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Analyzing the technical performance of trotting and training firms using data envelopment analysis

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2015 EAAP Conference - Warsaw

Some figures on Horse betting in Sweden

- Market for gambling in Sweden has grown by about 50% between 1995 and 2014.
- Horse betting represents 27% of gambling in Sweden. amounting to a turnover 1.26 billion Euros in 2013.
- The Swedish government raises 13.5 milion Euros in revenues from gambling on horses alone.
- Gambling and horse betting is not sensitive as many other sectors in society to cyclical economic changes and crises.
- There are 32 racetracks all over Sweden with about 9.000 races a year and 1.5 million visitors per year.

Some facts on Trotter/trainer firms in Sweden

- There are more than 6.000 registered at the AB Horse Racing Organization (Svensk Trav). of which 400 are so-called professionals.

- During the period of study (2009-2011) trotters/trainers are experiencing financial problems.

- The cost for horse owners to use a professional trainer is about 1.000 Euros per month.

- Trainers receive about 10% of possible racetrack winnings.

- trainer/trotter firms have two sources of income:
  1) Fee charged for training horses
  2) Performance at the racetrack
  These two sources of income represent on average 64% of their revenues.

Objectives of this study

- To analyze the technical efficiency of trotter and trainer firms in Sweden using Data Envelopment Analysis (DEA)
- To determine the determinants of technical efficiency scores attributed to these firms.
- Sensitivity of the empirical results to the sample data: (Influence of outliers)

Data being used

- In Sweden. all limited companies must send income statement to the Swedish Company Registration Office.

- 97 limited professional trotter and trainer firms were selected for the period 2009 to 2011.

- Data use for the DEA efficiency analysis are accountancy information concerning firm's total revenues and four cost items (personel cost. Material depreciation. Raw Material. supplies and other operating expenses. Other external expenses).

- A total of 242 observations were used in the DEA analysis.

- On average. a typical trotter/trainer firm has an annual income of 600 000 Euros.

Methodology

1) Application of the DEA approach to trainer/trotter firms.

$max_{\phi.\lambda}\phi$

$Subject\ to$:

$-\phi Y_i + \mathbf{Y}\boldsymbol{\lambda} \geq 0$

$X_i - \mathbf{X}\boldsymbol{\lambda} \geq 0$

$\boldsymbol{\lambda} \geq 0$

$N'\boldsymbol{\lambda} = 1$

X_i and Y_i are $m \times 1$ and $s \times 1$ column vectors inputs and outputs of firm i.

X and **Y** are $m \times n$ and $s \times n$ matrices of input and output for all firms.

$\boldsymbol{\lambda}$ is a $n \times 1$ vector of constant parameters.

$1/\phi$ is defined as the technical efficiency (TE) score and lies between 0 and 1. A fully efficient firm as a TE score of 1.

2) Outlier and outlier detection in DEA

- Analyze the patterns of the weights $\boldsymbol{\lambda}$'s among the i firms and form the following indicator:

$S_i = \sum_j \lambda_{ji}$

- Conduct a statistical analysis of the indicator $S_{i.}$ and exclude the outliers

3) Estimate the determinants of technical score using regression analysis:

