COSTS AND EFFICIENCY IN ENGLISH HIGHER EDUCATION

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AN ANALYSIS USING LATENT CLASS STOCHASTIC FRONTIER MODELS

Association for Education Finance and Policy,
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THE QUEEN'S AWARDS FOR ENTERPRISE

1. Introduction

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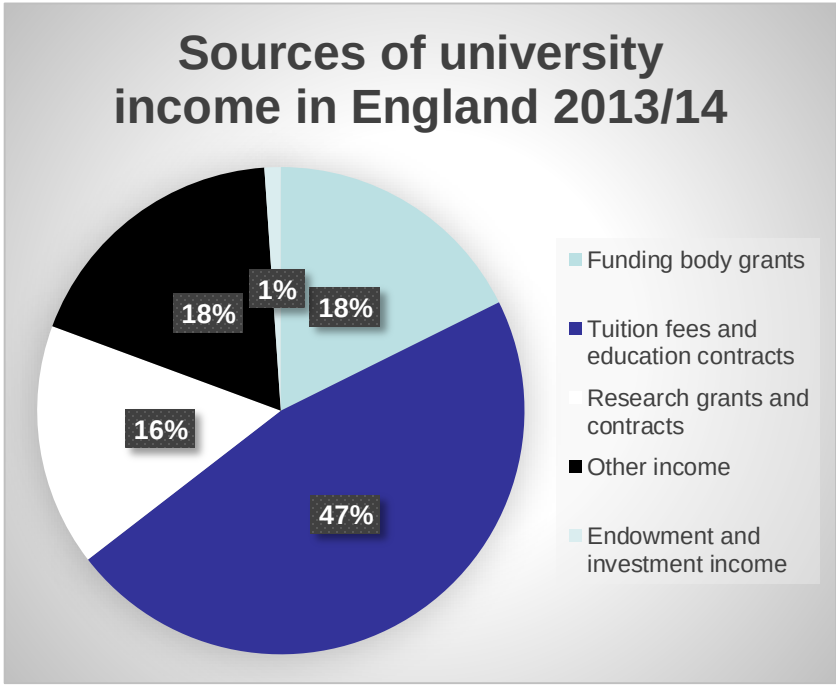
- HEIs receive public money
  - funding body grants
  - non-repayment of tuition fees
- Reduced incentive to be efficient
- Need to assess efficiency of higher education institutions (HEIs)



- Cost functions provide information on efficiency, economies of scale and economies of scope

https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/237411/bis-13-918-efficiency-in-higher-education-sector.pdf

1. Introduction

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The English higher education sector comprises very diverse groups of HEIs:

- ✓ Pre-1992 universities: degree programmes in all academic subjects; research mission
- ✓ Post-1992 universities: degree programmes in academic and vocational subjects; many have a research mission
- ✓ Former colleges of HE: often (but not exclusively) small, specialist HEIs; most do not have a research mission

1. Introduction

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Questions

- How does 'mission group' affect costs? i.e. how can we adequately model the heterogeneity in the sector?
- What are average costs of outputs of English HEIs?
- Are there economies of scale and scope in English HE?
- How efficient are English HEIs?

2. Literature Review

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- UK: Verry & Layard (1975); Verry & Davies (1976) recognise universities are multi-product firms
- USA: Cohn *et al* (1989) seminal work
- UK: Glass *et al* (1995a; 1995b); Johnes (1996; 1997; 1998); Izadi *et al* (2002); Stevens (2005); Johnes *et al* (2005; 2008); Thanassoulis *et al* (2011) recognise heterogeneity in UK context
  - ✓ Relatively low efficiency in panel data studies
  - ✓ Efficiency varies by type of university
  - ✓ Ray economies of scale; diseconomies of scope
  - ✓ Student quality, location of HEI are not important determinants of costs

2. Literature Review

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Most recent developments (RPM and LCM) to deal with heterogeneaity:

- USA: Agasisti & Johnes (2009) use latent class model (LCM) with SFA
  - ✓ Allows objectives *to vary by group* suggested by the data
- UK: Johnes & Johnes (2009) use a random parameter model (RPM) with SFA
  - ✓ Allows *each HEI* to have different objectives
- Findings:
  - ✓ HEIs are heterogeneous in terms of both cost structure and efficiency

3. Conceptual Issues

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The general form of the cost function is:

$$C_k = f(y_{ik}, w_{lk})$$

3 desiderata (Baumol 1982)

- Non-negative and non-decreasing function
- Allow for zero of some outputs
- No preclusion or enforcement of economies of scale and scope

A functional form which fulfils these desiderata is:

$$C_k = \alpha_0 + \sum_i \beta_i y_{ik} + \frac{1}{2}\sum_i \sum_j \gamma_{ij} y_{ik} y_{jk} + \sum_l \delta_l w_{lk} + \varepsilon_k$$

where ε_k is an institution-specific residual; α_0, γ_{ij} and δ_l are to be estimated.

