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Measuring the Efficiency of Marketing Efforts in the Indian Pharmaceutical Industry using Data Envelopment Analysis

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Abstract

Pharmaceutical companies have been spending huge amount of money on marketing and promotions, sales distribution, and travelling done by the sales representatives. However, they find it difficult to directly link the returns with these efforts. This study makes an attempt to examine whether the marketing efforts have significant influence on the sales performance in the industry. It uses the DEA model (Data Envelopment Analysis) to assess the efficiency of marketing efforts by pharmaceutical companies, and uses random effects maximum likelihood panel regression to assess the significance of the impact of marketing efforts.

Keywords: Pharmaceutical Industry, Marketing Efforts, Sales Performance, DEA Model, Random Effects Maximum Likelihood Panel Regression

Introduction

The pharmaceutical industry is a major segment of the Indian healthcare industry. It includes the industrial manufacture, separation, processing, refining and packaging of chemical materials. The Indian pharmaceutical industry meets around 70% of the country's demand for bulk drugs, drug intermediates, pharmaceutical formulations, chemicals, tablets, capsules, orals and injectables. It is ranked 3rd in terms of volume and 14th in terms of value globally. The domestic pharmaceuticals market was worth US$ 19.22 billion in 2012, and is expected to grow to US$ 55 billion in 2020.[1]

The Indian pharmaceutical industry is a highly competitive market, with a growth rate of 16% in 2012. There are almost 20,000 small and big players in the industry who strive hard to capture the market share by differentiating themselves from one another. Both domestic and global pharmaceutical market has become competitive and margins are reducing, so presently the industry is concentrating on manufacturing cost effective drugs in order to make exports possible. Today most companies in the industry have adopted or are in the process of adopting good manufacturing practices so that their products become easily acceptable both by domestic as well as international customers.

1 McKinsey Report on 'India Pharma 2020: Propelling access and acceptance, realizing true potential'

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Marketing practitioners and scholars are under tremendous pressure to be more accountable for and to show how marketing expenditure adds to shareholder value. This apparent lack of accountability has undermined marketing's credibility and threatened marketing's standing in the pharmaceutical companies. There are three challenges for justifying marketing investments to measure marketing productivity: firstly, the challenge of marketing activities to long-term effects, and secondly, the separation of individual marketing activities from other actions, and finally, the use of purely financial methods.

There has been a continuous attempt to relate marketing efforts in terms of cost with respect to sales, and this has been a very relevant requirement in the pharmaceutical industry, where marketing activities are quite unique. There are difficulties in directly relating marketing effort to sales in most industries, as many extraneous variables other that marketing inputs affects sales. This often leads to incomplete and erroneous calculation of marketing effectiveness. However in the pharmaceutical industry, the success of products is predominantly dependent on marketing and sales efforts, as other factors have relatively less influence. The usual promotional strategies and modes common in consumer product industries are not so significant here as the sales of the products in this industry largely depend on the efforts of the sales force. As the influence of extraneous variables beyond marketing efforts is less in amount and intensity, it is easier to relate marketing efforts to sales performance and assess its effectiveness in the pharmaceutical industry. In this context, the present study attempts to examine the impact of marketing efforts on sales in the pharmaceutical industry in India.

Literature Review

The literature on marketing efforts is wide, especially for the pharmaceutical industry. One strand of literature focuses on marketing modeling, mathematically relating sales to different marketing efforts. Sinha & Zoltners (2001) emphasized the use of models in measuring sales activities, and suggested why new sales models were required to be looked into to measure performances in pharmaceutical industry. Momaya & Ambastha (2004) emphasized on the usage of mathematical model to understand enhanced competitiveness in pharmaceutical industry. Gagnon & Lexchin (2008) argued that the pharmaceutical industry is marketing-driven, with spending on promotion almost twice as much as spending on research and development. de Boeck *et al*. (2010) argued why the existing sales force marketing model need to be changed and a more relevant outlook is required.

