Measuring the Relative Efficiency of European MBA Programs：A Comparative analysis of DEA, SBM, and FDH Model

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Abstract

This paper uses DEA models to evaluate European MBA programs. The analysis models of DEA include CCR, BCC, Bilateral, Slack-Based Measure, and the FDH model. We analyze the overall efficiency, pure technique efficiency and scale efficiency of European MBA programs. It is an acknowledged truth that UK business schools have always dominated the European MBA market in terms of both quality and quantity. We use the Bilateral model to measure and compare the efficiency of UK and non-UK MBA programs. We also investigate the most productive scale size for European MBA programs. Moreover, MBA programs are partitioned into 4 clusters based on their relative efficiency and value for money. Efficient management strategies are developed for the top 35 European MBA programs. Finally, we provide some management suggestions for European MBA programs.

Keyword： Performance Evaluation, Data Envelopment Analysis, SBM, FDH, Bilateral Model

Introduction

In recent years, the global MBA program market has become more competitive. The competition between higher education institutions has increased. It is an acknowledged truth that US business schools have always dominated the MBA market in terms of both quality and quantity. In 2003, US business schools still dominated the rankings: 57 of the top 100 global business schools are in the US, while only 28 are in Europe. Thus, the most important thing is how European MBA can enhance their operational and educational efficiency ? How can higher education in the European Union be made more attractive to students and teachers in the rest of the world? How can European MBA programs strengthen links between our universities to improve the quality and competitiveness of our higher education?

In this study, we measure the relative efficiency of European MBA programs. The methodology used to perform efficiency analysis of European MBA programs is Data Envelopment Analysis（DEA）. DEA is a mathematical programming tool that is well suited to this type of research for several reasons. DEA is a linear programming-based technique that converts multiple input and output measures into a single comprehensive measure of productivity efficiency (Epstein and Henderson, 1989). One of its most important features is its ability to handle multidimensional inputs and outputs, unlike traditional performance indicators that generally use one input-one output measures.

Since DEA was developed by Charnes, Cooper, and Rhodes（1978）, it has been

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widely applied to such industries as finance（Pastor,2002）and medical care（Finkler and Wirtschafter, 1993）. Recently, several studies have examined the performance and the efficiency of universities or educational programs using DEA Banker, Janakiraman and Natarajan（2004）； Caballero, Galache, Gomez, Molina and Torrico（2004）；Bifulco and Bretschneider（2003）；Grosskopf and Moutray（2001）；Colbert , Levary and Shaner（2000）. So far, no similar studies on European MBA programs have been done. In this paper we discuss the relative efficiency of inputs and outputs for the top 35 MBA programs in Europe. The analysis models of DEA include CCR, BCC, Bilateral, Slack - Based Measure（SBM）, and the FDH model. We also investigate the most productive scale size for European MBA programs. Finally, we provide some management suggestions for European MBA programs.

Data Envelopment Analysis Model

Farrell （1957） introduced a framework for efficiency evaluation and measurement, ehich was subsequently studied such as those by Charnes, Cooper, and Rhodes（1978）, Banker, Charnes, and Cooper（1984）etc.

(1）CCR Model

For any special DMUs , the CCR model with constant return to scale can be formulated as follows to obtain a score of technical efficiency：

Maximize $w_0 = \sum_r u_r y_{rj_0}$ （1）

Subject to $\sum_i v_i x_{ij_0} = 1,\ \sum_r u_r y_{rj} - \sum_i v_i x_{ij} \le 0, j = 1,...,n,$

$u_r \ge \varepsilon, r = 1,...,s,\ ,\ v_i \ge \varepsilon, i = 1,...,m$

（where m is the number of inputs, and s is the number of outputs）.

