

HELENA



Higher Education Global
Efficiency Analysis

DEA calculation for production simulation modeling with universities

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OR 2014, RWTH Aachen, 04.09.2014

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1. Introduction

Background

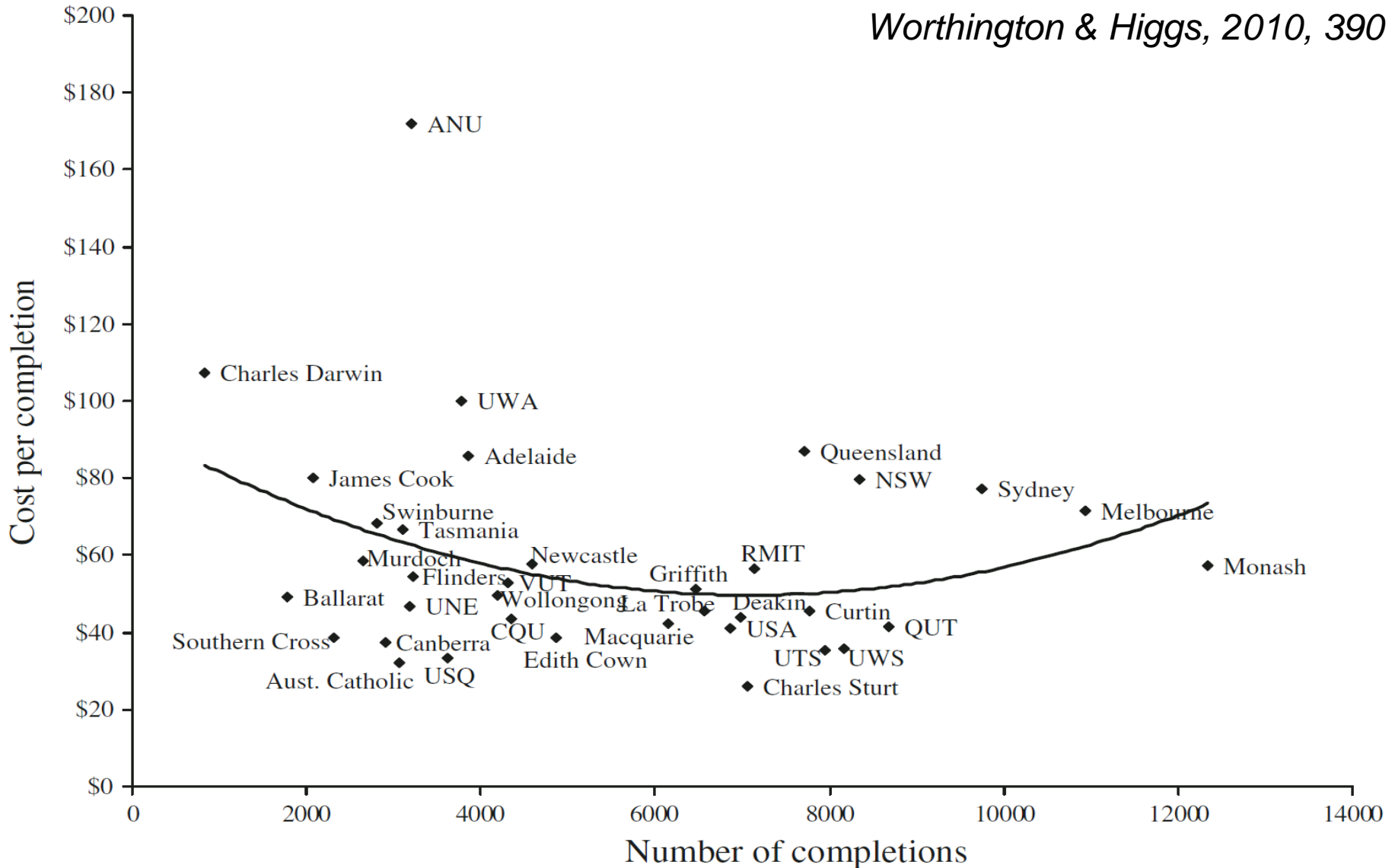
- Research and efforts to increase university performance, i.e. mergers
- Questions of university evaluation and efficiency measurement:
multiple stakeholders and objectives, unknown production function
- Efficiency analysis methods
 - MCDM (Multi Criteria Decision Making), **DEA (Data Envelopment Analysis)**,
AHP (Analytic Hierarchy Process), SFA (Stochastic Frontier Analysis)

Specific Research Question

- How can DEA efficiency results be used for creating a production function for university settings?