3. Conceptual Issues

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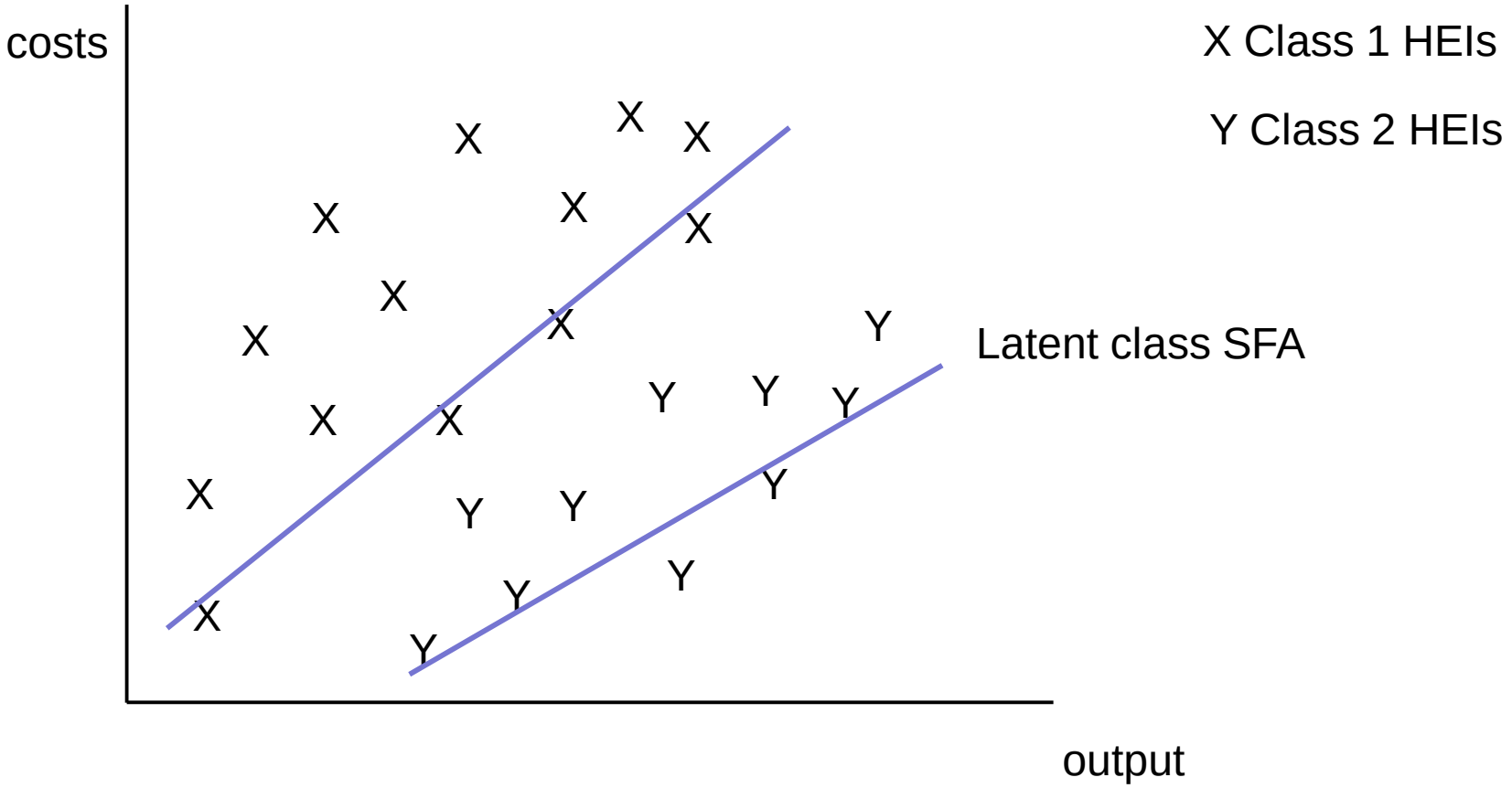
Heterogeneity