(2）BCC Model

The BCC model, named after Banker,, Charnes, and Cooper（1984）,was developed by relaxing the CCR model or the constant returns to scale assumption on the envelopment surface. The following model is the envelopment form of the BCC model（input orientation）：

Min $z_0 = \theta_B - \varepsilon\left(\sum_{i=1}^{m} s_i^- + \sum_{r=1}^{s} s_r^+\right)$ （2）

s.t. $\theta_B X_{io} = \sum_{j=1}^{n} X_{ij}\lambda_j + s_i^-,\ i=1,...m\ ,\ Y_{ro} = \sum_{j=1}^{n} Y_{rj}\lambda_j - s_r^+,\ r=1,...s\ ,$

$\sum_{j=1}^{n}\lambda_j = 1$, $s_i^-, s_r^+, \lambda_j \ge 0$

（where z_0 is unconstrained, , m is the number of inputs, and s is the number of outputs）.

(3）Slacks-Based Measure （SBM Model）

Tone（2001）has proposed a slacks-based measure（SBM）,which is non-radial and deals with input/output slacks directly. The SBM returns an efficiency measure between 0 and 1, and gives unity if and only if the DMU concerned is on the frontiers of the production possibility set with no input/output slacks.

In order to estimate the efficiency of a DMU （x_0, y_0）,we formulate the following fractional program in λ, s^-,and s^+:

$$\text{Min}\quad \rho = \frac{1-\frac{1}{m}\sum_{i=1}^{m} s_i^- / x_{i0}}{1+\frac{1}{s}\sum_{r=1}^{s} s_r^+ / y_{r0}} \qquad (3)$$

s.t. $x_0 = X\lambda + s^-, y_0 = Y\lambda + s^-, \lambda \geq 0, s^- \geq 0, s^+ \geq 0$.

(4) Free Disposal Hull (FDH Model)

In this section we take discussion with FDH (Free Disposal Hull). The purpose of FDH is to measure and evaluate the performance of a producer. FDH is a mathematical programming technique, developed by Deprins, Simar and Tulkens (1984). The following model is the equation form of the FDH:

Let $Y_0 = \{(x^k, u^k) | x^k \in R_+^I, u^k \in R_-^J, k = 1,2,...,n\} \cup \{(O^I, O^J)\}$

Denote a set of n actually observed production plans, to which the origin of the input-output space is added by convention (O^I and O^J are the $I-$ and $J-$dimensional null vectors); for brevity we call Y_0 the observations set or the data set. Let also $Y(Y_0)$ denote a reference production set constructed from Y_0. Then a free disposal hull (FDH) reference production set (Y_{FDH}) constructed from Y_0 can be written as follows:

$$Y_{FDH}(Y_0) = \left\{ \begin{bmatrix} u \\ x \end{bmatrix} \in R_+^{I+J} \middle| \begin{bmatrix} u^h \\ x^h \end{bmatrix} + \sum_{i=1}^{I} u_i \begin{bmatrix} o^J \\ e_i^J \end{bmatrix} - \sum_{i=1}^{J} v_j \begin{bmatrix} e_j^J \\ o^I \end{bmatrix}, \right.$$
$$(x^h, u^h) \in Y_0; u_i \geq 0; v_j \geq 0,$$
$$\left. i = 1,2,...,I; j = 1,2,...,J \right\} \qquad (4)$$

Where e_i^I denotes an I-dimensional zero vector with the i-th component equal to 1, and similarly, e_j^J denotes a J-dimensional zero vector with the j-th component equal to 1.

(5) Bilateral Model

This code solves the bilateral comparison model expressed as follows. It tests the null hypothesis that the efficiency of DMUs in two groups of concern belongs to the same statistical distribution obtained using nonparametric rank-sum statistics. The data format is the same as that for the CAT model, where the only level numbers permitted to be assigned are 1 or 2. We can formulate this idea in the following way for each DMU:

Min θ_B (5)

s.t. $\sum_{j \in II} X_j \lambda_j \leq \theta_B X_k$, $k \in I$, $\sum_{j \in II} Y_j \lambda_j \geq \theta_B Y_k$, $k \in I$, $\lambda_j \geq 0$ $(\forall j \in II)$.

