

Developing Global Competitiveness by Assessing Organized Retail Productivity Using Data Envelopment Analysis

Ms. Pooja Vyas
Research Scholar, IMSAR,
M.D. University, Rohtak (Hr.)
Email id: Pooja.vyas9@gmail.com

Abstract: *The purpose of this paper was to find out efficiently some of the top organized India retail companies have been performing relative to each other over the years and thereby to identify factors that help increase the efficiency of a retail company. The paper is deemed to be helpful to enable Indian retail companies gain a competitive advantage in the face of increased competition being faced in the emerging organized retail sector in India. The findings brought forth Advertising and Marketing expenses as the significant performance determining factors to be paid attention to.*

Keywords: Global Competitive Advantage, Organized Retail, Data Envelopment Analysis (DEA),

Performance Determinants,
Performance Indicators

INTRODUCTION: With opportunities come challenges. Retail and real estate are the two booming sectors of India in the present times. Retail, one of India's upcoming industries, has presently emerged as one of the most dynamic and fast paced industries of recent times with several players entering the market. Accounting for over 10% of the country's GDP and around 8% of employment (Indian Retail Sector – An Outlook 2007-2013), retailing in India is gradually inching its way towards becoming the next boom industry. But, with this growth comes a host of challenges which existing players have to face and overcome to remain

successful in the coming onslaught of heightened competition.

The Indian Retail Sector: A shopping revolution is ushering in India where, a large population in the 20-34 age group in the urban regions is boosting demand. This has resulted in huge international retail investment and a more liberal FDI policy making India currently the most attractive destination for global retailers with a GRDI score of 92 and a growth rate of 25 to 30% in the year 2007. Since the time the Narsimha Rao Government kicked off reforms in 1991 and interest rate deregulation became a reality, the retail sector has been like a toddler waiting to grow big. It has taken some time but finally it seems that the evolution of organized retailing in India is picking up momentum.

According to the Global Edge report on Market Potential for Emerging Markets (2008), India ranks eleventh in the list and has been able to maintain itself around this Figure for quite some years now. In fact, according to Global

Retail Development Index (2007), India is positioned as the leading destination for retail investment topping the chart above Russia and China. Indian organized retail is growing at a faster pace than was expected and could constitute 25% of the overall retail sector by 2014. According to a study on retail sector prepared by Deloitte Haskins and Sells, organized retail in India had 8% share of overall retail market (total retail pie) in 2007 in comparison to 5% in the year 2006 and is expected to grow still further in the future.

REVIEW OF LITERATURE: Retail productivity is an important issue and vast literature was found on its definitions and measurements. A review of this literature showed that multiple methodologies have been applied to assess productivity of individual retail stores, groups of stores, and the retail industry as a whole, but surprisingly little attention has been given to comparing the efficiency of retail organizations in India. Understanding

and measuring the productivity and efficiency of retailers have been important issues in retailing research (e.g., Bucklin 1978; Ingene 1982, 1984; Richford and Brown 1985; Ratchford and Stoops 1988). Retail productivity has been considered important for society and for the individual retail firm (Bucklin, 1978; Ingene, 1984). But, despite a special issue of the Journal of Retailing in Fall, 1984 and subsequent researches, there is still no single widely accepted definition and measurement methodology for retail productivity. Most of the international studies of retail productivity in the 1950s were based heavily on concepts developed in productivity assessments in the manufacturing sector. The European Productivity Agency and the National Institute of Economic and Social Research had provided foundation studies of various industrial sectors and economists drew on these sources (Rostas, 1948). These studies effectively set the parameters for studies, not only related to manufacturing but also to retailing, for the next 30 years

(Deurinck, 1955). On these foundations, and comparable ones in USA, several studies of retail productivity were undertaken. While in essence the concepts remain relevant, much has changed over 50 years in respect of both the nature of retail productivity and the factors affecting this productivity thus requiring new and innovative methods for measuring retail productivity and efficiency.

