EVALUATING THE IMPACT OF ADVERTISING ON SALES AND PROFITABILITY IN APPAREL INDUSTRY

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ABSTRACT

In this paper, we evaluate the dollar amount spend on advertising relative to sales, profit margin, and growth rates in order to benchmark the effectiveness of advertising in today's retail environment and does it lead directly to higher sales and increased profits affording positive earnings for the investor. In this study, we use data envelopment analysis technique to benchmark sixteen apparel firms to evaluate the effectiveness of their advertising dollars on the sales, profit margin, growth, return on assets, return on equity, and return on investment.

Keywords: Apparel Industry, Efficiency, Data Envelopment Analysis

INTRODUCTION

Are we getting the desired return from our advertising dollars? This question is of great interest to any company in general. In this paper, we benchmark the advertising dollars of sixteen apparel firms in terms of its impact on sales and profitability to find out which firm or firms are using their advertising dollars most effectively relative to other firms in the industry. We measure the effectiveness of advertising spending through its impact of profit margin, return on assets, return on equity, return on investment, sales growth rate, and growth of the firm.

Advertising is a method of communication between the retailer and the customer. It is a marketing tool used for the purpose of informing, persuading and building brand recognition, leading to purchases of goods and services by the customer. Advertising is facilitated through a mass marketing approach, reaching large audiences with the goal of generating high levels of sales. As sales increase, economies of scale occur, which may lead to decreases in costs, ultimately creating higher profits and earnings enjoyed by investors.

The way in which companies communicate to their customers has evolved over time. In earlier times, mid-twentieth century, print, radio and television were the most widely used media for advertising. Today, print has been decreasing while television continues to be significant in the mix. In using the one way communication strategy, the marketer is communicating a message to the consumer which does not result in direct feedback. Therefore, it is difficult to gauge the impact that advertising has on sales.

The company's strategy is to increase visibility of its products and/or services through these vehicles with the expectation that consumers will be exposed to its message which will lead to an increase in sales. Many studies have been done on "cause and effect" which have resulted in being non-conclusive. While this study does not focus on the methods of communication and the vehicles used to communicate, it is worthy to note some of the techniques that are being used to de-mystify the marketer's message and make it clearer to the consumers what the real value are for them leading to an increase in sales.

The question at hand is which firm is spending the advertising dollars more effectively in today's retail environment in terms of its impact on sales, margin, growth, return on assets, return on investment, return on equity, and sales. In this study, we use data envelopment analysis technique to benchmark sixteen apparel firms to evaluate the effectiveness of their advertising dollars on the sales, profit margin, growth, return on assets, return on equity, and return on investment. The study is important for several reasons. Firstly, it benchmarks a company's advertising spending relative to other firms in the industry. Secondly, it will help plan companies set their advertising budgets. By benchmarking advertising to gross margin ratio or reinvestment rate, a company can determine a reasonable and competitive level of advertising support for an ongoing business or product. Advertising agencies can also use the study as a new business development tool. The rest of the paper is organized along the following lines. In section II, we provide a review of previous studies. Section III discusses the model that we use in this study. Section IV discusses the methodology and data used in this study. Section V provides empirical analysis of our results. Section VI summarizes and concludes our study.

LITERATURE REVIEW

The impact advertising has on sales, profits and ultimately on earnings is very complex; it difficult to be conclusive. Many studies have been conducted with mixed results. There are many variables including the product, the type of retail outlet, the advertising strategy and the consumer.

Tuli, Mukherjee and Dekimpe (2012) evaluate the degree "advertising spending and growth in same-store sales are valued by investors." According to Tuli, Mukherjee, and Dekimpe, investors evaluate a company based on earnings which is the ability of the company to sell product profitably. The study examines the degree to which advertising enhances the level of sales for a company. According to Srinivasan and Sihi (2012) when firms have high advertising expenditures, they are signaling to stock market participants that they anticipate their advertising to be effective and that their performance is likely to be superior. In a study of 1052 firms over a period of 20 years, Luo and De Jong (2012) find that a decline in advertising spending reduces the rate of return for a the firms.