Data

Thirty-five MBA programs were subjected to empirical analysis and in this study. Data from the Financial Times survey (MBA rankings - January 2004) were used to determine the relative efficiency of the top MBA programs in Europe. This measure of efficiency is based on the level of output produced for each unit of input. The data is based on surveys of business school graduates and corporate recruiters. The information was collected from alumni three years after graduation and from business schools by the Financial Times. Of the 35 MBA programs involved in this study, 18 (51.42%) are in the UK, 6 are in France, 3 are

in Spain, and 2 are in the Netherlands and Ireland. One each is in Italy, Finland, Switzerland, and Norway.

Selection of variables

In this research, European MBA programs employ the three inputs international students, international faculty, and faculty with doctorates, which produce the outputs salary today, salary percentage increase, and value for money. Table 1 shows a summary statistics of the input and output statistics that were used to construct the DEA models. Constructing the models allowed us to investigate the relative efficiency scores for European MBA programs. The above three inputs have generally been used throughout the literature. The three inputs in the operational performance model are international students, international faculty, and faculty with doctorates. They are defined as follows:

1. *international students*: The percentage of international students; 2. *international faculty*:The percentage of faculty whose nationality differs from their country of employment; 3. *faculty with doctorates*: The percentage of faculty with the doctoral degree.

Identifying the output of productive activities in general and European MBA programs in particular, presents difficulties for cost measurement and also production performance. The three outputs used here were are salary today, salary percentage increase, and value for money. They are defined as follows:

1. *salary today*: The average salaries earned three years after graduation according to the 2001, 2002 and 2003 surveys. The figures are in US dollars and are not used for ranking.2. *salary percentage increase*: The percentage increase in salary from the beginning of the MBA programs to three years after graduation. This figure is a weighted average of the increases obtained from the 2002, 2003 and 2004 surveys. 3.*value for money*:This criterion is a short-term indicator calculated using the salary earned by alumni three years after graduation and course costs, including the opportunity cost of not working for the duration of the course.

Insert Table1

Empirical results

Correlation analysis

Table 2 shows the Pearson correlation coefficients for several of these variables. The main findings can be summarized as follows. The input variables（i.e., international faculty and faculty with doctorates）have correlation values of 0.471and 0.452 with respect to the output variables（i.e., salary today and value for money）.These are highly positive correlation coefficients, and they indicate that there is a strong relationship between input and output. The correlation analysis results show the positive relationship between the input and output variables examined in this study.

Insert Table2

Efficiency analysis

In this research, the analysis models of DEA included CCR, BCC, Slacks-Based Measure（SBM）, and FDH. DEA provides a comprehensive evaluation of overall performance. The results for each DEA model are summarized in Table 3. Table 4 shows the Pearson correlation coefficients for the

DEA models. The results for each DEA model are shown in Table 5.

First, an elementary insight is obtained by considering the dichotomous classification of DMUs as either efficient or inefficient. The number of efficient DMUs resulting from the use of different reference technologies is shown in the last row of Table 3. Clearly, and consistent with expectations, the FDH model turns out to be no better than other reference technologies. It results in 62.85□ efficient DMUs, compared with 17.1□for the CCR model, 40□for the BCC model, and 17.1□ for the SBM model. It is interesting to consider the extent to which the different methodologies agree on this basic dichotomous classification. All of the DMUs that are efficient for CCR, BCC and SBM are efficient for FDH also. The results also clearly illustrate the implications imposing convexity for non-parametric technical efficiency measurement. Of 22 efficient DMUs for FDH, only 6（17.1□）are efficient for CCR, and SBM, and 14（40□）are efficient for BCC. In addition, Table 3 contains some descriptive statistics for each of the five DEA models. The FDH-based index exceeds all others for average mean efficiency scores.

