performance measures for stores grouped by format. Binary variables for these format categories are included in the empirical model. Stores in the Supermarket Panel are grouped into four mutually exclusive, exhaustive format categories based on store size and distribution service offerings. The store format categories include conventional stores, food/drug combinations, supercenters, and warehouse / super warehouse formats (Convl, FoodDrug, SCenter, Superstore).

III. Model Estimation and Results

Estimates of the normal-gamma model using the method of maximum simulated likelihood estimation were obtained following Greene (2003). King and Park (2004) provide support for the specification which treats store size and labor as exogenous in modeling

productivity in supermarket operations. Coefficient estimates and asymptotic standard errors for the model are presented in table 2.

Discussion of the model results centers around three issues. First, the key factors that influence retail store performance along with the estimated factor elasticities and measures of returns to scale are presented. Our overall results align with those presented by Black and Lynch (2001) which highlight the productivity-enhancing effects of unionization and a specific set of workplace practices. Second, the stochastic frontier approach allows us to identify the technical efficiency of human resource practices and link efficiency effects to financial performance, an effect which has been neglected in previous work. We also show that the results are robust to the potential presence of endogeneity.

Factors Influencing Retail Store Performance

The coefficients associated with the store categories indicate how supermarket performance across each format compares with the average supermarket in the sample. The null hypothesis that the format effects (conventional, food/drug combination, supercenter, and warehouse / super warehouse) are jointly equal to zero is not rejected as the calculated χ^2 value of 1.160 was below the critical value χ^2_3 of 9.49 at the 95% confidence level. The store format variables were subsequently excluded from the model.

Industry surveys such as Points of Impact Retail Operations Survey typically compile average gross margins across different store formats such as conventional supermarkets, upscale, discount, and superstores, both upscale and conventional (National Grocers Association, 2005). Gross margins may vary from 32% for upscale stores to 23% for conventional stores with similar margin breakdowns presented for specific departments such as grocery, meat, general

merchandise, produce and so on. Our findings suggest that after controlling for inputs such as store size and labor use (including benefits and incentives) store formats are not a significant component influencing observed value added margins. Retail analysts who focus on store formats as a key feature influencing performance (gross margins) may be neglecting other store level management decisions that have a more direct influence on operations.

Labor expenses account for the largest proportion of operating expenses so food retailers are naturally interested in evaluating the impact of labor on value-added at the store level. From the translog model the input elasticities measure the change in store value-added in response to one percent increase in labor used and are shown in table 3. The input elasticity for the ith factor is defined as

$$\varepsilon_i = \frac{\partial \ln y}{\partial \ln x_i} = \alpha_i + \sum_j \beta_{ij} \ln x_j + \sum_q \gamma_{qi} \ln z_q \qquad (6)$$

and the elasticity of scale is the sum of the input elasticities, $\epsilon = \sum_i \epsilon_i$. The input elasticity for

full-time employees is 0.46 which is about 16 percent higher than that for part-time employees (0.399). All the input elasticities including the store size input are significantly different from zero. The input elasticities for labor and store size were evaluated for retail establishments across four categories for store selling area (0 - 25th percentile, 26 - 50th percentile, 51st - 75th percentile, and 75th - 100th). The input elasticities for both full-time and part-time labor both increase with store selling area, foreshadowing the productivity enhancing effects of large, national chains in retail operations.

The input elasticity for the part-time employees shows that part-time employees in self-distributing chains are more productive than their counterparts in wholesaler supplied operations. The productivity of labor (both full-time and part-time) is about 13 percent higher in stores in self-distributing chains, an effect which is statistically significant. Self-distributing stores are able to generate a greater change in value added for each unit of labor employed.