McAlister, Srinivasan and Kim (2007) note that advertising communicates and informs consumers which "enhance brand loyalty" and this indirectly translates into sales. Research by Chauvin and Hirshey 1993; Desai 2000; Joshi and Hanssens 2009, 2010, cited by Tuli et al (2012) indicates that when companies spend more money on advertising, investors see this as a strategy to increase the consumer base leading to more sales. Eng and Keh (2007) analyze the joint effect of advertising brand value on the firm;s future operating and market performance. They find that impact of advertising on future stock performance is minimal, but spending on advertising results in better brand sales. They also noted that advertising expenses lead to higher ROA, and the effects last up to four years. Rajagopal (2006) states that building a brand involves not only the physical traits of the product but also the

benefits it offers to the customer. Building brand equity requires a comprehensive and strategic marketing effort. Advertising is the tool that facilities this effort. "Strong brand equity allows the companies to retain customers better, service their needs more effectively and increase profit."

Kamber (2002) looked at advertising expenditures during an economic turndown. The study noted that reductions in adspend in 1991 lagged the economic downturn by about six months. Companies that maintained or increased adspend during the 1991 recession had a five-year sales growth that was 25 percent higher, as a whole, than companies that did not. Kamber also found a positive and statistically significant relationship between adspend during recession and subsequent sales growth. The study further reported that change in adspend during a recession had a positive and statistically significant relationship to short-term sales growth.

MODEL

The Data Envelopment Analysis Model:
Data envelopment analysis (DEA) is a linear programming technique that was developed by Charnes Cooper (1978) to assess the relative performance of homogenous organizational units. Further, this generalized optimization technique measures the relative performance of different decision-making entities (called decision-making units or DMUs) that have multiple objectives (outputs) and multiple inputs structure. Since, in this study, we analyze thirteen thrift and mortgage companies, these companies are the DMUs. DEA measures the efficiency with which a DMU uses the resources available (inputs) to generate a given set of outputs. The DEA methodology defines efficiency as a ratio of total outputs to total inputs and uses this to evaluate the relative performance of a DMU. Further, the DEA model estimates relative efficiency, which is with reference to the best performing DMU or DMUs (in case multiple DMUs are most efficient). The DEA allocates an efficiency score of unity or 100 percent to the most efficient unit. The low-performing DMUs' efficiency can vary between 0 and 100 percent in comparison to the best performance.

To develop a DEA model, we consider "n" Decision-making units (DMUs). Further, we define the following variables:

$j = 1, 2,\ldots, n$ (DMU variable).
$i = 1, 2,\ldots, m$ (inputs variable).
$r = 1, 2,\ldots\ldots, s$ (outputs variable).

Therefore, each DMU_j, $j = 1, 2,\ldots, n$, uses the following variable factors:

x_{ij} – amount of input i for the unit j, $i = 1,2,\ldots\ldots,m$ and $j = 1,2,\ldots,n$.
y_{rj} – amount of output r for the unit j, $r = 1, 2,\ldots.., s$ and $j = 1, 2,\ldots,n$.
u_r – weight assigned to the output r, $r = 1,2,\ldots..,s$
v_i – weight assigned to the input i, $i = 1,2,\ldots\ldots,m$.

Further, for each DMU, we form the virtual input and output using the weights (to be determined) v_i and u_r:

Virtual input = $\sum_{i=1}^{m} v_i x_{ij}$
Virtual output = $\sum_{r=1}^{s} u_r y_{rj}$
Where $j = 1,2, \ldots, n$ (DMU variable).

For a given DMU the ratio of virtual output to virtual input gives a measure of efficiency that is a function of the multipliers. In mathematical programming this ratio forms the objective function for the particular DMU being evaluated, so that symbolically. We want to determine the weights, using linear programming so as to maximize the ratio

$$\frac{Virtual\ Output}{Virtual\ Input}$$

The DEA methodology gives a measure of efficiency that is defined as the ratio of weighted outputs to weighted inputs. The most important issue in this method is the assessment of the weights. Charnes et. al., define the efficiency measure by assigning to each unit the most favorable weights. In general, the weights will not be the same for different units. Further, if a unit happens to be inefficient, relative to the others, when most favorable weights are chosen, then it is inefficient, independent of the choice of weights. Thus, given a set of weights, we define the efficiency with which a DMU processes the inputs to produce outputs as the ratio of the weighted sum of outputs to the weighted sum of inputs.