Insert Table3

Table 4 shows the Pearson correlation coefficients for several of these DEA models, including CCR, BCC, SBM and FDH. The correlation analysis results show a positive relationship among the DEA models investigated in this study.

Insert Table4

Table 5 presents the CCR efficiency scores under constant returns-to-scale, BCC technical efficiency scores, scale efficiency scores, slacks-based measure efficiency scores, and FDH efficiency scores.　As items for measuring efficiency, we used international students, international faculty, and faculty with doctorates as inputs, and salary today, salary percentage increase, and value for money as outputs. The main findings can be summarized as follows. The CCR efficiency score analysis results show that 6 MBA programs（i.e., London Business School）are relatively efficient, based on the same scale efficiency scores and SBM efficiency scores. Their efficiency scores are all equal to 1. This shows that resource utilization for these MBA programs is excellent. On the other hand, 29 MBA programs were found to be inefficient because their efficiency scores were less than 1. The scale efficiency scores as defined by the ratio CCR/BCC show large differences between the two groups. The average scale efficiency score was 0.9054. MBA programs are above average whereas 11 MBA programs were below it. Of the 35 MBA programs, 14（i.e., Institute de Empresa）have low BCC efficiency scores and relatively high scale efficiency scores, meaning that the overall inefficiency of these MBA programs is as shown in the CCR column of these MBA programs is caused by inefficient operations rather than scale inefficiency. Of the 35 MBA programs, 6（i.e., Insead）have BCC efficiency scores equal to 1 and relatively low scale efficiency scores. This can be interpreted as indicating that the CCR inefficiency scores can be mainly attributed to disadvantageous conditions. Another model which has received a considerable amount of research attention is FDH（Free Disposal Hull）. The FDH results show that of the 35 MBA programs, 23（65.71□）are efficient. These results cannot distinguish efficient MBA programs from inefficient programs correctly,

compared with the CCR, BCC and SBM models.

Insert Table5

Reference Set Analysis

The reference set and their frequencies for the 35 MBA programs are given in Table 6. The most frequent MBA program was found to be Iese Business School. The results also show that Iese Business School, SDA Bocconi, Cranfield School of Management, and University College Dublin: Smurfit, and Ashridge are efficient and are in the reference set of all of the other MBA programs.

Bilateral analysis

We applied the bilateral comparison method to the European MBA programs to determine the statistical difference in efficiency between UK MBA programs （Group Ⅰ） and those in other nations（Group Ⅱ）. Thus, Group consisted of 18 MBA programs, and Group Ⅱ consisted of 17 MBA programs. We construct the hypothesis as follows：

H_0 : Group Ⅰ and Group Ⅱ have same populations of efficiency score.

The Rank-Sum-Test（Wilcoxon-Mann-Whitney）method is a nonparametric test that is based on the ranking of data. Given independent data belonging to two groups, this method can be used to test serves to test the hypothesis that the two groups belong to the same population. Using T, we can check the null hypothesis that the two groups have the same population at a given level of significance α. In this research, the rank sum of UK MBA program was 362, while that of the other programs was 268. The test statistic T is given by：

$$T = \frac{362 - 18(18 + 17 + 1)/2}{\sqrt{18 \times 17(18 + 17 + 1)/12}} = 1.2541 \quad .$$

In this case, the null hypothesis cannot be rejected at a significance level of 5%. The results provide no evidence that the UK MBA programs and other programs have the different populations of efficiency scores. In other words, the UK MBA and non-UK MBA programs have similar efficiency. The result is likely due to their similarities in terms of region, culture, tradition, education system etc.

Returns to scale and most productive scale size

We will discuss the returns to scale of the 35 MBA programs in this section. Thus, a DMU_0 found to be efficient for a CCR model will also be found to be efficient for the corresponding BCC model, and constant returns-to-scale means that DMU_0 is the most productive scale size （Ahn, Charnes and Cooper; 1989）.Of the 35 MBA programs investigated in this study, 6（17.14%）showed constant returns-to-scale, 11（31.42%）showed decreasing returns-to-scale, 18（51.42%）showed increasing returns-to-scale.