On the other hand, another strand of literature focuses on the effectiveness of marketing efforts. Elling *et al*. (2002) argued that the system of assessing sales cost effectiveness was costly, inefficient, and rife with dissatisfaction, and for these reasons, pharmaceutical companies are considering what can be done to transform their sales model. Momaya & Ambasta (2004) suggested a change in sales force effectiveness measure for Indian pharmaceutical firms to compete in global markets. Gupta & Nair (2009) identified the need for pharmaceutical companies to reduce cost in sales effort and streamline the marketing activities.

Jakovcic (2009) discussed the impact that sales force has on sales, costs and profits, in both the short and the long term. He discussed different situations for sizing a sales force such as expansion into new markets, new product launches and downsizing, and he discussed three different methods that companies use to size their sales force. Agarwal *et al*. (2010) questioned the tradition ROI method to assess sales efforts and emphasizes the need of a new perspective to measure the marketing and sales effectiveness.

Palo & Murphy (2010) focused on the key forces that re-shape the pharmaceutical marketplace, including the growing power of healthcare payers, providers and patients, and the changes required to create a marketing and sales model that is fit for the 21st century. These changes will enable the industry to market and sell its products more cost-effectively, to create new opportunities and to generate greater customer loyalty across the healthcare spectrum.

According to Mariani (2008), companies can monitor the effects of promotional efforts through territorial market dynamics evaluation. Tools are applied in order to isolate the single contribution to information and product prescription. Medical-scientific information, like advertising and promotion, has the goals to improve brand and product notoriety, to improve the perception of product characteristics, and to augment the prescriptive propensity.

Performance measurement also has a wide literature. The balanced scorecard technique was proposed by Kaplan *et al*. (Kaplan & Norton, 1992, 1993, 1996) to understand the correlation between performance and strategies. Performance management received the focus of attention in the last two decades to analyse the multidimensional nature of the firm's performance (Anthony & Govindarajan, 2003; Kaplan & Norton, 1992, 1993, 1996; Zhu, 2000). However, the multidimensional performance measure may not be able to capture the various weights of the parameters explicitly (Ittner *et al*., 2003). Marketing efficiency can be measured in different ways: like (1) the net income generated by a marketing campaign divided by its cost, (2) the value premium attributable to a brand's reputation, (3) the customer lifetime value, which is the net present value of the revenue expected from a customer over the lifetime of the business relationship (Rust *et al*., 2004).

In this backdrop, the present study adopts data envelopment analysis (DEA) to analyse the performance of Indian pharmaceutical industry with respect to the multiple dimensions of their marketing efforts, in terms of tangible resources invested.

Methodology

The objective of the study is to measure the efficiency of marketing efforts of pharmaceutical companies in India. The sample companies selected for the study represented the top eleven pharmaceutical MNCs, with India-wide operations. Two of the companies, FKO and Organ on, were not considered for the analysis, as they represented very specialised segments, so that the final sample for the study included nine pharmaceutical MNCs. The study period was 2002-03 to 2011-12. The data for the study were collected from the Capitaline database.

The study uses data envelopment analysis (DEA) to measure the efficiency of marketing efforts in Indian pharmaceutical companies. DEA was first developed by Farrell (1957), and extended by Charnes *et al*. (1978). It is a non-parametric method that identifies what proportion of a unit's inputs are actually required to produce its given levels of outputs, as compared to other units. Mathematically, it is represented by the model expressed below.

$$\begin{aligned} \min E \quad s.t. \quad & \sum w_j = 1 \\ & \sum w_j I_{ij} \leq E.I_{i*} \\ & \sum w_j O_{ij} \geq O_{i!*} \end{aligned}$$

The inputs used in the study include marketing and promotional expenditure, distribution and selling expenditure, and travel expenditure. Marketing and promotional expenditure includes advertising expenditure, expenditure on sales promotions, and expenditure on marketing materials. Distribution and selling expenditure, for both primary and secondary sales, includes the costs of maintaining inventory through various channel members, logistics costs, and insurance costs. Travel expenditure, which is one the most significant marketing efforts in the pharmaceutical industry, includes travelling costs for marketing calls and other trade-related promotional activities. Sales revenue is taken as the output.

