MONASH University
Business and Economics

Go Boldly.

Star Gazing: The ability of Technical and Overall Efficiency to Pick Likely Winners and Losers

Authors: John R. Watson., and J Wickramanayake
Department of Accounting and Finance, Monash University.

EFMD EQUIS ACCREDITED

www.buseco.monash.edu

MONASH University
Business and Economics

www.buseco.monash.edu

Setting the Scene – Aim and Rational for this study

This study uses a common approach within frontier analysis namely DEA to evaluate the relative efficiency of 682 Australian managed funds to determine amongst other things if an association exists between managed fund ratings and efficiency.

Importance and motivation for this Study

Limited knowledge regarding the impact of ratings outside the USA
Khorana, Servaes and Tufano (2005) – Journal of Financial Economics

The unique structure of the Australian investment industry
ACCC => ASIC => APRA => RBA

Poor Financial Literacy
Worthington (2006) – Financial Services Review

The use of DEA as a tool for assessing managed fund performance
Murthi et al. (1997) McMullen & Strong (1998) Basso & Funari (2001; 2005)

Research Questions and Research Design.

- **RQ1: Is there a relationship between managed fund ratings and efficiency?**

  Ho: No relationship exists between Morningstar "overall" star ratings and DEA efficiency score.

- **RQ2: Do efficient funds with low Morningstar "overall" star ratings (lower than 5) receive a rating upgrade in the near to immediate future?**

  Ho: Efficient funds with low Morningstar "overall" star ratings are not upgraded.

- **RQ3: Do inefficient funds with high Morningstar "overall" star ratings (higher than 1) receive a rating downgrade in the near to immediate future?**

  Ho: Inefficient funds with high Morningstar "overall" star ratings are not downgraded.

MONASH University
Business and Economics

Go Boldly.

Research Design (DEA RUNS)

An overview of models to be used in this study

Overall Efficiency (CCR)

$$\text{Max } e_0 = \frac{\sum_{r=1}^{s} u_r y_{ro}}{\sum_{i=1}^{m} v_i x_{io}}$$

Economic Efficiency (BCC)

Dual of the equivalent LP model

Table 1 DEA Models

DEA Model	CCR-I Charnes et al. (1978)	BCC-I (Banker et al. (1984)
DATA X	Semi-p	Semi-p
Y	Free	Free
Returns to Scale Assumption	CRS	VRS
Range of Efficiency Score	Between 0 and 1	Between 0 and 1

EFMD EQUIS ACCREDITED

www.buseco.monash.edu

MONASH University
Business and Economics

Go Boldly.

Data and Variable Selection

- Input-output variables for 682 Australian managed funds covering a ten year period (January 1998 to December 2007) are obtained from the Morningstar Direct Database.
- The total value of assets in these funds is approximately AUD 314 billion and represents about 33% of the total size of the entire Australian investment industry.
- The Morningstar dataset used in this analysis includes all details on open, closed and finalised funds.

EFMD EQUIS ACCREDITED

www.buseco.monash.edu

MONASH University
Business and Economics

Go Boldly.

Data and Variable Selection

- **Five output variables capture the short-, the medium-, and the long term performance using annual gross returns.**
  - Short-term performance is captured by returns in final 12 months.
  - Medium-term performance is measured by 2- & 3-year returns.
  - Long term performance is measured by 5- & 10-year returns.

- **Eight input variables are used in the DEA analysis**
  - the standard deviations of the 1-, 2-, 3-, 5- and 10-year gross returns
  - sales charges incurred at the time of purchasing and selling
  - operating expenses
  - minimum initial investment.

EFMD EQUIS ACCREDITED

www.buseco.monash.edu

MONASH University
Business and Economics

Go Boldly.

Data and Variable Selection

Table 2 Inputs and Outputs previously adopted within the literature

Variables	Murthi el al. (1997)	McMullen and Strong (1998)	Baso and Funari (2001, 2005)
Inputs (X)	Standard deviation Expense ratio Total load Turn over	3-year std. deviation Sales charge Minimum Initial investment Expense ratio	Subscription costs Redemption Fees Std. deviation Sq-root of ½ variance β-coefficient
Outputs (Y)	Annual Return	1-year Return 3-year Return 5-year Return	1-year Return 2-year Return 3-year Return

EFMD EQUIS ACCREDITED

www.buseco.monash.edu

MONASH University
Business and Economics

Go Boldly.

