PRODUCTIVITY STRATEGIES IN THE RETAIL INDUSTRY

by

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for publication in the

Rio's International Journal On Sciences Of Industrial And Systems Engineering And Management.

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Abstract

The purpose of this paper is to estimate the efficiencies of retail companies and identify factors that influence them. We consider employees, total earning assets (that includes property, plant and equipment and current assets), inventory, and selling, general, and administrative expenses as inputs used to produce outputs such as sales, income before extraordinary items, and stock market values. Data Envelopment Analysis (DEA) is utilized to generate technical and scale efficiencies of 102 retail companies. We find that catalog, mail order, and convenience stores have the highest and auto and home supply stores and hobby, toys and game shops have the lowest efficiencies. Input efficiencies are found to have positive impact on stock market values. We calculate input efficiencies that should be helpful in identifying strategies to improve performance. Statistical relationships indicate that financially conservative policies may be detrimental for input efficiencies. This study also identifies peer companies against which an inefficient company can compare to improve its performance. The efficiencies estimated in this paper are extremely useful to evaluate top management performance. The inefficiencies help top management to identify shortfalls so that management can develop action plans to improve performance.

Keywords: Retailing, Performance, Data Envelopment Analysis, Performance Measurement.

INTRODUCTION

Retail trade has significant impact on the U.S. economy as retail sales constitute almost one-third of the U.S. gross domestic product. The sales of merchandise for personal or household use including automobiles are estimated to be over $3.7 trillion in 2005 (Standard & Poors, 2006). Retail trade is typically categorized into two segments namely nondurable and durable goods. Durable goods include building materials, automobiles, furniture, and some general merchandise. Nondurable goods include apparel and accessories, food and drug, and restaurants. In 2005, sales of nondurables constitute about $2.6 trillion. There are more than 1.4 million retail establishments in the United States employing over 23 million people in 2005. However, large businesses account for a significant portion of retail sales. The industry is extremely competitive. The purpose of this paper is to estimate efficiencies of large retail companies and identify factors that influence efficiencies. This paper focuses on all types of retail businesses including apparel,

auto, gas stations, building materials, hardware, garden, departmental, grocery, hobby, toy, game, lumber, electronic, shoe, variety, and women's apparel stores.

PREVIOUS WORKS

In today's competitive world, efficient operations are essential to be successful. This means keeping down inventory, using least possible number of employees, trimming down invested capital, spending less on sales, administrative, and marketing activities, and so on. However, a good portion of literature on efficiency of the retail industry deals with labor productivity because retailing is a labor intensive industry. For example, Sieling et. al. (2001) examine the labor productivity in the retail industry. Gadrey and Jany-Catrice (2000) analyze the reasons for higher number of retail employees per capita in the U.S. compared to France. Both of these studies focus at the industry level. Other studies deal with efficiencies of individual stores. For example, Metters et al.(1999) estimate efficiencies of individual branches of a bank using data envelopment analysis (DEA). Donthu and Yoo (1998) estimate efficiencies of individual restaurants using DEA. Thomas et. al (1998) use DEA to estimate efficiency of 552 individual stores. However, retail companies provide not just goods but better location, product assortment, timely delivery, information about products, service quality, and many other attributes (Betencourt and Gautschi, 1993). In addition, retail stores come with a variety of formats and different levels of services. Therefore, improved efficiency at the store level may not indicate superior performance at the corporate level. Typically financial ratios are used to evaluate firms at the corporate level. However, there is no systematic methodology to arrive at a composite indicator that will measure corporate performance. Our goal in this paper is to develop such a measure for individual companies in the retail industry using data envelopment analysis. Smith (1990) suggests the use of DEA to analyze financial statements. Athanassopoulos and Ballantine (1995) use DEA to estimate the corporate performance of grocery industry in the U.K. Yeh

(1997) uses DEA to estimate efficiencies of banks in Taiwan. The purpose of this paper is to estimate corporate efficiency of retail chains and identify factors that influence corporate efficiency. This paper is organized into five sections. In the next section, we discuss methodology followed by analysis of results. We close this paper with conclusions.

METHODOLOGY

The purpose of this paper is to measure efficiencies of retail chains at the corporate level. Efficiencies are typically measured by taking the ratio of outputs to inputs. This is easy when only one output and one input are involved. However, when more than one inputs and outputs are involved it is hard to define what is mean by efficiency. If we take ratios of outputs to inputs, there will be several such ratios when there are more than one input and output. If a company does not excel in all ratios, it is difficult to decide what weights each ratio should be given to compare efficiencies across companies. In addition, it should be possible to compare performance of one company against the other so that companies can identify sources of inefficiencies. The method typically used to compare efficiencies is frontier efficiency method. In this method, we first identify “best practice” frontiers. The frontier represents the best performance. The efficiencies are estimated based on the performance of companies on the frontiers.