3. Conceptual Issues

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Ray economies of scale S_R

✓ If $S_R > 1$ (< 1): economies (diseconomies) of scale

Product-specific economies of scale S_i

✓ If $S_i > 1$ (< 1): economies (diseconomies) of scale for product *i*

Economies of scope

✓ If $S_G > 0$ (< 0): global economies (diseconomies) of scope for producing all outputs jointly rather than in separate institutions

Product-specific economies of scope S_i

✓ If $S_i > 1$ (< 1): economies (diseconomies) of scale for product *i*

4. Model Specification

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COST Total expenditure minus expenditure on residences and catering operations

a) Outputs

TEACHING

- **UGS** FTE undergraduates in all sciences including medicine and dentistry (000s)
- **UGA** FTE undergraduates in non-science subjects (000s)
- **PG** FTE postgraduates in all subjects (000s)

RESEARCH

- **RES** Quality related funding and research grants

4. Model Specification

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b) Input prices

- **WAGE** The residual from a hedonic wage function i.e. a regression of institutions' salary costs against a vector of variables describing the numbers of staff in each of 10 age groups.

c) Estimation

- **SFA with latent class model (LCM)**. For HEI i at time t, m classes:

$$C_{k,m} = \alpha_{0,m} + \sum_i \beta_{i,m} y_{ik} + \frac{1}{2} \sum_i \sum_j \gamma_{ij,m} y_{ik} y_{jk} + \sum_l \delta_{l,m} w_{lk} + v_{k,m} + u_{k,m}$$

4. Model Specification

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d) Data

- From the Higher Education Statistics Agency
- 2013/14 covering 103 HEIs
- Excluded:
  - Universities of Oxford and Cambridge
  - Small and specialist institutions with costs below £25m per year;
  - University of Arts, London, for which we were unable to obtain hedonic salary cost;
  - Buckingham, which is fully private;
  - Open University, which specialises in distance learning;
  - London University (Institutes and Activities)

5. Results

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Descriptive statistics of variables, by latent class

	Class 1		Class 2	
	Mean	SD	Mean	SD
COST	193.443	123.361	184.298	205.650
UGS	4.938	2.648	5.078	3.997
UGA	6.029	2.955	5.819	3.530
PG	2.579	1.410	2.536	2.465
RES	23.045	43.774	28.784	58.878
No. in each class	54		49	

5. Results

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	Latent Class 1	
>£200K	£100K-£200K	<£100K
Imperial College	Lancaster	Northampton
Liverpool	City	Southampton Solent
Southampton	Surrey	St George's Hospital
Bristol	Nottingham Trent	SOAS
Warwick	Sussex	West London
Queen Mary College	Kent	Royal Veterinary College
Exeter	Bath	University for the Creative Arts
York	Portsmouth	Falmouth
Durham	Anglia Ruskin	
Leicester	Salford	
Reading	Middlesex	
Sheffield Hallam	Brunel	
London School of Economics	Hull	
East Anglia	Brighton	
Northumbria	Westminster	
Hertfordshire	De Montfort	
	Wolverhampton	
	Cranfield	
	East London	
	Oxford Brookes	
	Bradford	
	South Bank	
	Sunderland	
	Derby	
	Royal Holloway and Bedford	
	Huddersfield	
	London Metropolitan	
	Keele	
	London Business School	
	Lincoln	

Contains many 'average' HEIs

5. Results

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	Latent Class 2	
>£200K	£100K-£200K	<£100K
University College London	Central Lancashire	Birkbeck
Manchester	Kingston	Edge Hill
King's College	Greenwich	Institute of Cancer Research
Nottingham	Liverpool John Moores	Chester
Leeds	Leeds Beckett	Goldsmiths
Sheffield	Birmingham City	Roehampton
Birmingham	Essex	Institute of Education
Newcastle-upon-Tyne	London Sch Hygiene & Trop Med	Worcester
Plymouth	Bournemouth	Gloucestershire
Manchester Metropolitan	Bedfordshire	Cumbria
Coventry	Staffordshire	Buckinghamshire New
Loughborough	Teesside	Bath Spa
West of England	Aston	Winchester
	Canterbury Christ Church	Liverpool Hope
		York St John
		Chichester
		Bolton
		Royal College of Art
		University College Birmingham
		St Mary's Twickenham
		Harper Adams
		Arts University Bournemouth