Data and Variable Selection

Table 3 Explanatory Variables and Descriptive Statistics for DEA

Variable		Mean	Std Deviation	Min	Max
Inputs					
1 year annual standard deviation (%)	X_1	6.24	4.78	0.02	27.82
2 year annual standard deviation (%)	X_2	6.28	4.58	0.02	27.03
3 year annual standard deviation (%)	X_3	6.32	4.45	0.02	25.88
5 year annual standard deviation (%)	X_4	6.21	4.28	0.02	23.85
10 year annual standard deviation (%)	X_5	7.19	4.92	0.04	23.75
Sales Charges (%)	X_6	0.20	0.86	0.00	4.50
Management Expense Ratio	X_7	1.85	12.41	0.15	325.00
Minimum Initial Investment (AUD)	X_8	92.68	362.41	0.00	5,000.00
Outputs					
1 year annual gross return (%)	Y_1	5.51	8.58	-24.75	51.12
2 year annual gross return (%)	Y_2	9.67	7.08	-15.51	45.42
3 year annual gross return (%)	Y_3	10.92	6.76	-2.63	39.89
5 year annual gross return (%)	Y_4	11.15	6.92	-3.67	43.23
10 year annual gross return (%)	Y_5	7.99	4.25	-0.13	25.47

EFMD EQUIS ACCREDITED

www.buseco.monash.edu

MONASH University
Business and Economics

www.buseco.monash.edu

RESULTS (DEA ANALYSIS)

- 49 separate DEA runs were executed (refer Table 4) under assumptions of both VRS (BCC model) and CRS (CCR model) using DEA solver pro.
  - DEA Runs 1,9, 17, 25, 33, 41 and 49 [STP]
  - DEA Runs 2, 3, 6, 9, 10, 14, 18, 19, 22, 26, 27, 30, 34, 35, 38, 42, 43, 46, 50, 51 and 54 [MTP]
  - DEA Runs 4, 5, 7, 12, 13, 15, 20, 21, 23, 28, 29, 31, 36, 37, 39, 44, 45, 47, 52, 53 and 55 [LTP]
- the total number of input-output variables included in any DEA run ranges between 3 and 7.

MONASH University
Business and Economics

www.buseco.monash.edu

RESULTS (DEA ANALYSIS)

Variables considered in different Data Envelopment Analysis Runs

The following table presents a summary of the variables included within each of the 56 DEA runs conducted. The outputs variables are categorised according to the following abbreviations; [1YR_R] represents 1 year annual gross return, [2YR_R] the 2 year annual gross return, [3YR_R] the 3 year annual gross return, [5YR_R] the 5 year annual gross return, [10YR_R] the 10 year annual gross return. The input variables are categorised as follows; [1YR_SD] represents 1 year standard deviation, [2YR_SD] the 2 year standard deviation, [3YR_SD] the 3 year standard deviation, [5YR_SD] the 5 year standard deviation, [10YR_SD] the 10 year standard deviation, [SC] sales charges, [MER] management expense ratio and [MII] minimum initial investment.

RUN	1YR_R	2YR_R	3YR_R	5YR_R	10YR_R	SC	MER	MII	1YR_SD	2YR_SD	3YR_SD	5YR_SD	10YR_SD
1	■					■	■	■	■				
2		■				■	■	■		■			
3			■			■	■	■			■		
4				■		■	■	■				■	
5					■	■	■	■					■
6		■	■			■	■	■		■	■		
7				■	■	■	■	■				■	■
8	■	■	■	■	■	■	■	■	■	■	■	■	■
9	■						■	■	■				
10		■					■	■		■			
11			■				■	■			■		
12				■			■	■				■	
13					■		■	■					■
14		■	■				■	■		■	■		
15				■	■		■	■				■	■
16	■	■	■	■	■		■	■	■	■	■	■	■
17	■					■		■	■				
18		■				■		■		■			
19			■			■		■			■		
20				■		■		■				■	
21					■	■		■					■
22		■	■			■		■		■	■		
23				■	■	■		■				■	■
24	■	■	■	■	■	■		■	■	■	■	■	■
25	■					■	■		■				