When an MBA program exhibits decreasing return-to-scale （$\sum_{j=1}^{n} \lambda_j^* > 1$）, it is likely that the program can improve its performance by decreasing its size. In general, the proportion of MBA programs showing increasing returns-to-scale has increased over time, and the average size of MBA programs in sample have increased monotonically over time, which suggests changing technology over time. On the other hand, when an MBA program exhibits increasing

return-to-scale （$\sum_{j=1}^{n} \lambda_j^* < 1$） , it is likely that the program can improve its performance by increasing its size.Table 5 shows that the London Business School, Iese Business School, SDA Bocconi, Cranfield School of Management, University College Dublin: Smurfit and Ashridge MBA programs have the most productive scale sizes.

Insert Table6

Relationship between efficiency and value for money

Finally, we will discuss the relationship between efficiency and value for money. The efficiency score is the overall efficiency score from the CCR model. Figure 1 shows the relationship between efficiency and value for money. Based on the demand for and rate of progress in improvement, the 35 European MBA programs can be classified into 4 categories as follows：

Ⅰ. *MBA programs with high efficiency and high value for money*：

These include SDA Bocconi; Cranfield School of Management; Helsinki School of Economics; Imperial College London: Tanaka; Strathclyde GSB; Lancaster University Management School; Theseus International Management; Henley Management College; Ashridge. These MBA programs have relative efficiency values greater than 0.74 and value for money values higher than 2.76. These MBA programs should maintain their competitive advantage.

Ⅱ. *MBA programs with low efficiency and high value for money*：

These include Insead; IMD, Institute de Empresa; University of Cambridge: Judge; Warwick Business School; University of Oxford: Said; City University: Cass; Edinburgh University Management; Universiteit Nyenrode; ESCP – EAP; Bradford School of Management / Nimbas; University of Bath School of Management. These MBA programs have relative efficiency values lower than 0.74 and value for money values higher than 2.76. These MBA programs should maintain their competitive advantage and seek further improvement.

Ⅲ. *MBA programs with low efficiency and low value for money*：

These include Rotterdam School of Management; Manchester Business School; HEC Paris; Trinity College Dublin; ENPC MBA Paris; University of Durham Business School; Nottingham University Business School; Birmingham Business School. These MBA programs have relative efficiency values lower than 0.74 and value for money values lower than 2.76.

Ⅳ. *MBA programs with high efficiency and low value for money*：

These include London Business School; Iese Business School; Esade; University College Dublin: Smurfit; EM LYON; Norwayan School of Management. These MBA programs have relative efficiency values higher than 0.74 and value for money values lower than 2.76. These MBA programs need to improve resource input and seek to find further improvement immediately.

Insert Figure 1

Strategy matrix analysis

Based on the above 4 categories and, we suggest 4 strategies for MBA programs, as shown in the Figure 2.

Ⅰ. Maintenance Strategy

These institutions should maintain the competitive advantage of their MBA programs and courses.

Ⅱ. Improve Efficiency Strategy

These MBA programs should maintain their competitive advantage and seek further improvement. We suggest that they improve their technical and scale efficiency. They should adopt improving efficiency strategy to satisfy their students and improve their performance. Those MBA can design and offer a variety of courses.

Ⅲ. Strong Improvement Strategy

These MBA programs need to improve resource input and seek to find further improvement. But they have low efficiency and low value for money. It is important for them to be concerned about cost-benefit and resources, so we suggest that they adopt a strong improvement strategy. They should improve their technical and scale efficiency, and design and offer a variety of courses.

Ⅳ. Mass Customization Strategy

These MBA programs have high efficiency but low value for money. We suggest that they adopt a mass customization strategy to satisfy their students. They should offer a variety of electives for students.

