Outline of talk

- Introduction
- Background
- Reasons for merger in higher education
- Previous evidence on the consequences of mergers
- Model
- Results
- Conclusions

Introduction

Various forms of relationships can be observed in the English higher education (HE) sector:

- shared purchasing and services
- joint ventures and alliances
- full merger

This paper is concerned only with merger:

- 'Merger: two or more partners combining to create a single institution, which may retain the name and legal status of one of them or be an entirely new legal entity.' (HEFCE 2012, p11)

Introduction

- The current economic climate puts pressure on publicly-funded sectors to deliver more for less – including English HE

- Funding cuts can be absorbed by efficiency savings – possibly achieved by mergers (*the efficiency theory*)

'If institutional failure cannot be prevented …, then the Council will explore options such as mergers or takeovers led by other providers so that the institution in a new form becomes a going concern.' (The Browne Report 2010 p46)

'Throughout the world concentration of research funding is the name of the game,... How can you possibly compete as a single institution?' (Professor Sir Steve Smith, vice-chancellor of Exeter University, reported in *The Guardian* 16th October 2012)

Sir Roderick Floud former president of Universities UK believes that the number of universities in the UK should be cut by "at least one-third if not one-half" (*THE* 19-25 June 2014)

Introduction

Some questions:

- Does the merger of 2 (or more) HEIs cause an increase in subsequent efficiency?

- Do the efficiency effects of merger take time to reap?

Some problems:

- Historically there are comparatively few mergers in English higher education

- Merger activity and efficiency may themselves be endogenous

- So conventional econometric techniques of analysis may not be appropriate

Introduction

This paper uses a Bayesian approach organised around the use of Markov chain Monte Carlo (MCMC) and proposes a method of analysis which

- Assesses efficiency of HEIs in England
- Takes into account the endogeneity of merger activity and inefficiency
- Quantifies the determinants of inefficiency and of merger activity
- Identifies whether there have been efficiency gains following merger

The method can be used to investigate the efficiency effects of any sector (eg. police forces in England and Wales)

Background

The English higher education sector is very diverse (Huisman *et al* 2007)

This is considered desirable as it stimulates a dynamic sector giving more choice to students (Tight 2011; HEFCE 2012)

3 diverse groups can be observed in English HE:

- Pre-1992 universities: Traditional HEIs including Oxford and Cambridge, and universities established in the 1960s; they offer traditional programmes and subjects and have a research mission

- Post-1992 universities: Former polytechnics which offer a range of programmes including vocational degrees; some also have a research mission

- Former colleges of HE: Typically small, specialist HEIs; often do not have a research mission

Background

- There have been very few mergers in English HE,
- These have varied in HEI composition
- These have largely been HEI-motivated

- This contrasts with the experience in Wales, for example:

"The Welsh government has stepped in to reduce the number of universities in Wales; maybe the English government will have to do the same."

"…experience suggests that universities will not make such radical changes for themselves…"
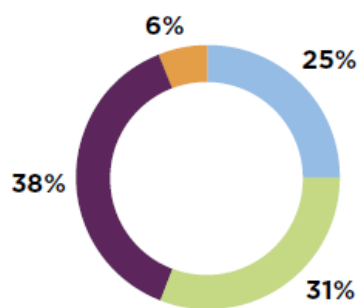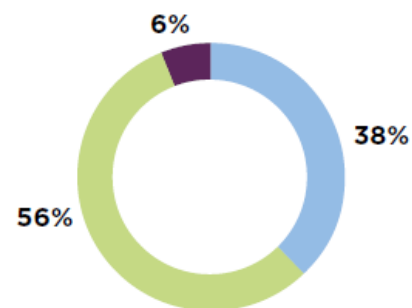
Sir Roderick Floud, *THE* 19-25 June 2014

Background

HE leaders' predictions for the next 5-10 years
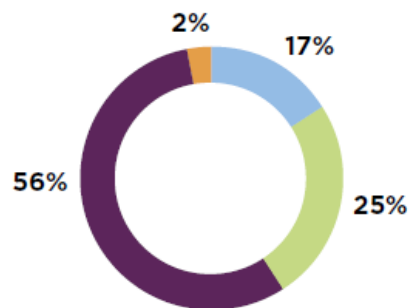
A number of institutional failures and insolvencies
- 2%
- 17%
- 25%
- 56%