Data envelopment analysis (DEA) is a non-parametric frontier method that uses linear programming technique to identify the frontier of most efficient companies. The multiple inputs and outputs of these most efficient companies can be used to construct a piecewise linear hull. This idea first occurred to Farell (1957). Afriat (1972), along with others, suggested that mathematical programming could be used to implement this idea. However, it was Charnes, Cooper and Rhodes (1978) who coined the term "Data Envelopment Analysis". The DEA was originally implemented for constant returns to scale (CRS) only and was input-oriented (i.e.

degree to which the factor inputs can be proportionally reduced for a given level of output until full technical efficiency is achieved). Bankers et al. (1984) extended this methodology to variable returns to scale (VRS) and also to output orientation (to what extent outputs can be expanded for a given factor inputs until full technical efficiency is achieved). Seinford and Thrall (1990) and Lovell (1993) present more detailed account of DEA.

The first step in the DEA is to define the unit of assessment typically called DMU (Decision Making Unit). In a DMU, various resources called inputs are converted into outcomes called outputs. Based on the inputs and outputs of all DMU's, a production possibility set is constructed using assumptions such as interpolated input-output combinations are feasible, inefficient input-output combinations can exist, and output cannot be produced without any input. Production can be subject to either CRS or VRS. In CRS, when all inputs are increased by a certain percentage, outputs also increase by the same percentage. However, in VRS, when all inputs are increased by a certain percentage, outputs increase by a lower or higher percentage. In other words, VRS production exhibits either economies or diseconomies of scale. In addition, the VRS assumes that production may not be occurring at their optimal scale, and produces a frontier which has increasing returns to scale at low input levels and decreasing returns to scale at high input levels. In short, this means that inefficient firms are only compared to others that are more or less the same size. Technical efficiency is measured by taking the ratio of the weighted sum of outputs to the weighted sum of inputs. The weights are chosen so as to maximize each firm's ratio. One major advantage of DEA is that it is not necessary to specify the form of the production function or error distribution and can handle more than one outputs and inputs. However, DEA does not have probabilistic component and therefore any deviation from the frontier is considered as inefficiency. We use two measures of efficiency. Technical efficiency measures the degree to which a firm can reduce its inputs (in fixed proportion) while being on the VRS frontier. Technical efficiency signifies how well a DMU is using its inputs to produce

outputs. Scale efficiency measures the degree to which a DMU projected to the VRS efficiency frontier can further decrease its inputs (again in fixed proportions) while still remaining within the CRS frontier. Thus scale efficiency measures the extent to which a firm can reduce inputs by moving to a part of the frontier with more beneficial returns to scale characteristics. The scale input efficiency provides an indication about economies or diseconomies of scale and is measured as a ratio of input efficiency under CRS to input efficiency under VRS.

The purpose of this paper is to estimate efficiency of retail companies. To apply DEA, we consider each company as a DMU. We assume that businesses can be denoted by input-output models where input resources are converted to goods and services. In addition, not all companies may be converting their input resources to outputs to the same degree and therefore companies may be operating at different efficiencies. A variety of factors may affect efficiency. The primary business category to which a company belongs can influence its efficiency. Its business strategy, store presentation, pricing, and many other day-to-day business decisions can affect the efficiency. Our goal is to develop efficiency measures so that less efficient companies can identify what more efficient companies are doing that makes them more efficient.

In order to apply DEA, we begin with the identification of inputs. Inventory represents a major asset of a company involved in retailing business. It is inventory that generates sales. Therefore, how effectively a company manages its inventory is of paramount importance. Total earning assets that include property, plant and equipment and current assets represent another input. Labor measured by the number of employees denotes the third input. Selling, general, and administrative expense constitute the fourth input. Since these inputs are used to generate sales, sales represent an output. Every company is there to make money. Therefore, income before extraordinary items denotes another output. Stock market values represent how much a company is valued by the investors stand for another output. To sum up, employees, total earning assets (that includes property, plant and equipment and current assets), inventory, and selling, general,

and administrative expense represent inputs and sales, income before extraordinary items, and stock market values constitute outputs. We choose companies operating within the United States with at least $1 billion of sales. The data is from Compustat data base for the period 2002.