The study also considers a nonlinear form of DEA, taking logarithmic data in place of the input and output variables. The model is expressed as below.

$$\begin{aligned} \min E \quad s.t. \quad & \sum w_j = 1 \\ & \sum w_j \ln(I_{ij}) \leq E.\ln(I_{i*}) \\ & \sum w_j \ln(O_{ij}) \geq \ln(O_{i!*}) \end{aligned}$$

To examine the impact of marketing effort on the efficiency scores, random-effects maximum likelihood panel regression was performed. Panel data allows control for unobservable company specific factors or heterogeneity, or change in variables that vary over time but not over entities (for example, macroeconomic policies). The dependent variable was the efficiency of a particular company, and the independent variables were the proportion of marketing and promotional expenditure, the proportion of distribution and selling expenditure, and the proportion of travel expenditure. It was assumed that the company specific unobserved variables were not correlated with the independent input variables. Thus, a random-effects model was used rather than a fixed-effect model, in which the unobserved company specific heterogeneity is constant and its effect does not change over time.

Formally, the model for firm *i* at time *t* can be represented as:

$$E_{it} = \beta_1 MPE_{it} + \beta_2 DSE_{it} + \beta_3 TrE_{it} + u_i + \epsilon_{it}$$

where MPE represents the proportion of marketing and promotional expenditure, DSE represents the proportion of distribution and selling expenditure, and TrE represents the proportion of travel expenditure. The specification is linear, with the random effect captured in the term u_i, a firm-specific time-invariant random variable. It should be noted that because the proportions add up to unity, only two of these will form a linearly independent system allowing recoverability of parameter estimates, so that the model is specified without a constant term. The maximum likelihood method is used to estimate the parameters, fitting a normal distribution to u_i. The dependent variables are the linear efficiency scores and the nonlinear efficiency scores, in turn.

Findings

The marketing efforts distribution and the overall efficiency scores of the pharmaceutical companies are shown in Table 1.

The company with highest efficiency scores was Abbott (which was 100% efficient in all years except for 2005-06) with an average efficiency score of 99.14%. The company seems to have shifted its marketing efforts, with a decrease in the proportion of distribution and selling expenditure by almost 50%, and an increase in the proportion of marketing and promotional expenditure.

The company with next-highest efficiency was Glaxo SmithKline (which has been 100% efficient from 2006-07 onwards), with an average efficiency score of 97.68%. The company seems to have maintained a consistent marketing effort distribution, with almost equal emphasis on distribution and selling expenditure and travel expenditure, and almost twice as much emphasis on marketing and promotional expenditure.

Pfizer has experienced a different trend in efficiency. The company showed a continuous increase in efficiency until 2007-08, reaching 91.76%, and thereafter dropping to 54.15% in 2011-12. The company seems to have shifted its marketing efforts, with a decrease in the proportion of marketing and promotional expenditure, and an increase in the proportion of distribution and selling expenditure. Interestingly, in 2007-08, at the peak of its efficiency, the company had reached a high proportion of marketing and promotional expenditure and distribution and selling expenditure.

The company with lowest efficiency was Merck, which was 100% efficient in 2002-03, and which dramatically slipped to 36.43% in 2007-08, with some recovery to 60.06% in 2011-12. This could have been affected by the regime change in European Union health industry regulations in 2007, as a significant proportion of Merck's sales are to the European Union. The company seems to have shifted its marketing efforts, with a decrease in the proportion of distribution and selling expenditure and travel expenditure, and an increase in the proportion of marketing and promotional expenditure.

Novartis also experienced consistently low efficiency, with an average efficiency score of 64.03%. The company also seems to have shifted its marketing efforts, with an

Table 1: Marketing Efforts Distribution and Average Efficiency of the Sample Companies

Company	*%age Marketing & Promotional Exp*	*%age Distribution & Selling Exp*	*%age Travel Exp*	*Efficiency*	*Nonlinear Efficiency*
Pfizer	49.83%	24.49%	25.68%	72.36%	86.19%
Abbott	43.89%	22.75%	33.35%	99.14%	98.74%
Astrazeneca	36.66%	17.45%	45.89%	67.19%	72.16%
Novartis	54.81%	25.01%	20.18%	64.03%	79.27%
Sanofi	40.44%	26.81%	32.75%	75.28%	84.94%
Merck	39.45%	24.48%	36.06%	58.64%	73.23%
GSK	48.59%	25.92%	25.49%	97.68%	98.76%
Fulford	17.40%	31.23%	51.37%	84.40%	87.23%
Wyeth	48.98%	22.95%	28.07%	76.08%	75.61%
average	42.23%	24.57%	33.20%	77.20%	84.01%