OBJECTIVES OF THE PRESENT

STUDY: The present study was undertaken to understand the factors affecting the performance of organized retail in India so as to better understand ways to help companies develop global competitive advantage in the retail sector. In particular, the study focused on:

1. Identifying the factors that have an effect on the performance of organized retail in India.
2. Analysis of the affect of these performance determining factors on the performance indicating factors

3. Identifying the more significant performance determining factors

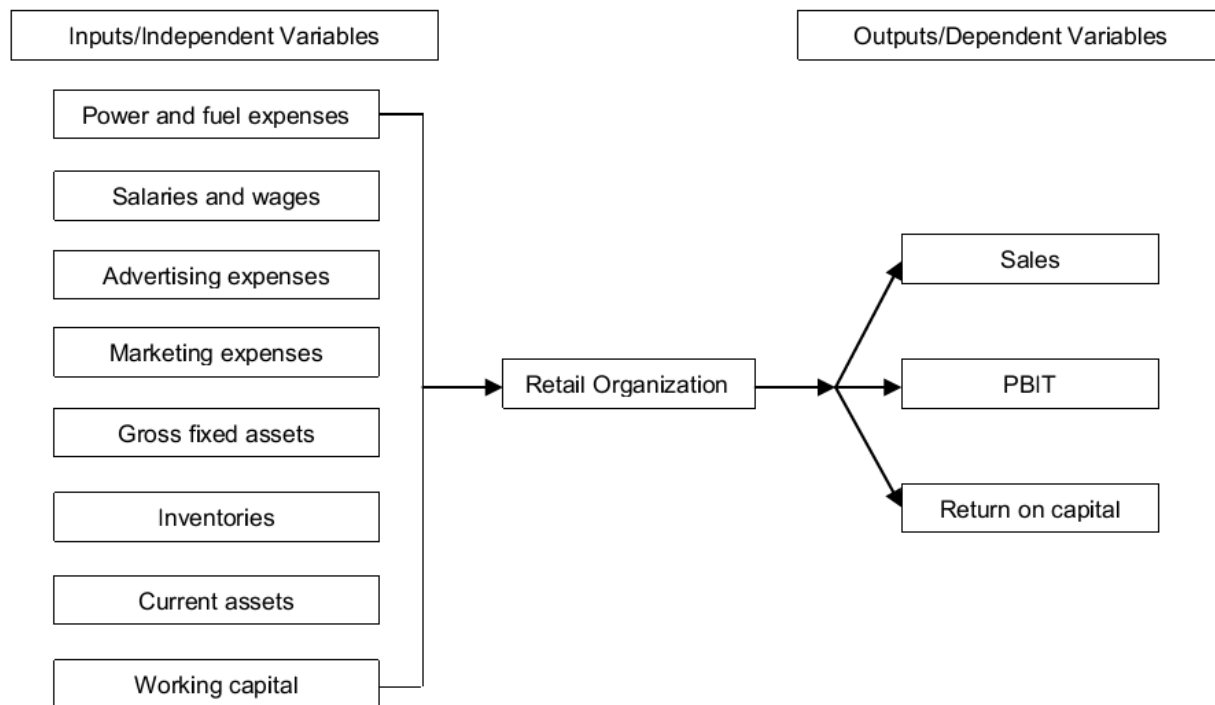
RESEARCH METHODOLOGY:

Data collection method & Justification of secondary source: The data used in this paper was collected from secondary sources. Data was obtained for 5 retail companies of India for the time period 2005 to 2012. The source of data was Prowess Database. Prowess is a database of large and medium Indian firms containing detailed information on over 20,000 firms. These comprise all companies traded on India's major stock exchanges and several others, including, the central public sector enterprises. The database covers most of the organized industrial activities such as banking, retailing, airlines and other service and manufacturing sectors of India. Prowess provides detailed information on each company including a normalized database of the financials covering 1,500 data items and ratios per company.

Besides, it provides quantitative information on production, sales, consumption of raw material and energy etc. As Prowess database has found useful applications in places where trust and reliability matter the most, Prowess became the preferred source of data in respect of the variables identified for the present study.

Selection of Variables: On the basis of literature studied, data was gathered in respect of 12 variables out of which 9 were taken as performance determinants and 3 as performance indicators. The performance determinants included Advertising Expenses, Marketing Expenses, Capital employed, Current Assets, Gross Fixed Assets, Inventories, Power and Fuel Expenses, Salaries and Wages and Working Capital, while the performance indicators included Sales, PBIT and Return on Capital Employed. The different variables considered for the study have been tabled in Figure 1.

Figure 1: Conceptual Input Output framework



Method of Analysis: Data was analyzed using two different techniques, Regression Analysis and DEA model. For Regression analysis, the nine performance determining factors were the independent variables while the three performance indicating factors were taken as the dependent variables. In the DEA Model, the performance determinants were used as the Input variables while the performance indicators were used as the Output variables.

