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EFFICIENCY SCORE APPROACH

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ABSTRACT—

Stochastic frontier analysis is employed for a comparison of value-added and traditional measures of performance. Results indicate value-added measures are not significantly different from traditional measures of performance and thus little if any information is gained by replacing traditional measures with value-added measures. However, value-added measures may be useful to managers for value creation decisions resulting in excess profits.

---KEY WORDS---

measures of performance, value-added measures, stochastic frontier analysis

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Comparative Analysis of Value-Added and Traditional Measures of Performance: An Efficiency Score Approach

Traditional measures of performance, directly derived from accounting profits, may not reflect economic reality. These traditional measures can be easily manipulated using accounting procedures, and thus they may not necessarily give an accurate yardstick by which performance can be evaluated. To take care of this problem, value-added measures of performance based on economic theory rather than accounting profits were developed.

Value-added means value creation to a business. So more companies are now looking at performance measures that depart from traditional ones. Important to business enterprises are measures of business performance as indicators of an enterprise's value. When an enterprise is operated efficiently, value is added to the business, so efficiency measures can be used to adequately describe performance.

Value-added measures are an application of economic profit, a concept developed by Marshall (1890). According to Marshall, economic profit is measured as the difference between total revenue and total cost which includes both expenses and cost of capital. Higgins (1998) defines cost of capital as the return on new, average-risk investment that a company must expect to maintain the share price.

Various studies have investigated the gains to using value-added measures rather than traditional measures. One of the most recently developed value-added concepts for evaluating a firm's performance is economic value added also known as EVA (Stewart 1991). EVA is a trade name for a specific method of calculating economic profit which was developed by Stewart & Co. According to Rutledge (1993), the value of economic profit is the economic return on equity capital used by managers. Therefore managers cannot claim to have made profits if an economic

return on equity has not been earned. Peterson and Peterson (1996) identify return on capital (ROC) as another value-added measure. Return on capital adjusts accounting data to reflect economic reality.

In an extensive study in which traditional and value-added measures of performance are compared, Peterson and Peterson(1996) examine these two measures and compare them with the market's assessment of company performance, namely stock returns. Their findings suggest that though traditional measures have no theoretical appeal, they should not be eliminated as a means of evaluating performance. This is because the traditional measures are not empirically less related to stock returns than return on capital. The possibility of value-added measures not being worthwhile is ruled out by Peterson and Peterson (1996). They state that the focus on economic rather than accounting profit plays an important role in the valuation of performance because managers' goal will be on value creation rather the mere manipulation of short-sighted accounting figures.

Efficiency measures have been previously used to determine performance. Sedik et al. (1999) use efficiency scores to evaluate corporate farm performance in Russia from 1991 to 1995. Ylvinger (2000) used alternative structural efficiency measures to estimate industrial performance.

Food Industry

The food industry is a competitive market (Gardner 1975). The relative efficiency of firms in the food industry across various countries is an issue of considerable concern to managers engaged in or considering exporting their products. As businesses grow and local markets become saturated, interest in trade possibilities with other countries increases. Krugman (1995)

reveals the possibility of capturing economies of scale in finely differentiated markets provides an incentive for most trade to be limited to firms within the food industry among similar developed countries. The increase in trade within the food industry among similar developed countries has culminated in the need for defining factors that determine efficiency in firms. Guynn (1998) observed that international market competition has intensified. Therefore knowledge of factors that enhance the efficiency of firms is vital information needed by managers to ensure that firms earn profits.

The dilemma that managers face is whether to use traditional measures or value-added measures to determine efficiency (Peterson and Peterson). Researchers are also faced with the dilemma of finding a performance measure based on economic theory and not mere historical data. More commonly used measures, traditional ones, are based on accounting data and are subjective to the accounting procedure used. So other measures based on economic theory have been developed. These measures are value-added measures. The question that now remains is whether the development of these measures are justified. Are they better measures of performance than the traditional measures?

These two issues, whether there is a difference between value-added and traditional measures of performance, and the need for a value-added measure of performance are the foci of this study. The objectives for the study are therefore based on these issues.

Objectives

The main objective of this study is to compare traditional and value-added measures of performance using efficiency scores. Another objective is to determine the need for a value-added measure of performance in the food industry. To achieve these objectives, a comparison is made

between efficiency scores derived from accounting profits versus economic theory to determine if there are differences between traditional and value-added measures. Technical efficiencies of food industry firms in the food industry in three industrialized countries are estimated. The various firms are ranked according to their levels of efficiency and a comparison of the two measures of performance is made based on these rankings.

Theoretical Model

A stochastic production frontier is used to estimate technical inefficiency (Fried et al. 1993). If producers use inputs $x \in \mathbb{R}^n_+$ to produce a scalar output $y \in \mathbb{R}^n_+$ with technology

$$y_i = f(x_i; \hat{b}) \exp\{v_i + u_i\}, \quad gi = 1, \dots, I \quad (1)$$

where \hat{b} is a vector representing technology parameters estimated for I producers. The disturbance term v_i is statistical noise and the nonpositive component of the disturbance, u_i measures technical efficiency. The loglinear form of equation (1) is used in the estimation of the parameters. This is given as

$$z_i = x_i \hat{b} + v_i + u_i, \quad (2)$$

where $z = \ln y$.