$$\text{Efficiency} = \frac{\sum_{r=1}^{s} u_r y_{rj}}{\sum_{i=1}^{m} v_i x_{ij}} \qquad (1)$$

The weights for a DMU are determined using mathematical programming as those that will maximize the efficiency of a DMU subject to the condition that the efficiency of other DMUs (calculated using the same set of weights) is restricted to values between 0 and 1. The weights are chosen that only most efficient units will reach the upper bound of the efficiency measure, chosen as 1. Let us take one of the DMUs, say the oth DMU as the reference DMU under evaluation whose efficiency (E_o) is to be maximized. Therefore, to compute the DEA efficiency measure for the oth DMU, we have to solve the following fractional linear programming model:

$$\max E_o = \frac{\sum_{r=1}^{s} u_r y_{ro}}{\sum_{i=1}^{m} v_i x_{io}} \qquad (2)$$

subject to

$$\frac{\sum_{r=1}^{s} u_r y_{rj}}{\sum_{i=1}^{m} v_i x_{ij}} \leq 1,\ j = 1,..,n \qquad (3)$$

$u_r \geq \varepsilon$, $r = 1,\ldots,s$

$v_i \geq \varepsilon$, $i = 1,\ldots,m$

where ε is an infinitesimal or non-Archimedean constant that prevents the weights from vanishing (Charnes, et. al., 1994). When we solve the above mathematical program, we get the optimal objective function (3.2) that represents the efficiency of DMU_o. If the efficiency is unity, then the firm is said to be efficient, and will lie on the efficiency frontier. Otherwise, the firm is said to be relatively inefficient. To find the efficiency measure of other DMUs, we have to solve the above mathematical program by considering each of the DMUs as the reference DMU. Therefore, we obtain a Pareto efficiency measure where the efficient units lie on the efficiency frontier (Thanassoulis, 2001). The fractional mathematical

programs are generally difficult to solve. To simplify them, we should convert them to a linear program format. The fractional program (2), (3) can be conveniently converted into an equivalent linear program by normalizing the denominator using the constraint $\sum_{i=1}^{m} v_i x_{io} = 1$. As the weighted sum of inputs is constrained to be unity and the objective function is the weighted sum of outputs that has to be maximized.

$$\max \sum_{r=1}^{s} u_r y_{ro} \qquad (4)$$

subject to

$$\sum_{i=1}^{m} v_i x_{io} = 1, \qquad (5)$$

$$\sum_{r=1}^{s} u_r y_{rj} - \sum_{i=1}^{m} v_i x_{ij} \leq 0, \; j = 1,..,n,$$

$$u_r \geq \varepsilon, \; r = 1,\ldots,s$$

$$v_i \geq \varepsilon, \; i = 1,\ldots,m$$

This model is the CCR (Charnes, Cooper, and Rhodes) model. Similarly, a general input minimization CCR model can be represented as

$$\min \sum_{i=1}^{m} v'_i x_{io} \qquad (6)$$

subject to

$$\sum_{r=1}^{s} u'_r y_{ro} = 1$$

$$\sum_{r=1}^{s} u'_r y_{rj} - \sum_{i=1}^{m} v'_i x_{ij} \leq 0, \; j = 1,..,n, \qquad (7)$$

$$u_r \geq \varepsilon, \; r = 1,\ldots,s$$

$$v_i \geq \varepsilon, \; i = 1,\ldots,m$$

According to the basic linear programming, every linear programming problem (usually called the primal problem) has another closely related linear program, called its dual. Therefore, the dual of the output maximizing DEA program is as follows:

$$\theta^* = \min \theta \qquad (8)$$

subject to

$$\sum_{j=1}^{n} \lambda_j x_{ij} \leq \theta x_{io}, \; i = 1,\ldots,m$$

$$\sum_{j=1}^{n} \lambda_j y_{rj} \geq y_{ro}, \; r = 1,\ldots,s \qquad (9)$$

$$\lambda_j \geq 0,$$

θ unrestricted.