Justification for Using DEA Method of Analysis: Efficiency is usually measured as ratios of outputs to inputs. A higher ratio of measured output to measured input factors can be directly interpreted as higher efficiency. There are a number of methodologies which can be used for evaluation of efficiency of a unit such as, output-to-input ratio approach, regression, cost function, total factor productivity indexes and many others. DEA was chosen as the primary technique for efficiency

evaluation since it was seen that though DEA works on the same concept as the traditional techniques of measurement, it covers lots of other aspects which the traditional techniques lack. DEA also has certain drawbacks but its advantages overshadow its disadvantages. The major advantages of DEA based method of efficiency evaluation includes utilization of both output and input observations, accommodation of multiple inputs and outputs, accommodation of both controllable and uncontrollable factors, computation of a single index of productivity, development of a relative measure of performance for each retail outlet using best performers as the bases, and non-imposition of any functional form on the data. Moreover, unlike total factor productivity indexes, DEA gives each of the observations its own set of weights which make the analysis more appropriate.

RESEARCH FINDINGS AND

ANALYSIS: Affect of the performance

determining factors of organized retail on performance indicators using Regression Analysis

Affect of performance determining

factors on Sales: The value of Adjusted R² was found to be .991 which shows that the model is a good fit. The significance of the F-value came out to be .000 which indicates that the model is statistically significant at 5% level of significance. In order to adjudge whether there exists multi-collinearity between the independent variables, Durbin Watson test was administered along with regression. The value of the Durbin-Watson test came out to be 1.629 which indicated that auto correlation was not present in the data. Considering the correlation coefficients among predictors, it was deduced that they were not related so data was free from multi collinearity. The Beta values and the significance levels of t-tests for significance of individual independent variables are given in Table 1.

Table 1: Regression Analysis with Sales as dependent variable

		Unstandardiz		Standardize		
1	(Constant)	23.481	20.021		1.173	.25
	Advertising Expenses	-7.243	2.844	-	-2.547	.01
	Capital employed	.01	.18	.00	.09	.92
	Current Assets	.22	.50	.09	.44	.66
	Gross fixed assets	-.569	.59	-	-.957	.34
	Inventories	1.110	.16	.33	6.697	.00
	Marketing expenses	2.572	1.730	.04	1.486	.15
	Power and fuel expenses	54.275	11.873	1.06	4.571	.00
	Salaries and wages	-1.170	3.493	-	-.335	.74
	Working capital	-.520	.43	-	-1.194	.24

Dependent Variable: Sales

As can be seen from Table 1, only 3 of the independent variables were found to be statistically significant in the model at 5% significance level. These include - Advertising Expenses, Inventories and Power & Fuel Expenses. Looking at the Beta values for all these variables, it could be seen that Advertising Expenses was negatively related to the dependent variable i.e. Sales while the other 2 variables i.e. Inventories and Power & Fuel Expenses were both positively related to the dependent variable. Looking at the Beta values, it can be said that in absolute terms Power & Fuel Expenses with a

Beta value of 1.069 had the maximum effect on Sales while Advertising Expenses with a Beta value of -.203 had the least effect.

Affect of performance determining factors on PBIT: The value of Adjusted R² was found to be .934 which shows that the model is a good fit. The significance of the F-value came out to be .000 which indicates that the model is statistically significant at 5% level of significance. The value of the Durbin-Watson test came out to be 1.267 showing that auto correlation was not present in the data. Considering the correlation coefficients among

predictors, it can be said that they were not related so data was free from multicollinearity. The Beta values and the

significance levels of t-tests for significance of individual independent variables are given in Table 2.

Table 2: Regression Analysis with PBIT as dependent variable

Model		Unstandardized		Standardized	t	Sig.
		Coefficient		Coefficients		
1	(Constant)	-10.749	8.005		-1.343	.19
	Advertising Expenses	-5.500	1.137	-1.032	-4.837	.00
	Capital employed	.02	.07	.05	.27	.78
	Current Assets	.12	.20	.32	.59	.55
	Gross fixed assets	-.317	.23	-	-1.333	.19
	Inventories	.21	.06	.44	3.285	.00
	Marketing expenses	5.479	.69	.69	7.920	.00
	Power and fuel expenses	9.555	4.747	1.26	2.013	.05
	Salaries and wages	-.589	1.397	-	-.422	.67
	Working capital	.04	.17	.05	.26	.79