The calculated returns to scale measure is 1.06 which is not significantly different from one, implying essentially constant returns to scale. Using an aggregate cost function for U.S. retail food stores based on value added at retail and three inputs including intermediate services, capital, and labor, Ratchford (2003) found slightly decreasing returns to scale. Our results for returns to scale align with those reported by Betancourt and Malanoski (1999) who found constant returns to scale with respect to output for a sample of U.S. supermarkets. The evidence on economies of scale presented by Oi (1992) in which larger sized stores are driven by lower operating costs are not confirmed by these results.

The coefficient on the human resources index measure indicates that a standard deviation increase in the index increases value added by about 3.6 percent or about $2,138 per week. The impact of human resource practices on value added varies with the number of stores under common ownership. Independent stores show the smallest gain from HR practices as value added increases by $1,044 while stores in a common ownership group of 50 or more attain an increase in value added of $3,711.

The productivity effects of individual components of the HR index were examined by disaggregating each component of the index and including the components in the model. The results show that the compensation package of benefits and incentives has the largest positive

effect on store level productivity at 13.8 percent. There is significant variety in the benefits and incentives packages offered to employees across the stores in the Supermarket Panel. The most frequently observed portfolio consists of 5 benefits and incentives (from nine listed) but this choice only accounts for a 22 percent share; stores do choose portfolios in each of the count categories ranging from 0 to 8. The implication is that stores are able to adjust the package of benefits offered and information linking specific packages to changes in value added could prove beneficial to store managers. For example, a package of the five most common benefits (individual health insurance, family health insurance, disability insurance, a company funded pension, and a 401(k) plan) which is provided by about 10 percent of food retailers increases store level productivity by 3.6 percent.

The statistically significant effect for membership in a self-distributing group reveals that these stores attain a value added which is about 15 percent higher than wholesaler supplied stores. Retail analysts link the effectiveness of Wal-Mart's supercenters to its superior self-distribution network while Kmart's competitive disadvantages were due in part to its lack of a self-distribution system. Self-distribution is recognized by retail analysts as a method to reduce supply chain costs and achieve greater efficiency, allowing stores to expand margins, improve in-stock availability and enhance store productivity.

The binary variable for union workforce has a statistically significant, positive effect implying that value added is about 19 percent higher in these retail operations. King, Jacobson, and Seltzer (2002) report that sales per labor hour, sales per square foot of selling area, and gross margin as a percent of sales are all higher in stores with a union workforce. They also note that hourly payroll expenses are more than $3.00 higher in stores with a union workforce. The

upward shift in weekly gross margin provides some justification for higher wages for union

workers, since the marginal product of labor, given store selling area and total labor hours, will

be higher in stores with a union workforce. Black and Lynch (2001) report that bundling of

specific practices (such as total quality management, profit sharing for nonmanagerial workers)

combined with unionization may have a positive impact on productivity. Results from this study

based on Supermarket Panel data show that interaction effects between the HR practices and

either membership in a self-distributing group or unionization are not significant.

Measuring Store Level Efficiency

Table 4 shows the mean performance efficiency for the food retailing establishments,

overall and by fixed effects components. The mean efficiency estimate was 0.86 across the

complete set of supermarkets, with 38 percent of stores achieving a rating above 0.90. The

economic impact of the inefficiency measure at the store level is a loss of value added of about

$6,500 dollars per week. Barros (2005) estimated a stochastic frontier model for 64 Spanish

supermarkets and reports an average technical efficiency of 0.864 and constant returns to scale,

results which align closely with our findings. Keh and Chu (2003) examined annual retail

productivity for 13 grocery stores for 10 years using a DEA approach and found increasing

returns to scale but do not link technical efficiency scores to store format, store size, or human

resource practices which are key levers available to store managers to influence performance.

To provide additional insight into how strategies on HR practices influence efficiency, we

define establishments which score above the mean on the HR index as high HR establishments.