Significant rationalisation through institutional mergers and takeovers
- 6%
- 25%
- 31%
- 38%

Substantial growth in multi-institution partnerships, alliances and networks
- 6%
- 38%
- 56%

Legend:
- Very likely
- Quite likely
- Quite unlikely
- Most unlikely

Boxall and Woodgates (2014)

Reasons for merger in higher education

1. **Efficiency theory**

A merger will occur if the merging HEIs believe they can be run more efficiently and effectively together than separately

- **Economies of scale** (Fielden and Markham 1997; Skodvin 1999; Patterson 2000; Kyvik 2002; Norgård and Skodvin 2002; Teixeira 2007; Green and Johnes 2009)
- **Economies of scope** (Patterson 2000; Harman 2000; Harman and Meek 2002; Kyvik 2002; Harman and Harman 2003; Aarrevaara 2007; Teixeira 2007)

Prediction: merger leads to lower inefficiency

Reasons for merger in higher education

2. Strategy motive

- A merger will occur for reasons of **survival and/or growth** for at least one of the participants (Pritchard 1993; Rowley 1997; Harman and Meek 2002; Harman and Harman 2003)

Prediction: inefficiency leads to merger

- A merger will occur to enhance **reputation** (Skodvin 1999; Engwall 2007; Harman and Harman 2008; Tirronenen and Nokkala 2009; Aula and Tienari 2011)
- A merger will occur to improve **international competitiveness** (Mok 2005; Tirronenen and Nokkala 2009)

Prediction: merger leads to lower inefficiency

Reasons for merger in higher education

Evidence in the UK HE context

- Efficiency theory is the main underlying cause of merger activity in GB (Rowley 1997)

- Economies of scale:
  - are significant and unexhausted for the typical HEI (Glass *et al* 1995a; 1995b; Johnes, G 1996; Johnes 1998)
  - are just exhausted for the typical HEI (Johnes 1997; Izadi *et al* 2002; Johnes *et al* 2005; Johnes *et al* 2008; Johnes and Johnes 2009)

- Economies of scope
  - are just exhausted or decreasing for the typical HEI (Glass *et al* 1995a; 1995b; Johnes 1997; Izadi *et al* 2002; Johnes *et al* 2005; Johnes *et al* 2008; Johnes and Johnes 2009)
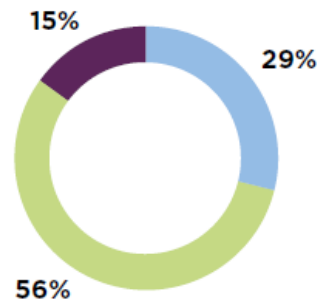
Reasons for merger in higher education

Evidence in the UK HE context

HE leaders' predictions for the next 5-10 years
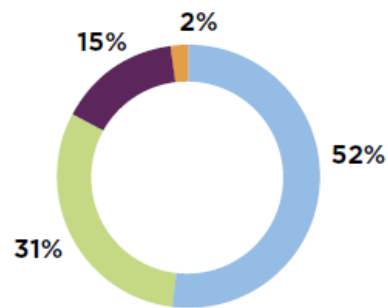
A 'de facto' super league of dominant institutions
- 2%
- 15%
- 52%
- 31%

Significant competition from new providers (eg private or overseas institutions)
- 15%
- 29%
- 56%
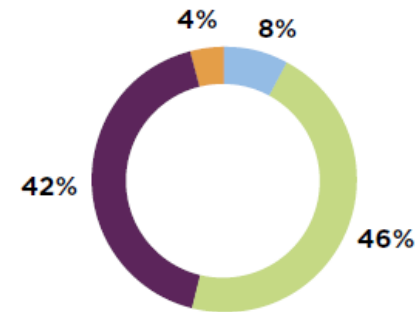
A trend towards low cost, no frills provision
- 4%
- 8%
- 42%
- 46%

Legend:
- Very likely
- Quite likely
- Quite unlikely
- Most unlikely

Boxall, M. and P. Woodgates (2014).