Dependent Variable: PBIT

As can be seen from Table 2, only 4 of the independent variables were found to be statistically significant in the model at 5% significance level. These include - Advertising Expenses, Inventories, Marketing Expenses and Power & Fuel Expenses. Looking at the Beta Values for all these variables, it

could be seen that Advertising Expenses was negatively related to the dependent variable i.e. PBIT while the other 3 variables i.e. Inventories, Marketing Expenses and Power & Fuel Expenses were positively related to the dependent variable. Looking at the Beta values it could be said that in absolute terms Power & Fuel Expenses with a Beta value of 1.262 had the maximum

effect on PBIT while Inventories with a Beta value of .443 had the least effect on PBIT.

The negative effect of Advertising Expenses on PBIT clearly shows that an increase in Advertising Expenses decreases PBIT and vice versa. Thus, every one unit decrease/increase in Advertising Expenses will lead to a 1.032 increase/decrease in PBIT, other variables remaining unchanged. The positive effect of Inventories, Marketing Expenses and Power & Fuel Expenses on PBIT indicates, that for every one unit increase in Inventories, Marketing Expenses and Power & Fuel Expenses, PBIT will increase by .443, .690 and 1.262 respectively, if the other variables remain constant.

Effect of Performance Determining Factors on Return on Capital

Employed: The value of Adjusted R² was found to be .748 which shows that the model is a good fit. The significance of the F-value came out to be .000 which indicates that the model is statistically significant at 5% level of significance. Existence of multicollinearity between the independent variables was seen by administering Durbin Watson test along with regression. The value of the Durbin-Watson test came out to be 2.578 which showed that auto correlation was not present in the data. Considering the correlation coefficients among predictors, it was deduced that they were not related so data was free from multicollinearity. The Beta values and the significance levels of t-tests for significance of individual independent variables are given in Table 3.

Table 3: Regression Analysis with Return on Capital Employed as dependent variable

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
1	(Constant)	-22.488	11.973		-	.07
	Advertising Expenses	-5.206	1.701	-1.273	-	.00
	Capital employed	.02	.11	.074	.1	.85
	Current Assets	.28	.30	.977	.9	.36
	Gross fixed assets	.21	.35	.426	.5	.56
	Inventories	-.043	.09	-.115	-.436	.66
	Marketing expenses	5.816	1.035	.955	5.620	.00
	Power and fuel expenses	4.862	7.100	.837	.6	.50
	Salaries and wages	-1.733	2.089	-.839	-.829	.41
	Working capital	-.171	.26	-.254	-.655	.51

Dependent Variable: Return on Capital Employed

As can be seen from Table 3, only 2 of the independent variables were statistically significant in the model at 5% significance level. These include - Advertising Expenses and Marketing Expenses. Looking at the Beta Values for these 2 variables, it was seen that Advertising Expenses was negatively related to the dependent variable i.e. Return on Capital Employed while Marketing Expenses was positively related to the dependent variable. Looking at the Beta values it could be

said that in absolute terms Advertising Expenses with a Beta Value of -1.273 had a more significant effect on the dependent variable than Marketing Expenses.

Looking at the standardized Beta values of the 2 significant variables, it becomes clear that an increase/decrease in Advertising Expenses leads to a decrease/increase in Return on Capital Employed, because of the negative relation of Advertising Expenses with Return on Capital Employed, while an increase/decrease

in Marketing Expenses leads to an increase/decrease in Return on Capital Employed, because of the positive effect of the former on the latter. Thus, for every one unit decrease/increase in Advertising Expenses, the Return on Capital Employed will increase/decrease by 1.273 while for every one unit increase/decrease in Marketing Expenses,

Efficient and inefficient Retail

Organizations: The results obtained from

data entered in the DEA model are tabulated in Table 4. It can be seen from this table that companies 1, 2, 3, and 5 were found to be running efficiently with company 1 showing consistency in efficiency across all the years studied. Organization 4 secured efficiency score less than 1 in the years 2005 and 2006 showing that it was relatively inefficient in these years in comparison to the other companies.