Table 2: Random-effects Maximum Likelihood regressions

	Dependent variable: linear efficiency score				*Dependent variable: nonlinear efficiency score*			
	Coeff.	Std. Err.	z stat	P > |z|	Coeff.	Std. Err.	z stat	P > |z|
MPE	0.2914	0.1103	2.64	0.008**	0.6202	0.0714	8.69	0.000**
DSE	0.4802	0.1920	2.50	0.012*	0.8273	0.1283	6.45	0.000**
TrE	1.6150	0.1891	8.54	0.000**	1.1399	0.1244	9.17	0.000**
σu	0.1694	0.0457			0.1033	0.0280		
σe	0.1359	0.0108			0.0918	0.0073		
ρ	0.6084	0.1363			0.5589	0.1417		
Wald $\chi2$	207.69				569.68			
Prob > $\chi2$	0.000**				0.000**			
Log Likelihood	39.2925				75.5034			

* significant at 5%

** significant at 1%

increase in the proportion of marketing and promotional expenditure and travel expenditure, and a decrease in the proportion of distribution and selling expenditure.

To examine the impact of marketing effort on the efficiency scores, random-effects maximum likelihood panel regression was performed. The results are presented in Table 2.

The random effect models were significant, as indicated by the Wald test. The linear efficiency scores were found to be positively impacted by all three categories of marketing expenditures, and all coefficients were significant at a 5% level. Further, increasing the proportion of travel expenditure is the most effective way to increase efficiency, followed by distribution and selling expenditure and marketing and promotional expenditure. Thus reducing expenditure on marketing and promotional activities and increasing expenditures on travelling as well as distribution and selling would improve efficiency. The firm-specific heterogeneity is estimated to have a standard deviation of 0.1694 and the error term has an estimated standard deviation of 0.1359. The contribution of firm-specific heterogeneity to overall unobserved variability is 60.84%, as captured by the estimate ρ.

The nonlinear efficiency scores showed similar results. This model appears to be a better fit, as it had a higher log-likelihood compared to the linear efficiency scores. All coefficients were significant at 1% level. Here the coefficient estimates indicate the percentage improvement in efficiency if the allocation to a particular marketing expenditure category is increased by 1%. The results are similar to those of linear efficiency scores: reducing expenditure on marketing and promotional activities and increasing expenditures on travelling as well as distribution and selling would improve efficiency.

Discussion

The variables considered in the study were marketing and promotional expenditure, distribution and selling expenditure, and travel expenditure. All the three variables had a significant impact on the efficiency scores, with travel expenditure being the most significant followed by distribution and selling expenditure and marketing and promotional expenditure. The log-likelihood ratio statistics for the nonlinear efficiency score model was considerably higher than that of the linear efficiency score model, suggesting that nonlinear efficiency score may be a more appropriate indicator for efficiency of marketing efforts in the pharmaceutical industry.

The above efficiency characteristics observed seems to align with the practicalities of marketing efforts in the pharmaceutical industry. In the Indian pharmaceutical industry where sales takes place by direct interaction of the sales force to the doctors and medical associations, it is quite pertinent that more travelling would lead to higher exposure and reach in the market, leading to possible enhancement in sales. Distribution also is an important aspect as availability of drugs in the market in due and appropriate time is an essential requirement. Promotional activities are unique in pharmaceutical industry, and

though an important aspect, it is primarily a support function compared to travelling and distribution.

There were some limitations inherent in the study. The study included only nine MNC pharmaceutical firms which contribute to about 55% of prescribed drugs in India. The study can be made more extensive by considering more number of pharmaceutical firms. Domestic pharmaceutical companies in India can be also included to find out whether similar characteristics persist or not. Further, the study can be extended to global perspectives by including pharmaceutical firms which operate in other domestic scenarios in different countries. Also, the variables considered were limited to only major aspects of marketing efforts, and disaggregated data were not available. The study can be extended to include other variables related to marketing efforts, such as sales force size, territorial spread, average sales calls made, and so on.

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