Low HR establishments comprise the set of remaining stores. Efficiency is not adversely

influenced by human resource practices as the difference in efficiency estimates (table 4)

between the high HR and low HR establishments is quite small. Evaluated on the basis of technical efficiency, retailers choosing a portfolio of human resource practices which score high on the HR index are able to match the performance of competitors pursuing an alternative strategy. The loss in value added ranges from $9,318 for high HR establishments to $4,611 for low HR workplaces. The high HR retailers also benefit from a higher average value added, which at an average of $79,696 per week is over twice as large as that recorded by low HR establishments ($38,598 per week). Similar results are apparent when comparing the performance of food retailers with HR indexes in the bottom quartile against the performance of food retailers ranking in the top quartile of the HR index. Technical efficiency at the store level is not adversely impacted when promoting HR practices for employees.

Productivity in food retail stores does respond to changes in use of full-time and part-time employees and this effect differs across high HR stores and low HR stores. The input elasticity for employee hours (both full-time and part-time in table 3) is significantly larger for high HR stores (0.91) than for low HR stores (0.82). These results suggest that investments in human resource practices influence the quality and service orientation of the workforce so that adjustments in hiring patterns have a greater positive impact on store level value added.

The managerial implications of the model can be developed by examining the impact on store level gross margins due to the change in value added implied by the stochastic frontier model. Gross operating margins are closely followed by retail analysts and used by investment analysts to predict operating earnings per share. If sales decline at the same rate as value added due to store level inefficiency, the resulting gross profit margin for the store would be smaller by 10.4 percent. A decline of this magnitude would be closely watched by both store level

executives and equity analysts. Both high HR establishments and low HR establishments would face similar declines in gross margin. However, the gross profit margin for the high HR establishments is higher (at 25.2 percent) than that reported by low HR establishments (24.7 percent) and would not be as adversely impacted by the shock.

A final point is to compare our results with recent research on productivity trends in the retail sector while examining whether results that are apparent for labor productivity measures are transmitted to the value added measures used by retailers. Foster, Haltiwanger, and Krizan (2006) highlight entry by large, national chains as a key component enhancing retail productivity, as the chains displace less productive single-unit establishments.

Information is available from the Supermarket Panel on the number of stores under common ownership facilitating a comparison between efficiency estimates from single-unit establishment and multi-unit stores. Membership in a larger group (GSize) did not play a significant role in the productivity model for food retailers. A similar result reveals that technical efficiency for single-unit store is indistinguishable from that attained by multi-unit food retailers. The restructuring of the retail trade sector towards large, national chains is a recent development in food retailing driven by the entry of Wal-Mart and the effects may not be apparent yet in the Supermarket Panel.

High paying establishments are defined as food retailers with earnings per worker above the mean. Food retailers achieving high productivity also generate high earnings per worker as 73% of high value retailers are also high paying establishments while only 17% of low value retailers are high paying. These results align with Haltiwanger, Lane and Spletzer (2006) who report a key empirical regularity that high productivity workplaces typically have high earnings

per worker. The stochastic frontier model allows us to examine the performance of food retailers on both a productivity (value added) and an efficiency basis. Establishments that score high on both measures (productivity and efficiency) again are the highest paying establishments.

Model Verification

We treat the HR Index measure (and its interaction term with group size) as endogenous variables and test for potential bias using a Wu-Hausman test. A set of five instruments was identified which are correlated with the HR practices observed in the store. Store adoption of a suite of 16 service offerings (such as bagging service, custom meat cutting, home meal delivery, loyalty card programs, home meal replacement, video department, banking, and so on) , the competitive positioning of the store as a price, service, quality, or variety leader, and decision sharing practices with outside brokers or vendors on pricing, shelf space allocation, displays and promotions were used as instruments. Two additional indicators are whether the store underwent a major remodeling such as significant new departments, equipment or changes in store dimensions or a minor remodeling, which involved only a replacement or change in equipment were also included.