Reasons for merger in higher education

Evidence in the UK HE context

- 'Successive studies of higher education in Wales conclude that, in the face of global competition and increasing marketisation, the sector will need to address its inherent weaknesses of fragmentation and lack of scale, tackle issues surrounding new forms of delivery, and markedly improve its research performance and financial resilience.' *Department for Children Education Lifelong Learning and Skills (Wales)* (2011).

Previous evidence on consequences of mergers

Case studies:

- Failure rate of HE mergers is 10% (Rowley 1997) compared to 25 to 50% in private sector (HEFCE 2012)

- Mergers are successful in the context of non-viable HEIs (Harman & Harman 2003)

- Mergers are more successful if they are geographically close (Skodvin 1999)

- Mergers undertaken for *academic* reasons may not reap rewards in terms of *efficiency* (Skodvin 1999)

Previous evidence

Statistical analyses:

- China (Mao 2009): efficiency and outcomes improved in year following merger; but did not in the second year

- China (Hu & Liang 2008): large rise in mean productivity in merger HEIs in year following merger, but a fall the second year after merger

- England (Johnes 2013):
  - the typical HEI involved in a merger has efficiency which is similar to the average non-merging HEI
  - the typical merged HEI is significantly more efficient than either pre-merger or non-merging HEIs
  - the effects can vary by the types of HEI participating in the merger; there are both winners and losers

Previous evidence

Statistical analyses: some caveats

Previous statistical analyses fail to take into account

- the complex relationship between inefficiency and merger
- that other underlying characteristics might cause merging institutions to perform differently from non-merging ones

Any measurement of efficiency typically

- does not incorporate any loss caused by the merger in learning experience on the part of students or staff
- does not incorporate any social costs arising from reduction in diversity between HEIs in the sector

Model

- Suppose: universities use *k* inputs ($k = 1, \ldots, K$) to produce *l* outputs ($l = 1, \ldots, L$)
- inputs and outputs are denoted by *X* and *Y* respectively
- subscript *it* represents university *i* in time period *t* ($i = 1, \ldots, N; t = 1, \ldots, T$).
- Inefficiency is estimated using a standard translog output distance function (ODF):

$$D(Y_{it}, X_{it}) = 1 \Rightarrow y_{1,it} = f\left(\tilde{y}_{m,it}, x_{s,it}\right) + v_{it} - u_{it}$$

- $v_{it} \sim iidN(0, \sigma_v^2)$ represents the error
- $u_{it} \sim iidN_+(0, \sigma_u^2)$ is the one-sided component, independently distributed and independent of the regressors
- lower case letters indicate logs, and $\tilde{y}_m = y_m - y_1, m = 2, \ldots, M$

Model

Tendency to merge

$$W_{it}^* = \mathbf{z}_{it}'\boldsymbol{\gamma} + \rho_1 \log u_{it} + \rho_2 \log u_{i,t-1} + \varphi W_{i,t-1}^* + \phi I_{i,t-1} + \varepsilon_{it},$$
$$\varepsilon_{it} \sim \text{iid} N(0,1)$$

- $I_{it} = \mathbf{1}\,(W_{it}^* \geq 0)$ is an observed merging indicator which is 1 if a merger took place and zero otherwise
- $\mathbf{z}_{it}$ is a vector of covariates
- Tendency to merge also depends on current and past inefficiency and is also possibly persistent (autoregressive)

Model

Inefficiency

$$\log u_{it} = \alpha_0 + \alpha_1 \log u_{i,t-1} + \mathbf{z}'_{it}\boldsymbol{\delta} + \alpha_2 W^*_{i,t-1} + \alpha_3 I_{i,t-1} + \xi_{it},$$
$$\xi_{it} \sim \text{iid} N\left(0, \sigma_\xi^2\right)$$