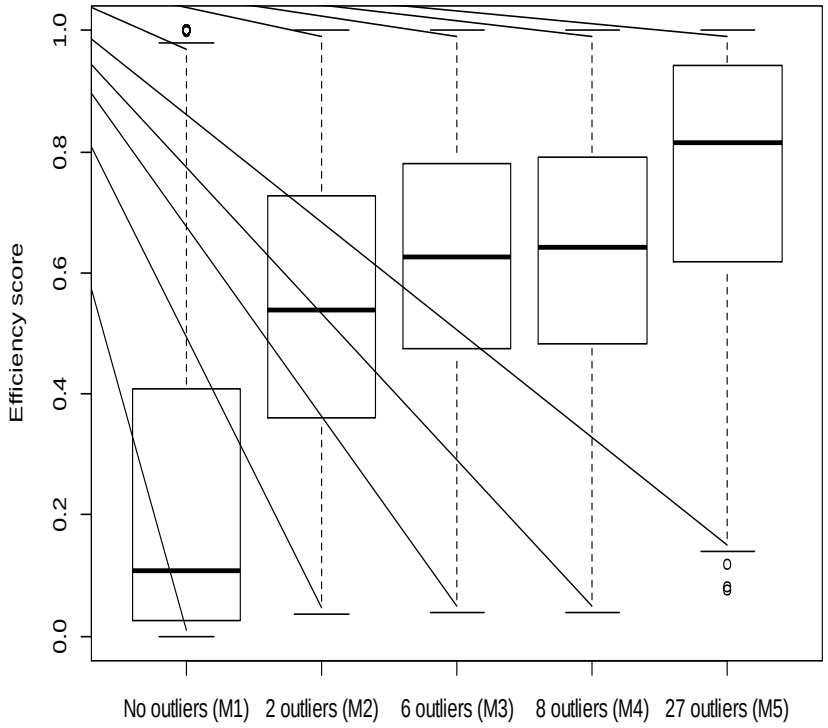
- Use a Tobit model approach

Empirical results: DEA scores

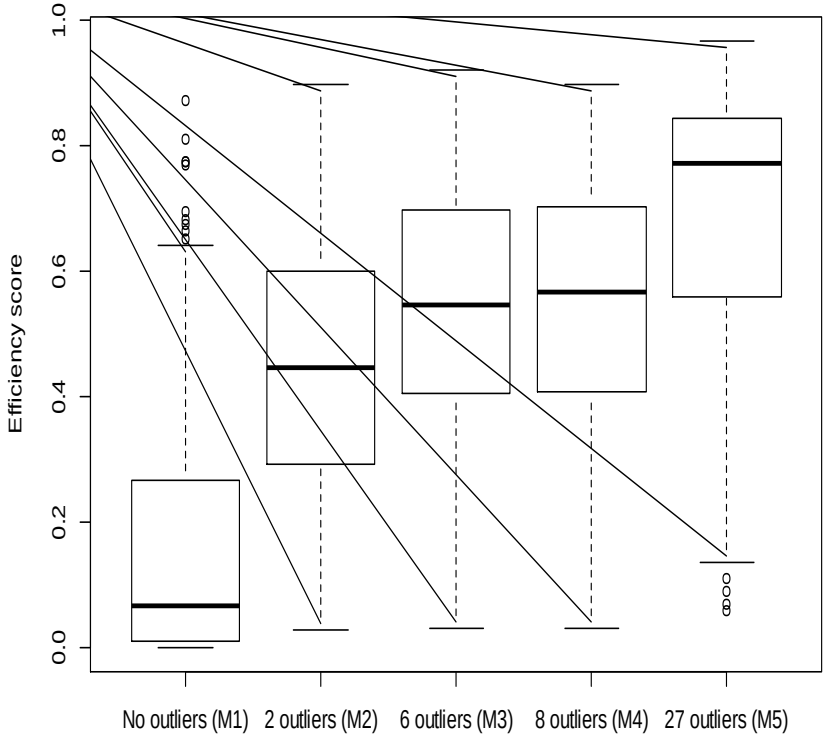
	ORIGINAL DATA		CLEANED DATA	
	Raw effIciency scores	Bootstrapped efficiency scores	Raw efficiency . scores	Bootstrapped efficiency scores
Minimum	0.000	0.000	0.076	0.058
25th Percentile	0.025	0.010	0.613	0.569
Median	0.108	0.066	0.809	0.770
75th Percentile	0.408	0.266	0.934	0.839
Maximum	1.000	0.879	1.000	0.968
Mean	0.269	0.177	0.750	0.678
Std. Deviation	0.096	0.069	0.025	0.023

Empirical results: Outlier detection

A. Raw efficiency scores



B. Bias-corrected efficiency scores



Empirical results: Tobit regression results

	M1	M2	M3	M4	M5
Sigma	0.1228***	0.1147***	0.1167***	0.1165***	0.1128***
	(0.0039)	(0.003)	(0.0028)	(0.0028)	(0.0027)
Intercept	0.3099***	0.6735***	0.7268***	0.6777***	0.781***
	(0.0325)	(0.0343)	(0.0414)	(0.0412)	(0.0431)
Mid.Sweden	0.0658***	0.0188	0.0168	0.0149	0.0123
	(0.0139)	(0.0121)	(0.0123)	(0.0123)	(0.0125)
North.Sweden	0.0184	-0.0472**	-0.02	-0.0002	-0.0095
	(0.0191)	(0.0173)	(0.0168)	(0.0168)	(0.0173)
Established	-0.0013**	-0.0021***	-0.0017**	-0.0009	-0.0002
	(0.0006)	(0.0006)	(0.0006)	(0.0006)	(0.0006)
Gender	-0.0906***	-0.0213	0.0121	0.0189	0.0683**
	(0.0165)	(0.0145)	(0.0154)	(0.016)	(0.0204)
Starts	0.0004***	0.0002***	0.0002***	0.0002***	0.0001***
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
Wins	-0.1276	-0.056	-0.3774**	-0.3393**	-0.5866***
(% of starts)	(0.1434)	(0.1183)	(0.1269)	(0.1129)	(0.1011)
Second placings	-0.8753***	-0.4322**	-0.2674	-0.1254	0.1686
(% of starts)	(0.1581)	(0.1453)	(0.1608)	(0.1652)	(0.1562)
Third placings	-0.1276	-0.3432**	-0.3667***	-0.3346**	-0.4278***
(% of starts)	(0.0789)	(0.104)	(0.1013)	(0.1062)	(0.0993)
Average winnings	0.0000	0.0000	0.0000	0.0000	0.0000
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
Year=2010	-0.0353**	-0.1805***	-0.2035***	-0.2175***	-0.2616***
	(0.0143)	(0.0136)	(0.0139)	(0.0143)	(0.0155)
Year=2011	0.023	-0.0149	-0.0109	-0.0093	0.01
	(0.0145)	(0.0138)	(0.0146)	(0.015)	(0.0168)
Log-Likelihood	566.66	595.74	577.83	573.79	542.86
LogL/n	2.28	2.41	2.38	2.38	2.45
n	249	247	243	241	222
K	11	11	11	11	11
AIC/n	-4.46	-4.73	-4.67	-4.67	-4.79
BIC/n	-4.31	-4.58	-4.51	-4.51	-4.62

Concluding remarks

- The empirical work presented in this work shows the potentiality of using DEA efficiency analysis to analyze the technical performance of horse-related firms such as professional trainers and trotters.
- The computed DEA scores clearly indicated varied technical performance results of trainers/trotter firms in Sweden.
- Outlier detection, although somewhat reducing the number of observations, is essential when conducting DEA analysis.
- Regression results on the determinants of TE scores are mixed and require further investigation.