RUN	1YR_R	2YR_R	3YR_R	5YR_R	10YR_R	SC	MER	MII	1YR_SD	2YR_SD	3YR_SD	5YR_SD	10YR_SD
26		■				■	■			■			
27			■			■	■				■		
28				■		■	■					■	
29					■	■	■						■
30		■	■			■	■			■	■		
31				■	■	■	■					■	■
32	■	■	■	■	■	■	■		■	■	■	■	■
33	■					■			■				
34		■				■				■			
35			■			■					■		
36				■		■						■	
37					■	■							■
38		■	■			■				■	■		
39				■	■	■						■	■
40	■	■	■	■	■	■			■	■	■	■	■
41	■						■		■				
42		■					■			■			
43			■				■				■		
44				■			■					■	
45					■		■						■
46		■	■				■			■	■		
47				■	■		■					■	■
48	■	■	■	■	■		■		■	■	■	■	■
49	■							■	■				
50		■						■		■			
51			■					■			■		
52				■				■				■	
53					■			■					■
54		■	■					■		■	■		
55				■	■			■				■	■
56	■	■	■	■	■			■	■	■	■	■	■

Table 5 Summary Statistics of Efficiency Scores Under the Assumption of Variable Returns to Scale and Constant Returns to Scale

The following table presents summary statistics for pure technical efficiency scores under the assumption of VRS and overall technical efficiency statistics under the assumption of CRS. Statistics are presented in columns 2 through 5 and 7 though 10 for the 49 DEA runs conducted. DEA runs 8, 16, 24, 32, 40, 48 and 56) given the mismatch of time period input and output data. Efficiency statistics (assuming VRS) are presented first in each column and efficiency statistics (assuming CRS) are presented in (parenthesis). In column 1 and in column 6 the DEA run number is provided along with the total number of input and output variables indicated in [parentheses].

DEA Run	Number of Efficient Funds	Mean Efficiency Score	Std Deviation of Efficiency Score	Median Efficiency Score	DEA Run	Number of Efficient Funds	Mean Efficiency Score	Std Deviation of Efficiency Score	Median Efficiency Score
01 [5]	30 (13)	0.433 (0.305)	0.245 (0.266)	0.335 (0.229)	29 [4]	9 (4)	0.413 (0.267)	0.231 (0.185)	0.405 (0.221)
02 [5]	30 (13)	0.475 (0.396)	0.232 (0.234)	0.408 (0.345)	30 [6]	19 (7)	0.438 (0.291)	0.245 (0.198)	0.400 (0.246)
03 [5]	29 (10)	0.519 (0.431)	0.225 (0.203)	0.475 (0.391)	31 [6]	22 (9)	0.487 (0.316)	0.239 (0.196)	0.478 (0.282)
04 [5]	28 (13)	0.532 (0.458)	0.224 (0.208)	0.502 (0.434)	32				
05 [5]	38 (16)	0.539 (0.436)	0.242 (0.222)	0.518 (0.408)	33 [3]	7 (1)	0.148 (0.072)	0.240 (0.193)	0.011 (0.011)
06 [7]	39 (15)	0.528 (0.447)	0.232 (0.216)	0.479 (0.398)	34 [3]	6 (1)	0.156 (0.060)	0.201 (0.155)	0.045 (0.015)
07 [7]	50 (23)	0.596 (0.502)	0.238 (0.219)	0.580 (0.474)	35 [3]	5 (1)	0.220 (0.057)	0.220 (0.138)	0.155 (0.016)
08					36 [3]	4 (1)	0.233 (0.045)	0.200 (0.107)	0.200 (0.016)
09 [4]	25 (12)	0.422 (0.297)	0.235 (0.261)	0.334 (0.225)	37 [3]	6 (1)	0.270 (0.066)	0.239 (0.128)	0.230 (0.022)
10 [4]	29 (13)	0.475 (0.395)	0.231 (0.234)	0.408 (0.345)	38 [5]	11 (3)	0.229 (0.064)	0.231 (0.157)	0.156 (0.017)
11 [4]	26 (10)	0.517 (0.430)	0.223 (0.202)	0.475 (0.391)	39 [5]	15(5)	0.351 (0.081)	0.264 (0.152)	0.339 (0.032)
12 [4]	26 (12)	0.527 (0.453)	0.219 (0.205)	0.500 (0.429)	40				
13 [4]	34 (15)	0.537 (0.434)	0.239 (0.220)	0.518 (0.391)	41 [3]	14 (4)	0.313 (0.212)	0.243 (0.232)	0.231 (0.137)
14 [6]	27 (15)	0.526 (0.445)	0.230 (0.215)	0.479 (0.398)	42 [3]	12 (4)	0.372 (0.260)	0.241 (0.204)	0.312 (0.209)
15 [6]	46 (22)	0.593 (0.499)	0.235 (0.217)	0.577 (0.471)	43 [3]	13 (3)	0.430 (0.280)	0.239 (0.185)	0.392 (0.238)
16					44 [3]	10 (3)	0.418 (0.283)	0.213 (0.171)	0.405 (0.256)
17 [4]	16 (4)	0.443 (0.075)	0.356 (0.197)	0.421 (0.012)	45 [3]	9 (4)	0.413 (0.267)	0.231 (0.185)	0.405 (0.221)
18 [4]	14 (4)	0.673 (0.069)	0.311 (0.163)	0.537 (0.021)	46 [5]	19 (7)	0.438 (0.291)	0.245 (0.198)	0.400 (0.398)
19 [4]	14 (3)	0.260 (0.074)	0.246 (0.158)	0.199 (0.026)	47 [5]	22 (9)	0.487 (0.316)	0.239 (0.196)	0.478 (0.282)
20 [4]	13 (3)	0.287 (0.102)	0.230 (0.165)	0.246 (0.058)	48				
21 [4]	17 (6)	0.344 (0.098)	0.270 (0.178)	0.317 (0.039)	49 [3]	12 (3)	0.167 (0.074)	0.253 (0.196)	0.019 (0.012)
22 [6]	20 (5)	0.272 (0.080)	0.259 (0.175)	0.210 (0.026)	50 [3]	14 (3)	0.188 (0.062)	0.229 (0.158)	0.076 (0.016)
23 [6]	29 (10)	0.408 (0.125)	0.281 (0.199)	0.405 (0.060)	51 [3]	11 (2)	0.247 (0.061)	0.237 (0.143)	0.191 (0.018)
24					52 [3]	11 (2)	0.268 (0.066)	0.217 (0.128)	0.242 (0.030)
25 [4]	14 (4)	0.313 (0.212)	0.243 (0.232)	0.231 (0.137)	53 [3]	14 (4)	0.342 (0.092)	0.268 (0.171)	0.316 (0.034)
26 [4]	14 (4)	0.372 (0.260)	0.241 (0.204)	0.312 (0.209)	54 [5]	18 (4)	0.260 (0.068)	0.253 (0.162)	0.202 (0.019)
27 [4]	13 (3)	0.430 (0.280)	0.239 (0.185)	0.392 (0.238)	55 [5]	26 (9)	0.401 (0.109)	0.280 (0.187)	0.393 (0.047)
28 [4]	10 (3)	0.418 (0.283)	0.213 (0.171)	0.405 (0.256)	56				