1. Introduction: Example Australia

Worthington & Higgs, 2010, 390



2. University Example Dataset

- **DEA** for university settings, often applied (i.e. Worthington & Higgs, 2010)
 - **Basic problem** of any comparative & quantitative view: Different definitions in data gathering and accumulation, *institutional and systemic*
 - **Additional problem** of changing measurement concepts as well as withheld data and data irregularities (e.g. DFG reporting)
 - **Indicators** in this dataset (case study) for 86 German Universities:
 - Graduates (Stat. Bundesamt / destatis.de), 2012 - *Teaching*
 - Third Party Funding (DFG) in four discipline areas, 2009 - *Research*
 - Number of Professors (DFG, homepages universities), 2009/2013
- **DEA (O-O, CCR)**; further on: Intervening (independent) variables

2. University Example Dataset

Institution	PR	UC	PW	WE	DW	PA	F-HU	F-LI	F-NA	F-EN	G-PH	G-MA	G-BA
Aachen FH	0	0	-	1	0	220	0.268	0.005	2.926	6.969	0	268	1169
Aachen TH	1	1	11.7	1	27.2	428	7.779	40.128	28.969	173.189	1994	1031	2333
Augsburg U	1	0	17.8	1	51.2	169	3.668	0.129	8.077	3.114	846	169	1024
Bamberg U	1	0	25.9	1	67.3	135	11.263	0.011	0.367	3.514	630	270	692
Bayreuth U	1	0	13.2	1	43.1	197	4.726	2.918	13.165	6.884	406	346	866
Berlin FU	1	0.5	27.5	1	60.19	593	49.503	85.407	26.732	3.399	1555	1066	1561
Berlin HU	1	0.5	23.0	0	57.39	580	25.441	98.126	13.927	2.036	1143	940	1230
Berlin TU	1	0	20.0	1	35.5	386	10.002	5.983	36.106	73.314	1481	824	1506
Bielefeld U	1	0	22.4	1	65.2	250	20.345	12.972	9.826	9.221	503	541	1525
Bochum U	1	1	19.7	1	42.2	422	16.150	20.299	24.093	24.934	1056	1192	2365
...													
Stuttgart U	1	0	7.3	1	27.8	260	6.928	2.928	14.870	87.519	205	148	1044
Trier FH	0	0	13.3	1	0	165	4.462	0.005	0.000	1.388	0	146	674
Trier U	1	0	20.6	1	62.0	160	9.339	0.000	3.273	0.181	927	41	753
Tuebingen U	1	1	13.7	1	54.6	408	13.795	89.197	16.169	2.671	777	294	1085
Ulm U	1	1	11.8	1	47.7	187	1.397	50.467	10.640	6.580	415	256	647
Weimar U	1	0	19.0	0	41.6	95	2.284	0.000	0.000	9.216	89	322	326
Wiesb.EBS	1	0	19.4	1	36	10.394	0.000	0.000	0.000	0	93	188	
Witten U	1	1	7.32	1	54.7	41	3.668	7.731	0.039	0.000	86	40	29
Wuppertal U	1	0	21.9	1	52.1	238	3.285	0.602	12.664	7.926	259	335	1115
Wuerzburg U	1	1	14.1	1	57.3	362	8.328	58.793	15.063	1.454	1658	160	914

3. DEA Results

- No “clear picture”
- Size does *not* play a role
- High eff. level
- Uni as well as UAS
efficient & less efficient
- Hypothesis: Other
intervening variables