- The dependence of technical inefficiency on W^*_{it} (latent merging indicator) and I_{it} (actual merging indicator) helps to distinguish between "latent" and "actual" effects of mergers
- Allowing for persistent inefficiency implies that there may be adjustment costs and inertia in decreasing inefficiency which could be present even after a possible merger

Error terms

$$\begin{bmatrix} \varepsilon_{it} \\ \xi_{it} \end{bmatrix} \sim N\left(\begin{bmatrix} 0 \\ 0 \end{bmatrix}, \boldsymbol{\Sigma} = \begin{pmatrix} 1 & \sigma_{12} \\ \sigma_{12} & \sigma_{22} \end{pmatrix} \right)$$

Model

- At time period t-1 HEIs i and j merge to become a new HEI (n)
- Inefficiency improvement is calculated as: $\Delta u_{nt} = u_{nt} - u_{n,t-1}$
- Such events have probabilities which are difficult if not impossible to compute using the classical approach
- In the Bayesian approach MCMC methods simplify the task
- We estimate the ODF in an unrestricted manner and examine the probability that improvements in inefficiency have occurred
- The required probability is $P(\Delta u_{nt} > 0 | \text{Data})$ marginally on the parameters to account for parameter-related uncertainty
- Through the use of MCMC such probabilities can be computed easily and routinely for all n and t
- These are probabilities of efficiency improvement after merger, **assuming that mergers and inefficiency are endogenous**

Output distance function

X and Y variables

PGINPUT	Total number of FTE postgraduate students
UGINPUT	Total number of FTE first degree and other undergraduates.
STAFF	Number of FTE academic staff
ACSERV	Expenditure incurred on centralised academic services (in £000s)
ADMIN	Expenditure on total administration and central services in £000s
PGOUTPUT	Number of higher degrees plus total other postgraduate qualifications awarded
UGOUTPUT	Number of first degree and other undergraduate degrees awarded
RESEARCH	Income received in funding council grants plus income received in research grants and contracts in £000s

Tendency to merge and inefficiency models

Z variables

|	
LSIZE	Total number of students i.e. PGINPUT+UGINPUT (in logarithms
LSIZESQ	The square of LSIZE
FIRST	Proportion of first degree graduates achieving first class honours
UPSEC	Proportion of first degree graduates achieving upper second class honours
LOWSEC	Proportion of first degree graduates achieving lower second class honours
THIRD	Proportion of first degree graduates achieving third class honours
UNC	Proportion of first degree graduates achieving unclassified degree

Data

- Higher Education Statistical Agency (HESA) data

- Unbalanced panel of data from 1996/97 to 2008/09 with n = 1694 (the number of HEIs varies from 126 to 138 in each year)

- Diverse groups of HEIs:

  Pre-1992 universities   n=699

  Post-1992 universities   n=396

  Former colleges of HE   n=599

- All money units in 2008 values

Results: Tendency to merge and inefficiency

Posterior means (and SDs); Marginal effects (and SDs)

	Posterior means		Marginal effects	
	W_{it}^*	$\log u_{it}$	W_{it}^*	$\log u_{it}$
constant	-0.2481 (0.0972)	0.0445 (0.0138)	---	---
$W_{i,t-1}^*$	0.1734 (0.0315)	-0.0107 (0.00315)	0.072 (0.0212)	0.034 (0.0021)
$\log u_{it}$	0.3115 (0.6781)	---	0.085 (0.071)	---
$\log u_{i,t-1}$	0.0971 (1.2234)	0.0126 (0.0031)	0.0401 (0.373)	0.0215 (0.0027)
SIZE	0.2341 (0.0732)	0.02415 (0.0116)	0.0151 (0.0022)	0.0341 (0.0071)
SIZESQ	-0.0110 (0.0113)	-0.0021 (0.0002)	-0.0035 (0.0001)	-0.0017 (0.0002)
FIRST	-0.0003 (0.0001)	3×10^{-5} (7×10^{-6})	-0.0005 (0.0001)	1×10^{-5} (1×10^{-6})
UPSEC	-0.0002 (0.0001)	3×10^{-5} (2×10^{-6})	-0.0004 (0.0001)	1×10^{-5} (3×10^{-6})
LOWSEC	0.0002 (0.0001)	1×10^{-5} (2×10^{-6})	0.0001 (0.0001)	2×10^{-5} (2×10^{-6})
THIRD	0.0001 (0.0002)	2×10^{-5} (4×10^{-6})	0.0004 (0.0001)	3×10^{-5} (1×10^{-6})
UNC	0.0003 (0.0001)	2×10^{-5} (1×10^{-6})	0.0003 (0.0001)	2×10^{-5} (1×10^{-6})
$I_{i,t-1}$	-0.0138 (0.0012)	-1×10^{-5} (1×10^{-6})	-0.0212 (0.0013)	-2×10^{-5} (1×10^{-6})