ANALYSIS OF DEA RESULTS

Efficiencies

In this paper, we analyze 102 retail companies with different primary businesses. Table 1 presents average CRS and VRS efficiencies of retail companies having similar primary business. Catalog, mail-order houses and convenience stores have an efficiency of 1. Auto & home supply stores and hobby, toys and game shops have the lowest efficiencies. Catalog, mail order houses enjoy significant advantage as they can reap benefits of economies of scale. They typically have fewer stores reducing need for total earning assets. Their inventories are stored in fewer locations resulting in reduced inventories. They also have fewer employees. Their selling, general, and administrative expenses are lower as they transport and store inventories in fewer stores and warehouses. Their warehouses and stores are typically larger. Companies exhibiting increasing (decreasing) returns to scale are likely to increase their outputs at a higher (lower) proportion than the proportion by which inputs are increased. Therefore, increasing (decreasing) returns to scale companies can improve (reduce) efficiencies by increasing their sizes. Therefore, the number of IRS, DRS and constant return to companies indicate opportunities to expand and contract in various stores categories.

In Table 2, we present companies with VRS efficiency of 1. They belong to auto dealers, gas stations, catalog, mail-order houses, convenience stores, drug & proprietary stores, grocery stores, home furniture & equipment store, lumber & other building material retailer, miscellaneous general merchandise stores, and variety stores. DEA can identify companies with an efficiency of 1 that an inefficient company can emulate to improve its performance. For

example, Caremark Rx Inc, PC Connection Inc, Supervalu Inc and other stores are peers for emulation by inefficient companies.

Factors Affecting Efficiencies

In this section, we analyze the influence of various factors on efficiencies. We examine the efficiencies using the Spearman Rank Correlation. Spearman Rank Correlation does not require any assumptions about the variables. The Spearman Correlation between various input efficiencies and current ratios, debt-asset ratios, quick ratios, market to book values, price-earning ratios, and stock ratings are given in Table 3. We only discuss associations which are statistically significant at better than 0.05 level.

Current ratio is calculated by dividing current assets by current liabilities. It represents a company's ability to pay short-term obligations. According to the Spearman Correlation, the current ratios are negatively associated with various input efficiencies. Even though, financial analysts look positively at higher current ratios, our analysis indicates that companies with high current ratios are likely to be less efficient.

Quick ratios are calculated by dividing current assets minus inventories by current liabilities. Since inventories are illiquid assets, quick ratios help to determine whether companies have sufficient liquid assets to satisfy short-term needs. The Spearman rank correlation indicates that quick ratios are positively associated with inventory efficiency. It can be inferred from this relationship that retail chains achieve higher quick ratios by efficiently utilizing their inventory levels.

The debt-to-equity ratio is calculated by dividing total liabilities by total shareholder equity. Lower debt equity ratio implies higher financial strength. Our analysis using the Spearman rank correlation indicates that debt-to-equity ratio is negatively associated with selling, general, administrative efficiencies. This implies that highly leveraged companies are

likely to overspend on selling, general and administrative expenses. This is contrary to conventional wisdom that highly leveraged companies are likely to reduce expenses to save cash to pay for interests on debts.

Another ratio that is of interest to strategic analysis is market-to-book value ratio as it represents performance in terms of wealth creation. The book value represents amount of invested capital and market value represents the value of the invested capital in the stock exchange. Therefore, higher is market-to-book value ratio, better is a company's performance in terms of wealth creation. All input efficiencies are found to be positively associated with market-to-book value ratios indicating that stock market does reward efficient companies.

The price-to-earning ratio, as the name implies, is obtained by dividing price of a stock of a company by the earning per share. This ratio also represents how much an investor is willing to pay for one dollar of earning of a company. Higher is the ratio, higher is the wealth creation ability of a company. Even though all input efficiencies are not positively associated with the price-to-earning ratios, the inventory efficiency is directly related to price-to-earning ratio. This indicates inventory efficiency of a retail chain has a direct bearing on the wealth creation ability of a company.

Standard and Poor (a rating agency in the United States) ranks stocks of companies using their past earnings and dividends and its comparative status as of the year end. Common stock rankings reflect growth and stability of earning and dividends and are not considered as market recommendations. The ranking is done using numerical code as follows:

7 Highest A+

8 High A

9 Above Average A–

16 Average B+

17 Below Average B

18 Lower B–

21 Lowest C

22 In Reorganization D

99 Liquidation LIQ

The Spearman rank correlation between stock ratings and VRS efficiencies are found to be negative and statistically significant at the five percent level. This indicates that the higher are the VRS efficiencies, higher are the stock rankings.