Table 4: Efficiency scores for companies in different years

	Year							
	2000	2006	2007	2008	2009	2010	2011	2012
1	1	1	1	1	1	1	1	1
2	1	1	1	1	1	1	1	1
3	NA	NA	1	1	1	1	1	NA
4	1	1	1	1	1	0.463	0.616	1
5	NA	NA	NA	NA	NA	NA	1	1

In using DEA, the weights were estimated separately for each retail organization such that its efficiency was the maximum attainable. As can be seen in Figure 2, DEA estimated the weights 0.001, 0.043, 0.001, 0.951, 0.001, 0.001, 0.001, 0.001 and 0.001 for the input variables and 0.010, 0.000, and 0.058

for the output variables for retail organization 5 for the year 2006. DEA estimated the weights such that the estimated efficiency of retail organization 5 (E5) was the maximum possible. However, the weights estimated for retail organization 5 were such that when they were applied to the

inputs (Xs) and outputs (Ys) of all other units in the analysis their ratio of weighted outputs to weighted inputs was less than or equal to 1. Similarly, DEA estimated a separate set of weights for each retail organization such that the estimated weights led to a maximum attainable efficiency for that organization. As seen from Figure 2, DEA optimized on each individual retail organization's performance in relation to the performance of all other retail organizations. While using DEA, the estimated weights were constrained so that no one input or output variable dominated the efficiency estimation. Minimum limits were also set for the estimated weights so that all inputs and outputs were forced to play a role in efficiency computation. The efficiency computed by DEA assumed that 100% efficiency is attained for an organization only when (1) none of the outputs can be increased without either increasing one or more inputs or decreasing some of its other outputs and (2) none of the inputs can be decreased without decreasing some of its outputs or

increasing some of its other inputs. Hence, 100% efficiency is defined to have been attained by a retail organization only when comparisons with other organizations do not provide evidence of inefficiency in the use of any inputs and in creation of any outputs.

Sensitivity/Gap analyses for inefficient

Retail Organizations: At the individual retail organization level, DEA also provided rich diagnostic information through sensitivity analysis. For every retail organization not on the efficient frontier, DEA identified a set of efficient reference organizations in the corresponding envelope. These efficient reference organizations (whose efficiency is 100%) helped in identifying the inadequacies or slacks in the controllable inputs/outputs of the inefficient organization. By comparing the controllable inputs and outputs of the inefficient organization with the controllable inputs and outputs of a linear combination of the efficient reference organizations that comprised the frontier (a virtual organization), the amount of slack in each of the variables

was computed. This can help the inefficient organization identify how to allocate resources more efficiently and improve its productivity. An inefficient organization may become efficient by increasing all outputs by an amount equal to its corresponding slack (i.e.,

move towards the efficient frontier vertically in the case of a 2- dimensional plot) or by decreasing all controllable inputs by amounts equal to its corresponding slacks (i.e., move towards the efficient frontier horizontally in the case of a 2- dimensional plot).

Table 5: Sensitivity analysis for retail organization 4 for the year 2010

	(Units Rs. Crore)			Improvement
	Estimated	Value	Value If	
Power and fuel expenses	0.001	6.8	4.489	-2.311
Salaries and wages	0.021	14.86	12.205	-2.655
Advertising expenses	0.001	21.17	4.032	-17.138
Marketing expenses	0.001	13.68	2.700	-10.980
Capital employed	0.001	216.97	56.832	-160.138
Gross fixed assets	0.001	80.96	65.724	-15.236
Inventories	0.001	37.63	34.199	-3.431
Current assets	0.001	183.15	62.786	-120.364
Working capital	0.001	123.62	-1.337	-124.957

Outputs				
Sales	0.002	231.49	231.490	0.000
PBIT	0.001	25.72	25.720	0.000
Return on capital employed	0.000	9.49	25.982	16.492

Table 6: Sensitivity analysis for retail organization 4 for the year 2010

	(Units Rs. Crore)			Improvement
	Estimated	Value	Value If	
Power and fuel expenses	0.001	9.69	7.178	-2.512
Salaries and wages	0.009	20.61	18.993	-1.617
Advertising expenses	0.001	29.85	7.532	-22.318
Marketing expenses	0.001	19.07	3.337	-15.733
Capital employed	0.001	335.32	137.685	-197.635
Gross fixed assets	0.001	97.24	82.077	-15.163
Inventories	0.001	53.36	53.360	0.000
Current assets	0.001	188.3	126.433	-61.867
Working capital	0.001	82.28	58.833	-23.447

Outputs				
Sales	0.002	343.23	343.230	0.000
PBIT	0.002	38	38.000	0.000
Return on capital employed	0.000	12.74	17.174	4.434