Results: Technical efficiency by merger type

Technical efficiency sample distributions by merger type
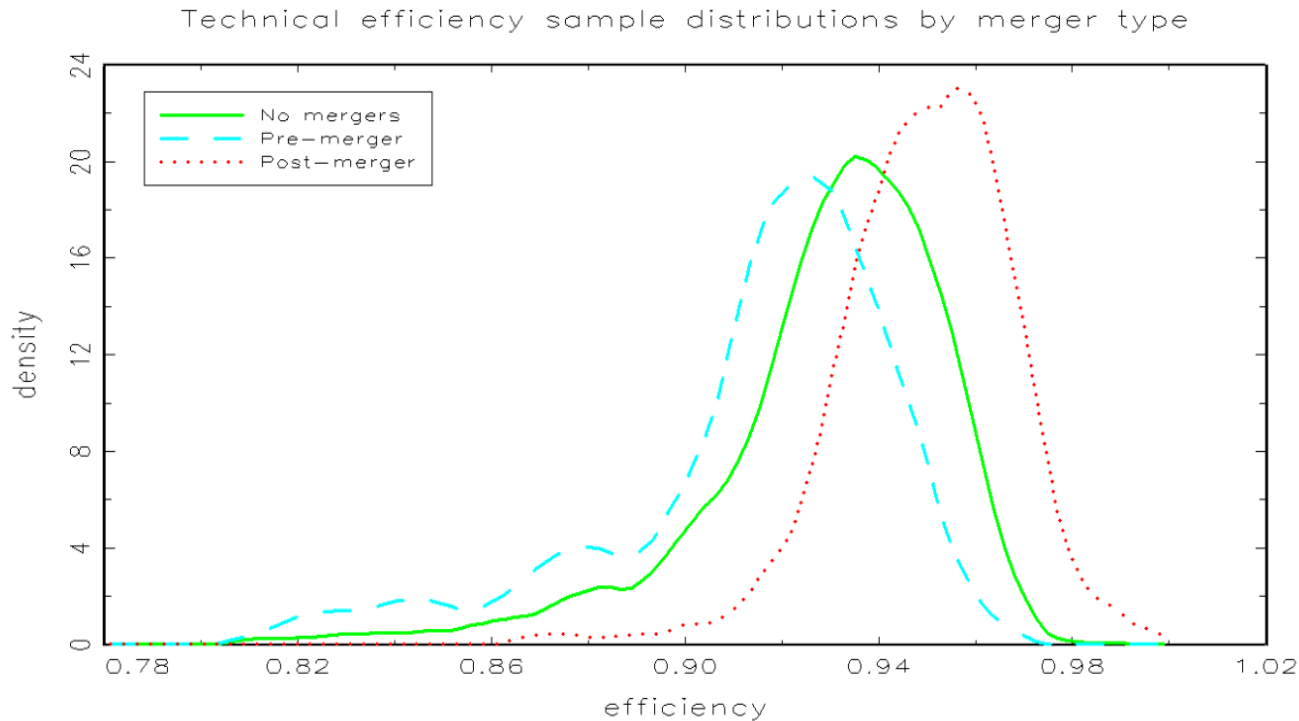
Results: New model compared to other models