If $\theta^* = 1$, then the current input levels cannot be reduced, indicating that DMU_o is on the frontier. Otherwise, if $\theta^* < 1$, then DMU_o is dominated by the frontier. θ^* represents the input-oriented efficiency score of DMU_o. The individual input reduction is called slack. In fact, both input and output slack values may exist in model (8)

$$s_i^- = \theta^* x_{io} - \sum_{j=1}^{n} \lambda_j x_{ij} \qquad i = 1,\ldots,m$$

$$s_r^+ = \sum_{j=1}^{n} \lambda_j y_{rj} - y_{ro}, \qquad r = 1,\ldots,s \qquad (10)$$

To determine the possible non-zero slacks after solving the linear program (8), we should solve the following linear program:

$$\max \sum_{i=1}^{m} s_i^- + \sum_{r=1}^{s} s_r^+$$

subject to

$$\sum_{j=1}^{n} \lambda_j x_{ij} + s_i^- = \theta^* x_{io}, \; i = 1,\ldots,m$$

$$\sum_{j=1}^{n} \lambda_j y_{rj} - s_r^+ = y_{ro}, \; r = 1,\ldots,s \qquad (11)$$

$\lambda_j \geq 0$,

θ unrestricted.

DMU_o is efficient if and only if $\theta^* = 1$ and $s_i^{-*} = s_r^{+*} = 0$ for all i and r. DMU_o is weakly efficient if and only if $\theta^* = 1$ and $s_i^{-*} \neq 0$ and (or) $s_r^{+*} \neq 0$ for some i and r. In fact models (3.8) and (3.9) represents a two-stage DEA process that can be summarized in the following DEA model:

$$\min \; \theta - \varepsilon\left(\sum_{i=1}^{m} s_i^- + \sum_{r=1}^{s} s_r^+ \right)$$

subject to

$$\sum_{j=1}^{n} \lambda_j x_{ij} + s_i^- = \theta x_{io}, \; i = 1,\ldots,m$$

$$\sum_{j=1}^{n} \lambda_j y_{rj} - s_r^+ = y_{ro}, \; r = 1,\ldots,s \qquad (12)$$

$\lambda_j \geq 0$,

θ unrestricted.

DATA AND METHODOLOGY

We study sixteen apparel firms in order to benchmark their advertising dollars impact on sales, profit margins, growth, return on assets, return on equity, and return on investment. Sixteen firms included in this study are: Alpha Pro Tech, American Apparel Inc., Carter's Inc., Columbia Sportwear Co., G-III Apparel Group Ltd, Gildan Activewear Inc., Joe's Jeans Inc., Jos A Bank Clothier Inc., Oxford Industries Inc., Phillips-Van Heusen Corp, Tandy Brands Accessories, True Religion Apparel Inc., Under Armour Inc., Unifirst Corp, VF Corp, Vlov Inc. The data for this study is from S&P Netadvantage and Schonfeld & Associates, Inc.'s advertising ratios and budgets. The data is for the year 2011. In order to benchmark the impact of advertising on sales, profit margin, growth, return on assets, return on equity, and return on investment for sixteen apparel companies, we consider the following

seven ratios: Ad-to-sales ratio, Ad-to-margin ratio, Ad-growth percentage, Return on Assets, Return on Equity, Return on Investment, and Sales Growth.

Section III describes the computational details of the DEA model. In addition, there are many non-computational aspects that are crucial to the application of DEA procedures. Besides the mathematical and computational requirements of the DEA model, there are many other factors that affect the specifications of the DEA model. These factors relate to the choice of the DMUs for a given DEA application, selection of inputs and outputs, choice of DMUs for a given DEA application, selection of inputs and outputs, choice of a particular DEA model (e.g. CRS, VRS, etc.) for a given application, and choice of an appropriate sensitivity analysis procedure (Ramanathan, 2003). Due to DEA's non parametric nature, there is no clear specification search strategy. However, the results of the analysis depend on the inputs/outputs included in the DEA model. There are two main factors that influence the selection of DMUs – homogeneity and the number of DMUs. To successfully apply the DEA methodology, we should consider homogenous units that perform similar tasks, and accomplish similar objectives. In our study, the firms are homogenous as they compete with each other in the same market. Furthermore, the number of DMUs is also an important consideration. The number of DMUs should be reasonable so as to capture high performance units, and sharply identify the relation between inputs and outputs. There are some simple rules of thumb that guide the selection of inputs and outputs, and the number of participating DMUs. The following are the guidelines for DMU model selection:

a. The number of DMUs is expected to be larger than the product of number of inputs and outputs (Darrat et. Al., 2002; Avkiran, 2001) to discriminate effectively between efficient and inefficient DMUs. The sample size should be at least 2 or 3 times larger than the sum of the number of inputs and outputs (Ramanathan, 2003).
b. The criteria for selction of inputs and outputs are also quite subjective. A DEA study should start with an exhaustive, mutual list of inputs and outputs that are considered relevant for the study. Screening inputs and outputs can be quite quantitative (e.g. statistical) or qualitative that are simply judgmental, use expert advice, or use methods such as analytical hierarchy process (Saaty, 1980). Typically inputs are the resources utilized by the DMUs or condition affecting the performance of DMUs. On the other hand, outputs are the benefits generated as a result of the operation of the DMUs, and records higher performance in terms of efficiency. Typically, we should restrict the total number of inputs and outputs to a reasonable level. As the number of inputs and outputs to a reasonable level. As the number of inputs and outputs increases, more number of DMUs get an efficiency rate of 1, as they become too specialized to be evaluated with respect to other units (Ramanathan, 2003).

To apply the DEA model, the major issue is to decide on the variables to be used as inputs and outputs. We can apply a simple measure of a cost and efficiency to determine the variables that should be minimized or maximized. A variable that has a cost associated with it should be minimized. On the other hand, a variable that indicates some measure of effectiveness should be maximized. A company wants to maximize return on assets, return on equity, return on investment, sales growth, and minimize ad-to-sales ratio, ad-to-margin ratio, and ad-growth percentage. Therefore, we use ad-to-sales ratio, ad-to-margin ratio, and ad-growth percentage as input variables and return on assets, return on equity, return on investment, sales growth as output variables. Finally, the choice of the DEA model is also an important consideration. We should select the appropriate DEA model with options such as input maximizing or output minimizing, multiplier or envelopment, and constant or variable returns to scale. DEA applications that involve inflexible inputs or not fully under control inputs should use output-based formulations. On the contrary, an application with outputs that are an outcome of managerial goals,

input-based DEA formulations are more appropriate. In addition, for an application that emphasizes inputs and outputs, we should use multiplier version. Similarly, for an application that considers relations among DMUs, envelopment models are more suitable. Furthermore, the characteristics of the application dictate the use of constant or variable returns to scale. If the performance of DMUs depends heavily on the scale of operation, constant returns to scale (CRS) is more applicable, otherwise variable returns to scale is a more appropriate assumption.

In our study, both inputs and outputs of apparel firms are important. Therefore, we select the multiplier model for our analysis. In addition, the output factors used in the study: return on assets, return on equity, return on investment, and sales growth are a direct outcome of managerial policies. Therefore, we use input-based formulation for our study. Furthermore, the performance of these firms does not depend on the scale of operations, thus variable returns to scale is safe assumption. Also, the structure of the DEA model uses an equation and separate calculation for every input and output. Therefore, all the input and output variables can be used simultaneously and measured in their own units. Thus, we apply the input-oriented multiplier model (4 & 5) to estimate the efficiency of the apparel companies so as to study the impact of advertisement.