TABLE 7: Contingency Table between Morningstar "Overall" Star Ratings and DEA Scores

PANEL A: OVERALL						
($\chi2$ = 0.02185)*	RANGE					
RATING	DEA score < 0.2	0.2 < DEA score < 0.40	0.40 < DEA score < 0.6	0.6 < DEA score < 0.8	DEA score > 0.8	Grand Total
1	32	53	24	4		113
2	42	51	26	10	1	130
3	49	86	40	33	5	213
4	11	66	48	50	8	183
5	2	5	5	14	17	43
Grand Total	136	261	143	111	31	682
PANEL B: SHORT TERM						
($\chi2$ = 0.03305)*	RANGE					
RATING	DEA score < 0.2	0.2 < DEA score < 0.40	0.40 < DEA score < 0.6	0.6 < DEA score < 0.8	DEA score > 0.8	Grand Total
1	89	21	3	0		113
2	88	26	12	2	2	130
3	123	37	35	14	4	213
4	68	47	34	30	4	183
5	7	1	4	8	23	43
Grand Total	375	132	88	54	33	682
PANEL C: MEDIUM TERM						
($\chi2$ = 0.02499)*	RANGE					
RATING	DEA score < 0.2	0.2 < DEA score < 0.40	0.40 < DEA score < 0.6	0.6 < DEA score < 0.8	DEA score > 0.8	Grand Total
1	37	54	19	1	2	113
2	56	34	33	5	2	130
3	68	70	34	37	4	213
4	11	66	54	40	12	183
5	3	5	3	13	19	43
Grand Total	175	229	143	96	39	682
PANEL D: LONG TERM						
($\chi2$ = 0.01419)*	RANGE					
RATING	DEA score < 0.2	0.2 < DEA score < 0.40	0.40 < DEA score < 0.6	0.6 < DEA score < 0.8	DEA score > 0.8	Grand Total
1	31	25	38	13	6	113
2	38	29	39	19	5	130
3	39	61	47	45	21	213
4	6	36	64	54	23	183
5	1	4	6	11	21	43
Grand Total	115	155	194	142	76	682

- RQ1: Is there a relationship between managed fund ratings and efficiency?