Comparison of models: Bayes factors of new model against 3 alternatives

	Entire sample	Pre-1992	Post-1992	Former CHEs
New model against:				
Conventional SFM $\rho_1 = \rho_2 = \varphi = \alpha_1 = \alpha_2 = \alpha_3 = 0$	61.332	58.415	77.315	144.01
Probit SFM $\alpha_1 = \alpha_2 = \alpha_3 = 0$	31.225	21.006	42.206	24.12
Dynamic SFM $\gamma = \rho_1 = \rho_2 = \varphi = \alpha_1 = \alpha_2 = \alpha_3 = 0$	11.344	9.727	20.015	22.09

Results: New model compared to other models

Technical efficiency averages, sample densities
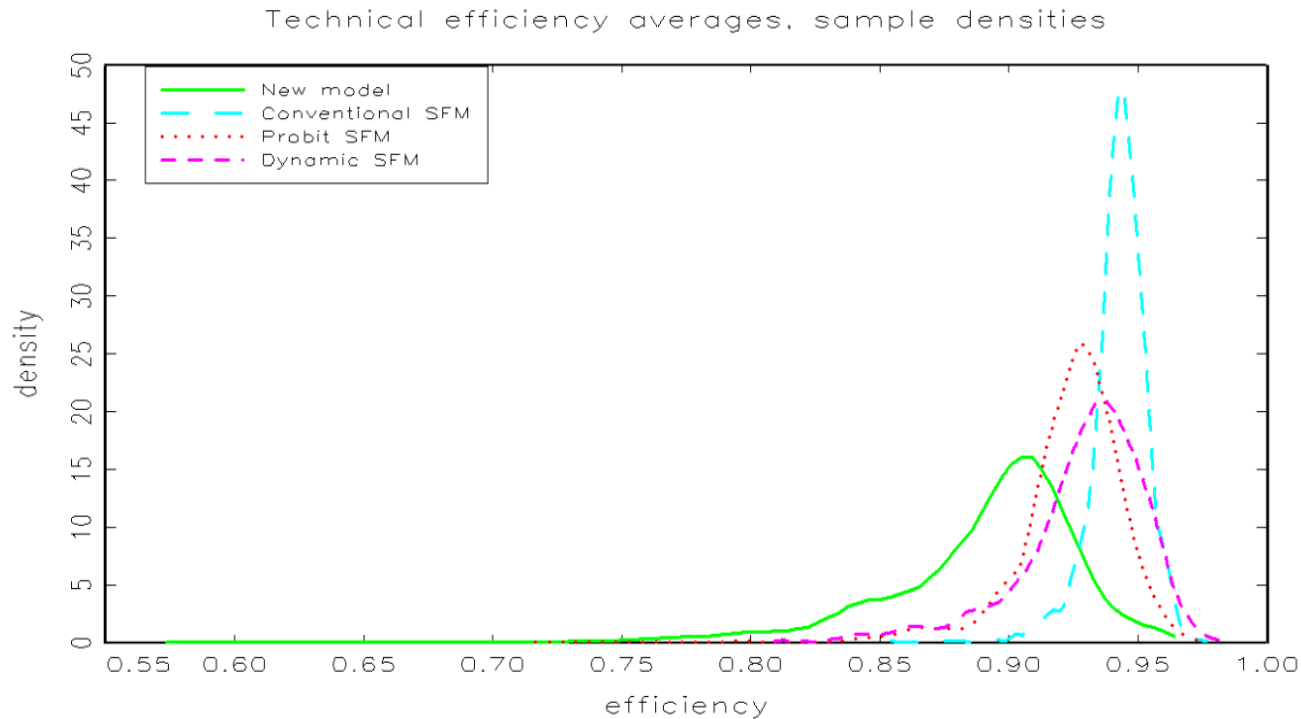
Results: Efficiency improvement