EMPIRICAL ANALYSIS

As the data for this study is from S&P Netadvantage and Schonfeld & Associates, Inc.'s advertising ratios and budgets, each of the firms is a comparative, homogenous unit, and we can apply the DEA methodology to asses a comparative performance of these organizations. As illustrated above we use ad-to-sales ratio, ad-to-margin ratio, and ad-growth percentage as input variables and return on assets, return on equity, return on investment, sales growth as output variables. The study analyzes the performance of 16 apparel firms using the multiplier model. Using the DEA methodology, we calculate an efficiency score for the 16 firms on a scale of 1 to 100 for the year 2011. Table 1 illustrates the efficiency scores and the rankings of the 16 firms. As illustrated in Table 1, in the year 2011, 10 firms are 100% efficient as compared to all other firms. These firms are: Alpha Pro Tech, G-III Apparel Group Ltd, Joe's Jeans Inc., Jos A Bank Clothier Inc., Oxford Industries Inc., Phillips-Van Heusen Corp, Tandy Brands Accessories, True Religion Apparel Inc., Under Armour Inc., Unifirst Corp, VF Corp, Vlov Inc. The other firms in the order of increasing efficiency in the range of 80%-89% efficiency are: Carter's Inc., Columbia Sportwear Co., and Gildan Activewear Inc. In addition, American Apparel Inc. is 59% efficient.

Figure 1 illustrates the efficiency factor as a bar chart. The pareto-efficient firms form the efficiency frontier, and the inefficient firms are below the efficiency frontier. Once we identify inefficient apparel firms, the next step is to identify the efficient peer group or firms whose operating practices can serve as a benchmark to improve the performance of these firms. Table 2 illustrates the peer group for the inefficient firms. As shown in the table, Phillips-Van Heusen Corp and Tandy Brand Accessories serve as peer for American Apparel Inc. In addition, American Apparel is more comparable to Tandy Brand Accessories (weight 89%) and less comparable to the more distant peer Phillips-Van Heusen Corp (11%). Thus, American Apparel Inc. should scale up its return on assets, return on equity, return on investment, sales growth to make them comparable with Tandy Brand Accessories. Similarly, Carter's Inc. has Unifirst Corp. (58%) as the closest peer that it should emulate and Phillips-Van Heusen (24%) as the distant peer firm and Vlov Inc. (18%) that can also be investigated. Columbia Sportwear Co. has Unifirst Corp. (70%) as its immediate peer, and Phillips-Van Heusen (21%) as its next distant peer, and

Vlov Inc. (9%) as its far distant peer. Similarly, Gildan Activewear Inc. has Unifirst Corp. (66%), Jos A Bank Clothier Inc.(29%), and Tandy Brand Accessories (6%) as its peers. Unifirst Corp. is the most immediate for most of the inefficient firms. On the other hand, Phillips-Van Heusen is the distant or far distant peer for three inefficient firms. Similarly, Gildan Activewear Inc. is the far distant peer for one of the and Columbia Sportwear Co. Vlov Inc. is the far distant peer for Carter's Inc. inefficient firms and immediate peer for Axis Firm. Therefore, Unifirst Corp. is the most efficient firm among all the firms as not only are 100% efficient, but also serves as the role model for all (except one) firms. Similarly, Tandy Brands Accessories is the next most efficient firm among the group of given firms. Likewise, Phillips-Van Heusen serves as the next far distant peer firm for all firms (except one). Similarly, Jos A Bank Clothier Inc. is the next immediate peer for Gildan Activewear Inc. as the two firms share similar characteristics. Thus, Phillips-Van Heusen and Jos A Bank Clothier Inc. are the next most efficient firms among the group of firms under consideration. The efficient peer firms have a similar mix of input-output levels to that of the corresponding inefficient firm, but at more absolute levels. The efficient firms generally have higher output levels relative to the firm in question. The features of efficient peer firms make them very useful as role models that inefficient firms can emulate to improve their performance. Furthermore, Unifirst Corp. is used as an efficient peer to almost all Pareto-inefficient firms, so their frequency of use as an efficient-peer, expressed as a percentage of the number of pareto-inefficient firms, is 75%. Thus, we have enhanced confidence that Unifirst Corp. is a truly well performing firms as they outperform all the other firms. Similarly, Tandy Brand Accessories serve as a peer to one of the inefficient firms. Furthermore, these firms are more likely to be a better role model for less efficient firms to emulate because their operating practices and environment match more closely those of the bulk of firms.