Insert Figure 2

Conclusions

In this study, we have used nonparametric DEA methods to analyze the efficiency European MBA programs. The main findings can be summarized as follows. The CCR efficiency score analysis results show that 6 MBA programs are relatively efficient, and the results were scale efficiency and SBM efficiency. The results of FDH analysis cannot distinguish between efficient MBA program and inefficient program correctly, compared with the CCR, BCC and SBM models. The bilateral analysis results provide no evidence that UK MBA programs and non-UK MBA programs have different populations of efficiency scores. It is likely that this is due to their similarities in term of culture, tradition, education system etc. Of the 35 MBA programs investigated in this study, 6 exhibit constant returns-to-scale, 11 exhibit decreasing returns-to-scale. These MBA programs can improve their performance by decreasing their size. Of the 35 MBA programs, 18 exhibit increasing returns-to-scale. These MBA programs can improve their performance by increasing their size. Finally, of the 35 MBA programs, 6 are the most productive scale sizes. We have also discussed the relationship between efficiency and value for money for European MBA programs. Those MBA programs that have low efficiency and low value for money need to improve their input resources and seek further improvement.

Throughout the study, special emphasis has been placed on quantifying and discussing the impact of model choice on the results. For this purpose, we have also introduced a framework for model comparison and used several simple techniques to analyze the results. The MBA programs studied here can be partitioned into 4 clusters based on relative efficiency and value for money. Efficient management strategies have been proposed for the top 35 European MBA programs. The results of this research can help those involved in managing these programs understand their relative operating performance and, therefore, respond by appropriately regulating the levels of the input and output items.

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Appendix

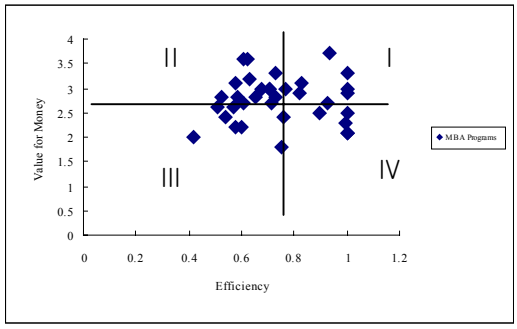

Figure 1： Relationship between efficiency and value for money for 35 MBA programs

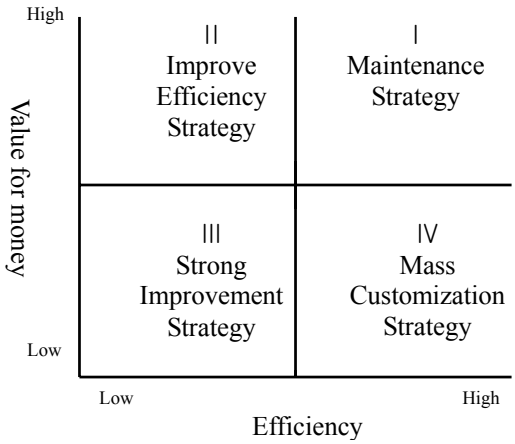

Figure 2： Strategies for MBA programs

Table 1 Summary of statistics for 35 DMUs in European MBA programs

	International students %	International faculty %	Faculty with doctorates %	Salary today $US	Salary percentage increase %	Value for money
Max	97	98	98	137521	194	3.7
Min	28	12	7	54075	62	1.8
Average	69.2	35.685	71.342	89208	115.228	2.762
SD	19.23	21.038	22.005	21693	31.787	0.456

Table 2 Pearson correlation analysis

	(1) International students	(2) International faculty	(3) Faculty with doctorates	(4) Salary today	(5) Salary percentage increase	(6) Value for money
(1) International students	1					
(2) International faculty	0.334**	1				
(3) Faculty with doctorates	0.259	0.028	1			
(4) Salary today	0.079	0.471**	0.023	1		
(5) Salary percentage increase	0.141	0.069	0.156	0.57**	1	
(6) Value for money	0.091	0.192	0.452**	0.275	0.055	1