English HE mergers

Year of merger	Efficiency and posterior s.d.		Posterior probability that efficiency improved
	Time t-1 (time of merger)	Time t (post-merger)	
2000/01	0.944 (0.0031)	0.925 (0.0034)	0.00000000
1998/99	0.938 (0.0134)	0.901 (0.0104)	0.01458038
2000/01	0.955 (0.0221)	0.928 (0.0012)	0.11124715
1997/98	0.921 (0.0033)	0.901 (0.0172)	0.12673479
2007/08	0.935 (0.0201)	0.914 (0.0044)	0.15371994
2006/07	0.938 (0.0219)	0.917 (0.0117)	0.23884027
2000/01	0.940 (0.0117)	0.931 (0.0115)	0.29164104
1999/00	0.932 (0.0048)	0.928 (0.0071)	0.42067466
2008/09	0.944 (0.0115)	0.941 (0.0055)	0.50697267
2002/03	0.942 (0.0134)	0.945 (0.0015)	0.58803415
2001/02	0.921 (0.0121)	0.922 (0.0084)	0.62706305

Results: Efficiency improvement

English HE mergers

Year of merger	Efficiency and posterior s.d.		Posterior probability that efficiency improved
	Time *t*-1 (time of merger)	Time *t* (post-merger)	
2006/07	0.915 (0.0117)	0.922 (0.0032)	0.71806241
2005/06	0.905 (0.0100)	0.910 (0.0110)	0.72169140
2004/05	0.935 (0.0410)	0.963 (0.0021)	0.81239089
1998/99	0.921 (0.0110)	0.932 (0.0028)	0.83375165
2001/02	0.925 (0.0173)	0.944 (0.0055)	0.85236840
2004/05	0.947 (0.0126)	0.961 (0.0028)	0.86096216
2000/01	0.928 (0.0035)	0.938 (0.0012)	0.99656109
2004/05	0.931 (0.0022)	0.955 (0.0071)	0.99939222
1997/98	0.929 (0.0032)	0.940 (0.0011)	0.99942459
2004/05	0.939 (0.0028)	0.952 (0.0014)	0.99998357
1998/99	0.922 (0.0045)	0.944 (0.0012)	0.99999884
2004/05	0.931 (0.0135)	0.998 (0.0010)	0.99999963
1997/98	0.916 (0.0033)	0.935 (0.0011)	0.99999998
2005/06	0.918 (0.0034)	0.944 (0.0012)	1.0000000

Results: Efficiency improvement

- Of 25 mergers, 11 have probability of efficiency improvement less than 70%

What are the characteristics of a "successful" merger?

- Geography (Skodvin 1999)?

- Similar culture and mission (HEFCE 2010)?

- Possibly not: Of the 11 mergers which have probability of efficiency improvement < 70%, 6 are between HEIs of the same type

'a lesson from previous private and public sector mergers is that mergers do not deliver savings unless they are based on sound strategic rationale, are thoroughly planned, and well executed. The act of merely adding together two entities with their respective attributes, challenges and weaknesses, creates a larger entity with the same underlying structures.' (Berriman and Jacobs 2010)