The instruments are valid because are they show a strong correlation with the human resource practices of the store. Decisions by food retailers on services, competitive positioning, decision sharing, and remodeling outcomes influence the training, skill levels, type of workforce, and the type of compensation packages that will be offered by the store. We do not expect that the instruments will be significantly influenced by unobserved, short-term shocks that compose the error term in the model for value added. Decisions on service offerings and competitive positioning reflect long-term strategies of the food retailer. Decision sharing practices involve

information needs and capabilities of external vendors and brokers which are not driven by the

short-term marketing, assortment, and pricing decisions that influence sales and value added at

the store level. The test statistics confirm that endogeneity is not a significant factor in the

specification of the value added model as the calculated χ^2 value of 1.374 was below the critical

value χ^2_2 at any conventional significance level.

IV. Summary and Conclusions

Retail managers are frequently interested in relating store level performance to specific

management or human resource strategies. Berman and Evans (2001) outlined strategies

available to retailers to enhance net profit margin (related to our value added measure) and

mentioned store level adjustments such as lowering labor costs, reducing costs by emphasizing

self-service, or selling exclusive product lines. This study presents results from a stochastic

frontier analysis of U.S. food retailers using a unique data set from a national survey of

supermarkets. We place particular emphasis on linking productivity and efficiency to human

resource practices adopted by food retailers. A measure which captures critical components of

the human resource strategies pursued by the food retailers is identified including information on

new employee training, training of key employees, the relative proportion of full-time to part-

time employees, benefits and incentives offered to full-time and part-time employees, and the

uniformity of benefits and incentives provided to employees.

The empirical work documents that food retailing firms which score higher on the HR

index attain better performance. The coefficient on the human resources index measure indicates

that a standard deviation increase in the index increases value added by about 3.6 percent. The

statistically significant effect for membership in a self-distributing group reveals that these stores

attain a value added which is about 15 percent higher than wholesaler supplied stores. Retail

managers could use these results to focus on identifying the optimal set of HR practices in order

to improve store performance.

The stochastic frontier identifies the technical efficiency effects of human resource

practices. The mean efficiency estimate was 0.86 across the complete set of supermarkets and

efficiency is not adversely influenced when food retailers pursue a "high road" human resource

policy. Evaluated on the basis of technical efficiency, retailers choosing a portfolio of human

resource practices which score high on the HR index are able to match the performance of

competitors pursuing an alternative strategy.

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Table 1. Variable Descriptions and Summary Statistics for Food Retailing Establishments

Variable	Description	Mean	Standard Deviation	Survey Question[a]
ValAdd	Value-added ($/week)	$56,556	$53,810	Q52, Q54
SSize	Store selling area (square feet)	28,100	22,747	Q8
FTHrs	Full-time labor (hours per week)	1,032.9	909.7	Q20
PTHrs	Part-time labor (hours per week)	896.7	785.9	Q20
NwEmpTrn	Training hours for new hires such as cashiers	31.46	17.26	Q18
KyEmpTrn	Training hours for store managers, grocery department managers, and scanning coordinators	40.10	60.90	Q19
FtPtRati	Proportion of full-time to part-time employees hired at the store	0.54	0.16	Q20
IBComp	Compensation package of benefits and incentives offered to full-time and part-time employees	5.70	3.46	Q25
UnifComp	Benefits and incentives offered to both full-time and part-time employees	1.95	1.93	Q25
GSize	Ownership group size (number of stores)	199.3	536.9	Q14
SelfDist	Member of a self-distributing group, 1 if yes	0.37	0.48	Q15
Union	At least 25% of employees covered by a collective bargaining agreement, 1 if yes,	0.24	0.43	Q25
Convl	Conventional format, 1 is yes	0.64	0.48	Q30
FoodDrug	Food/drug format, 1 if yes	0.23	0.42	Q30
SCenter	Warehouse, Supercenter, Super Warehouse format, 1 if yes	0.09	0.29	Q30

| **Superstore** | Superstore format, 1 if yes | 0.04 | 0.2 | Q30 |

[a] The question number for each variable in the 2002 Supermarket Panel Annual Report.