Table 5 and 6 show the gap calculated for various inputs of the inefficient organization by comparing them with the combined weighted inputs of all the efficient organizations for year 2009 and year 2010 respectively. Table 5 shows the sensitivity analysis results for retail organization 4 for the year 2009 while

Table 6 has the sensitivity analysis results for retail organization 4 for the year 2010. These tables show the amount of slack in each of the controllable input and output observations for this retail organization. This slack was computed by comparing the input and output of retail organization 4 with the inputs and

outputs of its efficient reference organizations. These efficient reference organizations were organizations which operate under circumstances similar to that of organization 4, but have 100% efficiency. The results show that retail organization 4 could have become efficient (increased efficiency from 0.463 to 1.00 in year 2009 and from 0.616 to 1.00 in year 2010) by increasing all outputs by the corresponding slack amounts or decreasing all controllable inputs by corresponding slacks. Retail organization 4's estimated weights for the 12 variables are also shown in Table 5 and Table 6 for the year 2009 and 2010 respectively. DEA estimated these weights such that the estimated efficiency of 0.463 and 0.616 for retail organization 4 is the maximum attainable. No other combination of weights would have produced a higher efficiency estimate for retail organization and yet satisfied all of the constraints in the optimization. As can be seen from tables 5 and 6, the maximum contribution to total input savings was from marketing expenses

(2005:17% & 2006:25%) and advertising expenses (2005:17% & 2006:23%). Though working capital was seen as a major improvement area in the year 2005, it got substantially covered in the year 2006 (from 21% to 9%). Thus, retail organization 4 in order to become efficient needed to pay more attention on the marketing and advertising expenses as the most potential improvements factors. From the perspective of improving outputs, the results suggested that a need existed to improve return on capital. Keeping these factors in mind, retail organization 4 became efficient in the year 2007 as can be seen from Figure 5.

CONCLUSION: A similar study can be conducted taking a larger number of retail organizations and variables into consideration to form a more comprehensive picture of the performance of retail organizations in India. The present study compares the performance efficiency of retail organizations having similar formats. The study can be extended to compare the efficiency of different formats

of the same company to understand which format is performing more efficiently and hence is more suited for a developing country like India.

REFERENCES:

- Achabal, Dale D., Heineke John M., and McIntyre Shelby H. (1984). Issues and Perspectives on Retail Productivity. *Journal of Retailing*, 60 (Fall): pp.107-127.
- Bal H., Örkücü H. H. (2005). Combining the Discriminant Analysis and the Data Envelopment Analysis in View of Multiple Criteria Decision Making: A New Model. *Journal of Science*, Gazi University, Vol. 3, No 18, pp. 355-364.
- Banker, Rajiv D. and Morley Richard C. (1986). Efficiency Analysis for Exogenously Fixed Inputs and Outputs. *Operations Research*, 4 (July/August): pp.513-521.
- Bloom, G. F. (1972). Productivity in the Food Industry: Problems and Potential. Cambridge, MA: MIT Press.
- Bucklin, Louis P. (1978). Productivity in Marketing. Chicago: AMA.
- Bush, Robert P., Bush Alan J., Ortinau David J., and Hair Joseph F. Jr. (1990). Developing A Behavior-Based Scale to Assess Retail Salesperson Performance. *Journal of Retailing*, 66 (Spring): pp.119-136.
- Deurinck, G. (Ed.) (1955). Productivity Measurement, Vol. 1 Concepts EPA, Project 235 (Paris: OEEC).
- Douthett, Jefferey T. (1984). Comparative Productivity Performance in Fast-Food Retail Distribution, *Journal of Retailing*, 60 (Fall): pp.98-106.
- Dreaming with BRICs: The Path to 2050, Global Economic No. 99, Goldman Sachs, 2003
- Dyson R.G., Allen R., Camanho A. S., Podinovski V.V., Sarrico C.S., Shale E.A.. (2001). Pitfalls and Protocols in DEA. *European*

Journal of Operational Research,
No 132, pp. 245-259.

- Farrell, M. (1957). The Measurement of Productive Efficiency. Journal of the Royal Statistical Society, Series A, General, 120, Part 3, pp.253-281.

- Global Retail Development Index, AT Kearney Survey, 2007
Goldman, Arieh. (1992). Evaluating the Performance of the Japanese Distribution System. Journal of Retailing, 68 (Spring), pp.11-39.