Results: Efficiency of merged HEIs over time
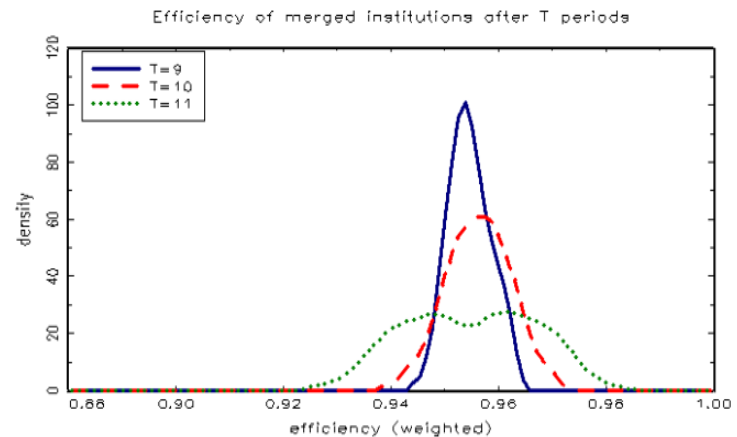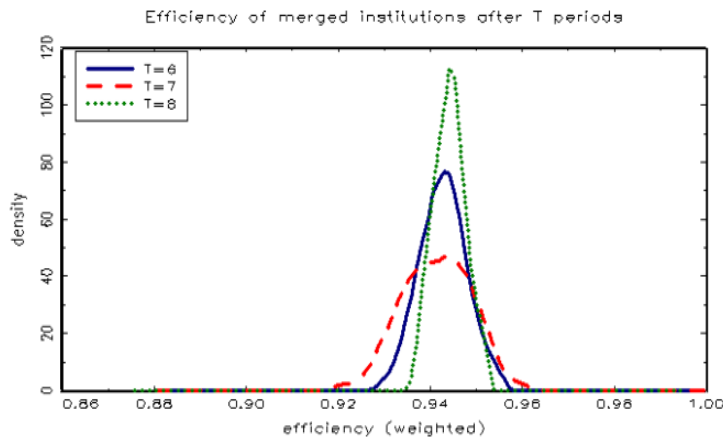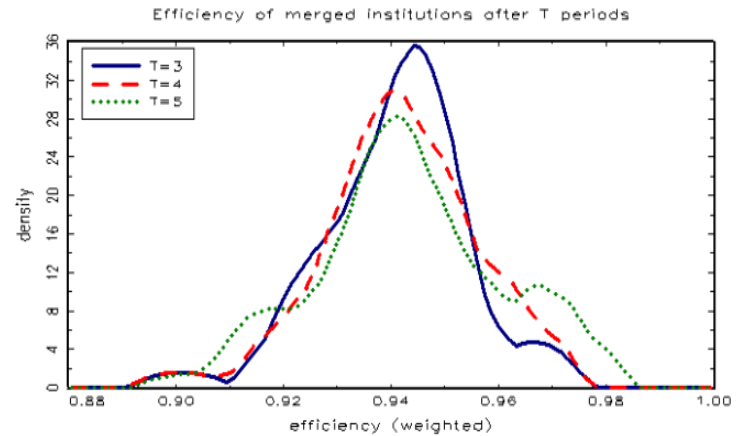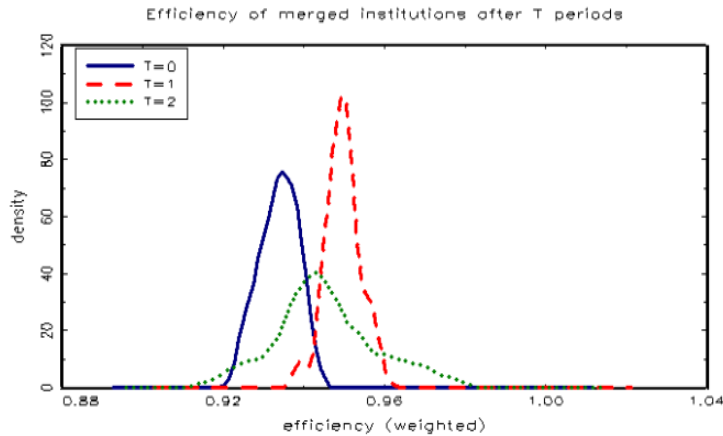
Conclusions

- Inefficiency is significantly, positively affected by **tendency** to merge and **action** of merging (in the previous time period)

- Tendency to merge is not significantly affected by inefficiency

- But the new model which takes into account the endogeneity of merging and inefficiency performs better than 3 nested models which do not

- Inefficiency and tendency to merge are positively, significantly related to the size of HEI; the relationship is non-linear

- Efficiency improvement is not experienced across all mergers: 11 of 25 mergers examined have probability < 0.70 that efficiency does not improve in time t compared to t-1 (year of merger).

- Mean efficiency peaks soon after merger, and plateaus at a value of 0.94 to 0.95; dispersion around the mean is wide particularly in the 3 to 5 periods after merger.

Conclusions

- Caveats: measurement of efficiency does not incorporate
  - loss imposed by the merger in terms of learning (and teaching) experience on the part of students (or staff)
  - possible social costs arising from reduction in diversity between HEIs in the sector caused by merging

Thank you!