Contains a mix of many large HEIs as well as many small HEIs

5. Results
AICs

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HEI with mean levels of output

AICs	Class 1	Class 2
UGS	6763	7726
UGA	4337	3401
PG	13533	29474
RES	2.67	2.58
No. in each class	54	49

Control for: HEDONIC WAGE

5. Results
Economies of scale

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HEI with mean levels of output

	Class 1	Class 2
Scale		
Ray economies	1.06	0.94
UGS	1.00	0.75
UGA	0.77	0.96
PG	0.67	1.46
RES	0.97	1.37

5. Results
Economies of scope

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HEI with mean levels of output

	Class 1	Class 2
Scope		
Global economies	0.01	-0.20
UGS	-0.04	-0.03
UGA	0.15	0.08
PG	0.13	-0.30
RES	-0.03	-0.20

5. Results
Histogram of efficiency scores

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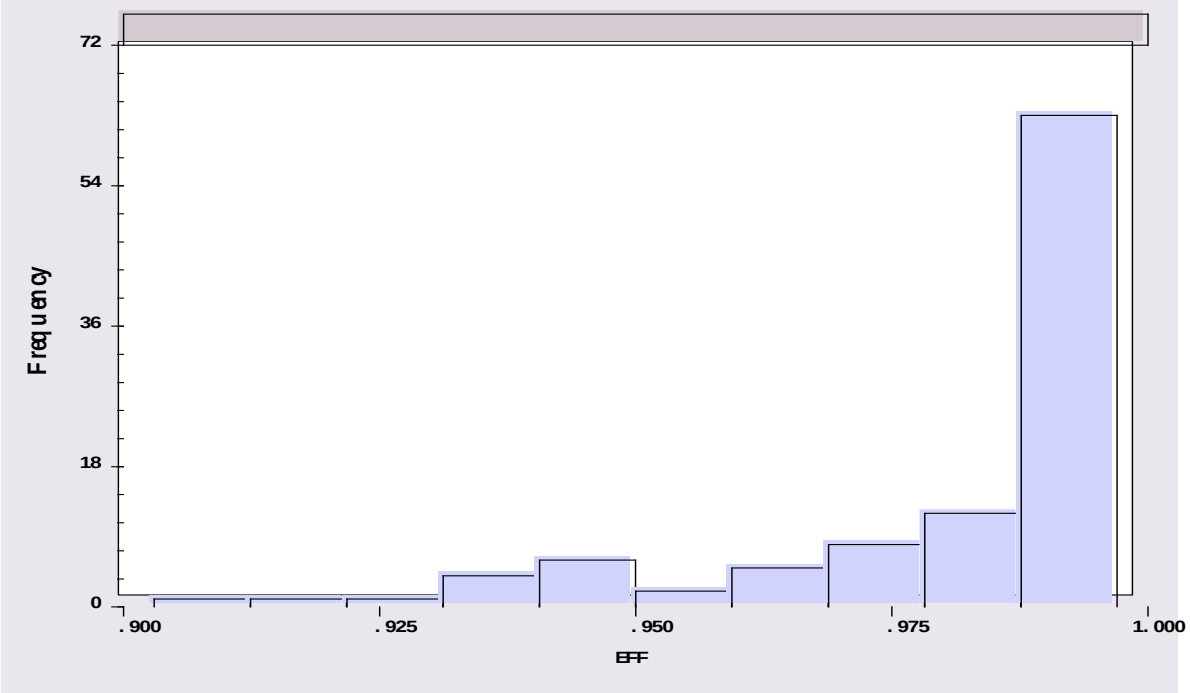

6. Conclusions

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- Estimates of AICs seem plausible
- There may be ray economies of scale for the HEIs in class 1
- No economies of scope at the global level; some possible economies of scope for UGA in both classes
- Estimates of efficiency suggest the sector is highly efficient when heterogeneity is accounted for using LCM
- What allowances for heterogeneity should be made when determining efficiency?