Note： * *Significant at the 0.01 level.*
** *Significant at the 0.05 level.*
*** *Significant at the 0.1 level.*

Table 3 Summary statistics for efficiency measures（N=35）

	CCR	BCC	SBM	FDH
Mean	0.7419	0.8194	0.6675	0.9385
S.D	0.1705	0.1735	0.1876	0.1099
Max.	1	1	1	1
Min.	0.4211	0.4591	0.3226	0.5421

No. of efficient DMUs	6 (17.14□)	14 (40□)	6 (17.14□)	22 (62.85□)

Table 4 Correlation analysis of DEA models

	CCR	BCC	SBM	FDH
CCR	1			
BCC	0.81**	1		
SBM	0.94**	0.70**	1	
FDH	0.54**	0.64**	0.48**	1

Note：* *Significant at the 0.01 level.*
** *Significant at the 0.05 level.*
*** *Significant at the 0.1 level.*

Table 5 Efficiency scores of DEA models for MBA programs

DMU (2003Eurpoean Ranking)	Global Top-100 Ranking	Efficiency					Bilateral Model	
		CCR	BCC	Scale	SBM	FDH	Score	Group
(1) Insead	(6)	0.624	1	0.624	0.494	1	0.678	II
(2) London Business School	(7)	1	1	1	1	1	1.155	I
(3) IMD	(13)	0.611	1	0.611	0.462	1	0.671	II
(4) Iese Business School	(18)	1	1	1	1	1	2.732	II
(5) Instituto de Empresa	(26)	0.673	0.709	0.948	0.584	1	0.749	II
(6) Rotterdam School of Management	(28)	0.506	0.550	0.920	0.475	0.93	0.703	II
(7) University of Cambridge: Judge	(30)	0.524	0.524	0.999	0.489	1	0.617	I
(8) Warwick Business School	(34)	0.580	0.655	0.885	0.520	1	0.617	I
(9) University of Oxford: Said	(35)	0.705	1	0.705	0.668	1	0.821	I
(10) SDA Bocconi	(43)	1	1	1	1	1	1.911	II
(11) Manchester Business School	(44)	0.597	0.603	0.990	0.561	1	0.678	I
(12) Cranfield School of Management	(54)	1	1	1	1	1	1.296	I
(13) HEC Paris	(63)	0.716	0.767	0.934	0.648	0.84	0.770	II
(14) City University: Cass	(68)	0.705	0.732	0.963	0.635	1	0.721	I
(15) Edinburgh University Management School	(73)	0.654	0.686	0.953	0.609	0.86	0.654	I
(16) Universiteit Nyenrode	(74)	0.732	0.787	0.929	0.632	0.97	0.903	II
(17) Helsinki School of Economics	(78)	0.932	1	0.932	0.753	1	1.017	II
(18) Imperial College London: Tanaka	(79)	0.826	0.841	0.983	0.676	1	0.853	I
(19) ESCP - EAP	(82)	0.629	0.815	0.771	0.599	1	0.776	II
(20) Esade	(83)	0.750	0.878	0.853	0.614	1	1.152	II
(21) Bradford School of Management/Nimbas	(85)	0.731	1	0.731	0.709	1	0.731	I
(22) Trinity College Dublin	(86)	0.610	0.613	0.995	0.549	0.75	0.638	II
(23) University College Dublin: Smurfit	(89)	1	1	1	1	1	1.124	II
(24) University of Bath School of Management	(91)	0.587	0.602	0.975	0.531	0.67	0.603	I
(25) ENPC MBA Paris	(92)	0.421	0.459	0.917	0.322	0.54	0.450	II
(26) Ashridge	(95)	1	1	1	1	1	1.634	I
(27) University of Durham Business School	(97)	0.572	0.590	0.969	0.517	0.78	0.586	I
(28) Strathclyde GSB	(98)	0.892	1	0.892	0.737	1	0.892	I
(29) Lancaster University Management School	–	0.768	0.778	0.988	0.647	0.82	0.768	I
(30) Theseus International Management Institute	–	0.821	1	0.821	0.536	1	1.096	II
(31) Henley Management College	–	0.991	1	0.991	0.968	1	1.259	I
(32) Nottingham University Business School	–	0.537	0.658	0.815	0.507	0.86	0.537	I
(33) Birmingham Business School	–	0.578	0.736	0.785	0.482	0.80	0.578	I
(34) EM LYON	–	0.757	0.763	0.992	0.625	0.97	0.770	II
(35) Norwayan School of Management	–	0.923	0.924	0.998	0.801	1	0.946	II
Average		0.7419	0.8194	0.9054	0.6675	0.9385		