Table 2. Stochastic Frontier Parameter Estimates for Food Retailing Establishments

Parameter	Variable	Base Model Estimate[a]	Disaggregated HR Index Estimate[a]
	Intercept	-9.283* (-3.044)	-8.370* (-3.117)
	SSize	0.954 (1.110)	0.810 (0.982)
	FTHrs	-0.064 (-0.101)	0.111 (0.155)
	PTHrs	-0.012 (-0.027)	-0.314 (-0.546)
	SSize * SSize	-0.055 (-0.714)	-0.074 (-0.856)
	FTHrs * FTHrs	0.086* (2.619)	0.063 (1.288)
	PTHrs * PTHrs	0.049* (4.599)	0.009 (0.259)
	SSize * FTHrs	0.006 (0.055)	0.047 (0.393)
	SSize * PTHrs	0.048 (0.751)	0.091 (1.164)
	FTHrs * PTHrs	-0.105* (-2.351)	-0.010 (-1.260)
	HR Index	0.045* (1.896)	
	NwEmpTrn		0.023 (0.628)
	KyEmpTrn		-0.031 (-1.466)
	FtPtRati		-0.205* (-0.958)
	IBComp		0.136*

		(2.780)
UnifComp		-0.072
		(-1.494)
GSize	0.00003	0.00006
	(0.692)	(1.143)
SelfDist	0.142*	0.084
	(2.822)	(1.531)
Union	0.174*	0.181*
	(3.860)	(3.494)
GSize * NwEmpTrn		0.00003
		(0.822)
GSize * KyEmpTrn		-0.00001
		(0.292)
GSize * FtPtRati		-0.00008*
		(-1.807)
GSize * IBComp		0.00007
		(0.072)
GSize * UnifComp		-0.00005
		(-0.528)
θ	4.979*	
	(8.356)	
σ^2_v	0.243*	
	(17.376)	
P	0.773*	
	(4.013)	
Log Likelihood	-66.617	
Number of Observations	325	

[a] Asterisk indicates asymptotic t-values (shown in parentheses) with significance at $\alpha = 0.10$ level.

Table 3. Estimated Input Elasticities for Food Retailing Establishments

	With Respect to Input of		
	SSize	FTHrs	PTHrs
Overall Elasticities	0.199	0.464	0.399
Stores Size (by quartiles)			
Less than 12,000 ft^2	0.268	0.393	0.356
Between 12,000 - 22, 000 ft^2	0.209	0.463	0.367
Between 22,000 - 40,950 ft^2	0.187	0.486	0.416
Greater than 40,950 ft^2	0.142	0.512	0.447
Self-distributing stores	0.164	0.499	0.430
Wholesaler-supplied establishments	0.222	0.442	0.379
High on HR Index[a]	0.173	0.518	0.396
Low on HR Index	0.223	0.415	0.405

[a] Indicates the establishment scores above the mean on the HR index measure.

Table 4. Efficiency Decomposition for Human Resource Practices of Food Retailers

	Observations	Mean	Standard Deviation	Minimum	Maximum
Overall Efficiency	325	0.863	0.090	0.176	0.966
High on HR Index[a]	156	0.862	0.104	0.176	0.958
Low on HR Index	169	0.864	0.074	0.497	0.966
High on Specific Component of HR Index[b]					
New Employee Training	144	0.859	0.094	0.198	0.958
Key Employee Training	111	0.848	0.090	0.543	0.944
Full-time to Part-time	156	0.863	0.074	0.561	0.958
Benefits and Incentives	167	0.859	0.102	0.176	0.957
Uniformity of Benefit & Incentives	159	0.861	0.102	0.176	0.954

[a] Indicates the establishment scores above the mean on the HR index measure.
[b] Indicates the establishment has adopted the human resource management practice identified.