After calculating the efficiency of a firm using DEA, and identifying the efficient peers, the next step in DEA analysis is feasible expansion of the output or contraction of the input levels of the firm within the possible set of input-output levels. The DEA efficiency measure tells us whether or next firm can improve its performance relative to the set of firms to which it is being compared. Therefore, after maximizing the output efficiency, the next stage involves calculating the optimal set of slack values with assurance that output efficiency will not increase at the expense of slack values of the input and output factors. Once efficiency has been maximized, the model does seek the maximum sum of the input and output slacks. If any of these values is positive at the optimal solution to the DEA model that implies that the corresponding output of the firm (DMU) can improve further after its output levels have been raised by the efficiency factor, without the need for additional input. If the efficiency is 100% and the slack variables are zero, then the output levels of a firm cannot be expanded jointly or individually without raising its input level. Further, its input level cannot be lowered given its output levels. Thus, the firms are pareto-efficient with technical output efficiency of 1. If the firm is 100% efficient but one slack value is positive at the optimal solution then the DEA model has identified a point on the efficiency frontier that offers the same level on one of the outputs as firm A in question, but it offers in excess of the firm A on the output corresponding to the positive slack. Thus, firm A is not Pareto-efficient, but with radial efficiency of 1 as its output cannot be expanded jointly. Finally, if the firm A is not efficient (<100%) or the efficiency factor is greater than 1, then the firm in question is not Pareto-efficient and efficiency factor is the maximum factor by which both its observed output levels can be expanded without the need to raise its output. If at the optimal solution, we have not only output efficiency > 1, but also some positive slack, then the output of firm A corresponding to the positive slack can be raised by more than the factor output efficiency, without the need for additional input. The potential additional output at firm A is not reflected in its efficiency measure because the additional output does not apply across all output dimensions. Table 3 illustrates the slack values identified in the

next stage of the DEA analysis. The slack variables for 100% efficient firms as well as less than 100% efficient firms are not zero. Therefore, all the firms used in this study are not Pareto-efficient as the DEA model has been able to identify some feasible production point which can improve on some other input or output level. For example, for American Apparel Inc., besides increasing the output level of Return on Assets by 23.40 units, there is further scope for increasing interest to Return on equity by 96.86 (units), Return on Investment by 20.82 (units), and Sales Growth percentage by 24.16 (units). In addition American Apparel Inc. can also shrink the input level of Advertisement growth percentage by (.24%). American Apparel Inc. can follow Tandy Brands Accessories and Phillips-Van Heusen as its role models and emulate their policies. Similarly, Carter's Inc. can reduce its Advertisement growth percentage by 2.56 units and Return on Assets by 10.09 units, Return on equity by 20.20 (units), Return on Investment by 9.36 (units), and Sales Growth percentage by 9.38 (units)while maintaining efficient levels equivalent to that of its peers—Unifirst Corp. and Phillips-Van Heusen. On the same lines, we can find slack values for Columbia Sportwear Co., and Gildan Activewear Inc. Table 3 illustrates the slack values of the relevant factors for inefficient firms.

In addition, we can also record the optimal multipliers of the multiplier model. Table 4 illustrates the optimal multipliers for all the firms. Thus, we can also calculate the impact that one unit change in either input or output will have on the efficiency rating. For example American Apparel is 51% efficient. Thus, to become relatively efficient, we should increase the efficiency by 100-59% or 41%. Using the increment of 41%, we can calculate that we should reduce advertisement growth % by (.41/.02) or 19.09 units and increase sales growth % by (.41/.04) or 10.22 units. Table 5 illustrates the deficit or surplus calculations after using optimal multipliers.

SUMMARY AND CONCLUSIONS

Using data envelopment analysis approach, this study compares the relative performance of sixteen apparel companies against one another with seven performance variables as the benchmark parameters for the year 2011. This study finds that Alpha Pro Tech, G-III Apparel Group Ltd, Joe's Jeans Inc., Jos A Bank Clothier Inc., Oxford Industries Inc., Phillips-Van Heusen Corp, Tandy Brands Accessories, True Religion Apparel Inc., Under Armour Inc., Unifirst Corp, VF Corp, Vlov Inc. consistently outperform all the other firms with 100% relative efficiency. In addition, Carter's Inc., Columbia Sportwear Co., Gildan Activewear Inc., and American Apparel Inc. The study also shows the areas in which inefficient firms are lagging behind and how they can improve their performance to bring them at par with other firms.

TABLES, FIGURES, & REFERENCES

Tables, figures, references, and full paper available upon request from the authors.