CONCLUSIONS

In this paper, we estimate efficiencies of retail chains. We treat employees, total earning assets (that includes property, plant and equipment and current assets), inventory, and selling, general, and administrative expenses as inputs to produce outputs such as sales, income before extraordinary items, and stock market values. Our analysis indicates that cataloging companies and convenience stores have significant competitive advantage over other types of retail chains. Auto and home supply stores and hobby, toys and game shops are found to have the lowest efficiencies. Input efficiencies are found to have positive impact on stock market values. The CRS and VRS efficiencies, efficiencies of inputs, peer companies, and whether companies are operating under DRS or IRS should help companies to identify appropriate strategies to increase their performances. The efficiencies estimated in this paper are extremely useful to evaluate top management performance. The inefficiencies help top management to identify shortfalls so that management can develop action plans to improve their performance.

Table 1

Constant Returns to Scale, Variable Returns to Scale, Scale Efficiencies, and Ranks of Variable Returns to Scale

Category of Primary Business	CRS	VRS	Rank	Scale	IRS/DRS/CRS
Apparel And Accessory Stores	0.478	0.684	9	0.713	2/0/0
Auto And Home Supply Stores	0.360	0.393	19	0.923	4/0/1
Auto Dealers, Gas Stations	0.801	0.870	4	0.927	7/1/0
Bldg Matl,Hardwr,Garden-Retl	0.544	0.653	11	0.851	2/0/0
Catalog, Mail-Order Houses	1.000	1.000	1	1.000	1/0/3
Convenience Stores	1.000	1.000	1	1.000	1/0/1
Department Stores	0.353	0.482	17	0.788	1/7/0
Drug & Proprietary Stores	0.687	0.787	6	0.870	2/3/1
Grocery Stores	0.680	0.811	5	0.861	4/4/0
Hobby, Toy, And Game Shops	0.408	0.458	18	0.891	1/10/2
Jewelry Stores	0.460	0.482	16	0.951	2/0/0
Lumber & Other Bldg Matl-Retl	0.499	0.776	7	0.689	1/2/0
Misc General Mdse Stores	0.734	0.902	3	0.830	0/2/0
Misc Shopping Goods Stores	0.511	0.566	14	0.914	3/6/0
Radio,TV,Cons Electr Stores	0.520	0.581	13	0.909	1/2/0
Retail Stores	0.611	0.658	10	0.930	4/0/0
Shoe Stores	0.495	0.502	15	0.985	2/0/0
Variety Stores	0.578	0.708	8	0.849	4/5/0
Women's Clothing Stores	0.483	0.598	12	0.809	2/2/0
Average	**0.578**	**0.676**		**0.869**	

Table 2
Companies with VRS Efficiency of 1, Primary Business Category and the Number of Inefficient Peers

Company	Primary Business Category	# of inefficient peers
Autonation Inc	Auto Dealers, Gas Stations	1
CDW Corp	Catalog, Mail-Order Houses	6
PC Connection Inc	Catalog, Mail-Order Houses	67
7-Eleven Inc	Convenience Stores	1
Caremark Rx Inc	Drug & Proprietary Stores	81
Walgreen Co	Drug & Proprietary Stores	3
Kroger Co	Grocery Stores	4
Publix Super Markets Inc	Grocery Stores	1
Supervalu Inc	Grocery Stores	37
Whole Foods Market Inc	Grocery Stores	23
Bed Bath & Beyond Inc	Home Furniture & Equip Store	28
Home Depot Inc	Lumber & Other Bldg Matl-Retl	1
Costco Wholesale Corp	Misc General Mdse Stores	7
Wal-Mart Stores	Variety Stores	14

Table 3: The Spearman Correlations Among Various Parameters

Description	Current Ratio (102)	Debt-Equity Ratio (102)	Quick Ratio (100)	Market /Book (102)	Price-Earning Ratio (102)	Stock Rating (72)	Sales/Earning Assets (102)
VRS Efficiency	-0.40***	-0.12	-0.11	0.34***	0.18*	-0.26**	0.63***
Asset Efficiency	-0.40***	-0.19*	-0.15	0.32***	0.19*	-0.21*	0.71***
Inventory Efficiency	-0.27***	-0.04	0.24**	0.32***	0.29***	-0.25**	0.33***
Employees Efficiency	-0.32***	0.00	0.05	0.33***	0.16*	-0.27**	0.34***
Selling, General Administrative Efficiency	-0.27***	-0.23**	0.00	0.36***	0.16*	-0.25**	0.37***

*** the level of significance=0.01
** the level of significance=0.05
* the level of significance=0.10

Number of observations in bracket.

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