Aachen FH	Aachen TH	Augsburg U	Bamberg U	Bayreuth U	Berlin FU
73.80	100.00	100.00	100.00	73.40	100.00
Berlin HU	Berlin TU	Bielefeld U	Bochum U	Bonn U	Braunsch.U
97.20	100.00	100.00	100.00	100.00	85.80
Bremen HS	Bremen JU	Bremen U	Chemn.TU	Clausth.TU	Cottbus TU
91.90	40.70	100.00	93.80	74.80	66.80
Darmstadt TU	Dortm.TU	Dresden TU	Du.-E.U	Duesseld.U	Erlangen-N.U
93.10	67.00	100.00	81.60	78.50	80.90
Frankfurt U	Freib.TU	Freiburg U	Friedr.ZU	Gels.FH	Giessen U
100.00	100.00	95.00	100.00	54.30	75.80
Greifsw.U	Goett.U	Halle-W. U	Ham.U	Ham.UdBW	Ham.-H. TU
78.60	79.20	63.30	100.00	100.00	88.50
Hann.MedH	Hann.TiH	Hann.U	Heidelb.U	Hohenh.U	Ilmenau TU
100.00	100.00	64.10	100.00	100.00	100.00
Jena U	Kaisersl.TU	Karlsru.KIT	Kassel U	Kiel U	Koblenz-L.U
100.00	100.00	100.00	66.60	62.40	64.30
Konst.U	Koeln FH	Koeln Kath	Koeln RFH	Koeln U	Leipz.U
100.00	71.20	99.90	36.90	90.00	85.60
Luebeck U	Lueneb.U	Magdeb.U	Mainz U	Mannh.U	Marburg U
83.10	53.20	82.20	100.00	100.00	70.30
Muen.HS	Muen.LMU	Muen.TU	Muen.UdBW	Muenster FH	Muenster U
56.00	100.00	100.00	77.10	83.50	100.00
Oldenb.U	Osnabr.U	Ostw.-L.HS	Paderb.U	Passau U	Potsdam U
100.00	56.50	59.50	66.50	100.00	95.30
Regensb.U	Rostock U	Saarbr.U	Siegen U	Stuttg.U	Trier FH
68.30	50.40	56.60	59.80	87.00	51.60
Trier U	Tueb.U	Ulm U	Weimar U	Wiesb.EBS	Witten-H.U
100.00	82.20	93.80	66.90	100.00	89.10
Wuppert.U	Wuerzb.U
70.00	92.40

4. Regression Analysis

- ***Intervening / independent variables tested:***
 - (1) Total Number of Professors (PA)
 - (2) Share of Women Professors (PW)
 - (3) Share of Women PhD (DW)
 - (4) East or West Germany (WO)
 - (5) Existence of a University Clinic (Medical School) (UK)
 - (6) Right to Grant PhD (PR)

- **Dependent variable: Efficiency value DEA for University / UAS**

4. Regression Analysis

- **Results (R)**

Factor	Estimate	Std. Error	t Value	Pr (t)
dw - Share of Women PhD	0.031695	0.1336993	0.237	0.813
pa - Total number of Professors	0.001275	0.0001541	0.827	0.411
pr - Right to grant PhDs	0.1218221	0.0912619	1.335	0.186
pw - Share of Woman Professors	-0.1494217	0.3393056	-0.440	0.661
uk - University Clinic	-0.0129239	0.0526655	-0.245	0.807
wo - West or East Germany	0.0312197	0.0492419	0.634	0.528

5. Discussion and Outlook

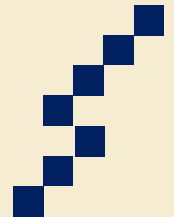
How can DEA efficiency results be used for creating a production function for university settings?

(A) It was shown that input and size indicators are not sufficient for HE production settings (theoretical production function).

(B) One or several indicators as intervening variables (independent) has/have not been identified in a statistically significant way (close hit: PhD granting right).

(C) But the basic idea of *combining DEA with regression analysis* for the identification of intervening variables in production analysis has been *established*.

(D) Possible further options: **(i)** Further enlarged datasets for analysis (downside: comparability); **(ii)** Rejection of hypothesis regarding external intervening variables (inter-organisational) but more internal factors.



**Thank you for
your attention!**

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Förderkennzeichen 01PW11007