  Ho: No relationship exists between Morningstar "overall" star ratings and DEA efficiency score.

Table 8 Probit Analysis for Testing the Link Between Managed Fund Efficiency Scores and Morningstar Upgrades and Downgrades

The following table presents the Berndt-Hall-Hall-Hausman probit analysis results for testing the relationship between high and low DEA scores with the Morningstar rating received by a fund six months following the construction of the efficiency score under the assumption of variable returns to scale (Panel A) and constant returns to scale (Panel B). Z-statistics are reported in parentheses while * signifies significance level at the 10% level **signifies significance level at the 5% level and *** signifies significance level at the 1% level. The McFadden R-Square, LR statistic, probability and sample size (N) including the number of observations with a dependent variable (1 and 0) are also reported.

PANEL A: VARIABLE RETRUNS TO SCALE

Model Rating Change DEA Efficency Score	BCC Upgrade Overall	BCC Upgrade Short Term	BCC Upgrade Medium Term	BCC Upgrade Long Term	BCC Downgrade Overall	BCC Downgrade Short Term	BCC Downgrade Medium Term	BCC Downgrade Long Term
High Efficiency Score	0.2195 (2.1284)**	0.0957 (1.6582)*	0.0175 (1.8347)*	0.1472 (1.3955)				
Low Efficiency Score					-1.2471 (-11.1721)***	-1.0241 -(12.2161)***	-1.1828 (-11.3593)***	-1.1938 (-10.0794)***
McFadden R^2	0.0372	0.0491	0.0392	0.0262	0.0652	0.0690	0.0664	0.0495
LR Statistic	33.7235	44.4299	35.4916	23.7183	53.8302	56.9437	54.8240	40.8288
Prob	0.033	0.0973	0.0665	0.1629	0.0000	0.0000	0.0000	0.0000
N	682	682	682	682	682	682	682	682
Obs. with Dep. = 0	423	423	423	423	482	482	482	482
Obs. with Dep. = 1	259	259	259	259	200	200	200	200

PANEL B: CONSTANT RETRURNS TO SCALE

Model Rating Change DEA Efficency Score	CCR Upgrade Overall	CCR Upgrade Short Term	CCR Upgrade Medium Term	CCR Upgrade Long Term	CCR Downgrade Overall	CCR Downgrade Short Term	CCR Downgrade Medium Term	CCR Downgrade Long Term
High Efficiency Score	0.2793 (2.5928)***	0.0348 (0.4787)	0.2453 (2.4173)**	0.2631 (2.3072)**				
Low Efficiency Score					-1.0895 (-11.2466)***	-0.8421 (-12.0026)***	-1.0352 (-11.5050)***	-1.0957 (-10.7552)***
McFadden R2	0.0454	0.0469	0.0464	0.0358	0.0596	0.0507	0.0581	0.0519
LR Statistic	41.0890	42.5528	41.9990	32.4326	49.1996	41.8495	47.9842	42.8330
Prob	0.0095	0.6321	0.0156	0.0210	0.0000	0.0000	0.0000	0.0000
N	682	682	682	682	682	682	682	682
Obs. with Dep. = 0	423	423	423	423	482	482	482	482
Obs. with Dep. = 1	259	259	259	259	200	200	200	200

- RQ2 and RQ3: Do efficient funds with low(high) Morningstar ratings receive a rating upgrade (downgrade) in the near to immediate future?

Ho: Efficient funds with low(High) Morningstar “overall” star ratings are not upgraded(downgraded).

MONASH University
Business and Economics

Go Boldly.

Conclusions and future research

A strong positive association is found to exist in all cases between the average DEA efficiency score, (computed using short-, medium-, and long-term information) and the Morningstar “star’ rating.

RQ1: ANSWER = YES

Funds that are found to be efficient (inefficient) have a high likelihood of receiving a rating upgrade (rating downgrade) within six months following the analysis

RQ 2 and RQ3 ANSWER = YES and YES

EFMD EQUIS ACCREDITED

www.buseco.monash.edu

MONASH University
Business and Economics

www.buseco.monash.edu

THANK YOU