Empirical Model

The empirical model used in this study is a random effects model. Pitt and Lee (1981) suggest that the loglinear version of the stochastic model, equation(2), can be estimated using panel data. In this case, the model is generalized to handle both time-series and cross-section units. This model is comparable to those proposed by Nerlove (1965) and Wallace and Hussain (1969) except that u_i is one-sided distributed. If the u_{it} terms are replaced by u_i , the model is given as:

$$z_{it} = x_{it}\beta + v_{it} + u_i, \quad (3) \quad I=1, \dots, N, \quad t=1, \dots, T,$$

where u_i is i.i.d. one-sided distributed with truncated normal density function

$$h(u) = \frac{2}{\sqrt{2\pi}\sigma_u} \exp\left\{-\frac{u^2}{2\sigma_u^2}\right\}, \quad u \leq 0; \quad (4)$$

and v_{it} is i.i.d. normal.

The efficiency component is time-invariant and v_{it} and u_i are assumed to be independently and identically distributed. Both generalized least squares and maximum likelihood procedures were used to determine which procedure best suited the data being used. The likelihood function of this model has been derived by Pitt and Lee (1981) as:

$$\begin{aligned} \ln L = & N \ln 2 - \frac{NT}{2} \ln(2\pi) - \frac{N(T-1)}{2} \ln s_v^2 - \frac{N}{2} i_n (s_v^2 + T s_u^2) \\ & - \frac{1}{2 s_v^2} \sum_{i=1}^N (y_i - x_i b)' \left(I_T - \frac{s_u^2}{s_v^2 + T s_u^2} ii' \right) (y_i - x_i b) \\ & + \sum_{i=1}^N \ln \left[1 - \Phi \left(\frac{s_u}{s_v (s_v^2 + T s_u^2)^{1/2}} \sum_{t=1}^T (y_{it} - x_{it} b) \right) \right] \end{aligned} \quad (5)$$

where $\Phi(x)$ is the standard normal cumulative density function evaluated at x . Separate frontier models are used for each performance measure.

Data

Panel data used for this study are composed of 148 firms in the food industry. These firms belong to the major group 20 of the Standard Industrial Classification (SIC) Code (Office of

Management and Budget 1987). Countries covered in this study are three major industrialized nations, Britain, France and the United States. The data are unbalanced, and span a ten year period from 1989 to 1998 and are derived from financial statements of firms compiled by Disclosure Incorporated (May 1999).

The traditional measure of performance used is return on assets(ROA) and the value-added measures is return on capital(ROC). The performance measures represent the output variable. Two sets of variables identified by previous literature (Craig and Douglas 1982) as influencing market and financial performance are marketing-mix variables and market-structure variables. The marketing-mix variables are sales force expenditure, advertising expenditure, promotional expenditure, other marketing expenditure, relative price, product quality, new products, and product R&D. The market-structure variables are year of initial sale, long-term industry growth, industry concentration, capacity utilization, shared marketing expenditure, purchase frequency, and use of direct distribution. In this study five of the marketing-mix variables and two of the market structure variables are used as input variables. Therefore, the input variables are sales force expenditure, advertising expenditure, promotional expenditure, other marketing expenditure, industry concentration, and capacity utilization. Table 1 lists the definitions of the variables used and how they are calculated.

Results and Discussion

Preliminary results showed that the maximum likelihood procedure was the appropriate procedure for the efficiency estimation as was the case for the study by Pitt and Lee(1981). Tables 2 and 4 give the mean efficiencies of ROA and ROC for the total sample and for the three countries. An analysis of variance shows that the two measures are not significantly different from

one another. These results are given in Table 3.

The analysis showed that there are no significant differences between traditional and value-added measures of performance. Peterson and Peterson(1996) had similar results. Therefore value-added measures do not have much edge over traditional measures. However the concept of value creation in a business enterprise is an important one since firms that are able to add value to their business enterprise earn excess profits. Excess profits are earned due to market imperfections due to differentiation. The disadvantage of using value-added measures is that they are often very difficult to calculate because of various adjustments that must be made to the accounting figures. A number of consulting firms in the United States are specialized in selling procedures that compute these value-added measures but this may be expensive for small businesses, whose scale of operation may not even need such great detail.

Conclusion and Recommendations

Value-added measures are useful information for managers in that with this information, managers have a guide to help them in decisions that lead to value creation. However these measures are not significantly different from traditional measures of performance and must not replace them. Value added measures can be used along with traditional measures when it is necessary.

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Table 1. Definition of Variables

Variable	Definition
Advertising Expenditure	Media Expenses Divided by Revenue
Sales Force Expenditure	Sales Force Expenses Divided by Revenue
Promotion Expenditure	Promotion Expenses Divided by Revenue
Other Marketing Expenditure	Other Marketing Expenses Divided by Revenue
Industry Concentration	Percent of Sales by Four Largest Firms in the SIC Group
Capacity Utilization	Asset Turnover Ratio
EBIT	Earnings Before Interest and Taxes
Return on Assets	Net Income/Assets
Return on Capital	Ebit(1-tax Rate)/Capital

Table 2. Descriptive Statistics of Efficiency Estimates

Performance Measure	Mean	Minimum	Maximum
ROA	0.24	0.11	0.79
ROC	0.16	0.07	0.41

Table 3. Analysis of Variance to Test Differences of Means of ROA and ROC

Source of Variation	Degrees of Freedom	Sum of Squares	Mean Square	F-ratio
Mean	1	11.64	11.64	0.00014
Among Groups	1	0.51	0.51	
Within Groups	21609	1.54	0.0000713	
Total	21611	13.69		

Table 4. Mean Efficiency Estimates

Country	Mean Efficiency	
	Traditional Measure	Value-added Measure
France	0.22	0.15
Britain	0.23	0.16
United States	0.25	0.16