Table 6 Reference Set Analysis and Returns to Scale for 35 DMUs

	DMU (2003Eurpoean Ranking)	CCR Efficiency	Reference Set	Frequency in Reference Set	Rank	Returns to Scale
(1)	Insead	0.624	4、12、26	0	24	Σλ>1
(2)	London Business School	1	2	0	1	Σλ=1
(3)	IMD	0.611	4、12、26	0	25	Σλ>1
(4)	Iese Business School	1	4	25	1	Σλ=1
(5)	Instituto de Empresa	0.673	4、12、26	0	21	Σλ>1
(6)	Rotterdam School of Management	0.506	4、10、12	0	34	Σλ<1
(7)	University of Cambridge: Judge	0.524	4、12、26	0	33	Σλ<1
(8)	Warwick Business School	0.580	4、12	0	29	Σλ>1
(9)	University of Oxford: Said	0.705	4、12	0	20	Σλ>1
(10)	SDA Bocconi	1	10	15	1	Σλ=1
(11)	Manchester Business School	0.597	4、10、12、26	0	27	Σλ<1
(12)	Cranfield School of Management	1	12	21	1	Σλ=1
(13)	HEC Paris	0.716	4、10、12	0	18	Σλ<1
(14)	City University: Cass	0.705	4、12	0	19	Σλ>1
(15)	Edinburgh University Management School	0.654	4、10	0	22	Σλ<1
(16)	Universiteit Nyenrode	0.732	4、10、12	0	16	Σλ<1
(17)	Helsinki School of Economics	0.932	10、23	0	8	Σλ>1
(18)	Imperial College London: Tanaka	0.826	12、26	0	11	Σλ>1
(19)	ESCP - EAP	0.629	4、10、12	0	23	Σλ>1
(20)	Esade	0.750	4、10	0	15	Σλ<1
(21)	Bradford School of Management / Nimbas	0.731	4、10	0	17	Σλ>1
(22)	Trinity College Dublin	0.610	4、12	0	26	Σλ<1
(23)	University College Dublin: Smurfit	1	23	2	1	Σλ=1
(24)	University of Bath School of Management	0.587	4、12	0	28	Σλ<1
(25)	ENPC MBA Paris	0.421	4、12	0	35	Σλ<1
(26)	Ashridge	1	26	8	1	Σλ=1
(27)	University of Durham Business School	0.572	4、12	0	31	Σλ<1
(28)	Strathclyde GSB	0.892	4、10	0	10	Σλ<1
(29)	Lancaster University Management School	0.768	4、10	0	13	Σλ<1
(30)	Theseus International Management Institute	0.821	4、12	0	12	Σλ>1
(31)	Henley Management College	0.991	10、12、23、26	0	7	Σλ<1
(32)	Nottingham University Business School	0.537	4、10	0	32	Σλ<1
(33)	Birmingham Business School	0.578	4、10	0	30	Σλ<1
(34)	EM LYON	0.757	10、12、26	0	14	Σλ<1
(35)	Norwayan School of Management	0.923	4、12	0	9	Σλ<1