International comparisons of performance in public services

Outcome based measures for education

Mary O'Mahony
Philip Stevens

National Institute of Economic and Social Research

Introduction

Aims of this presentation

- **Outline methods to be used in evaluating public sector performance**
- **Focus on outcome-based measures for education**
- **International comparative context**

Outcomes and outcomes: Measurement issues

Quality-adjusted output measures in the private sector:

- Produce *i* services, Q_i is the quantity of service *i*
- The growth in aggregate services is a weighted average of the growth in quantities, with weights given by the share of service i in the total value of output produced.

$$D(t)Y^J = \sum_i w(t)_i^J \, D(t)Q_i^J$$

Applying the private sector method to public services

- Lack of information on prices – need measure of marginal benefit to the consumer
- Even if the service is publicly-provided there may be issues of asymmetric information that imply payments by consumers are not a true reflection of marginal benefits
- Solutions
  - Cost shares have often been used as weights but may be divergence between marginal costs and benefits
  - Could use value judgement weights, but controversial
  - Use outcome weights

Applying the outcome method in practice

- Need to define the outcome measure
- Outcomes will depend not only on the service provided but also on other extraneous or background influences
- Need to control these influences
- Methods exist for dealing with this
  - Base calculations on a population that controls for outside influences
  - Regression methods – regress outcomes on controls

An application to education

- Three measures of output
  - Volume measure
  - Test scores
  - Earnings
- Tornqvist chain-linked index:

$$\Delta Q_t = \sum_i \omega_{i,t} \Delta \ln(PUP_{i,t})$$

weight — No of pupils

Volume of output

Pupil/Student Numbers, UK, 1994-2001

	Nursery	Primary	Secondary		Further Education	Higher Education		Special	Total
			up to age 15	age 16+		Undergrad	Postgrad		
1994	99.0	98.7	97.8	99.2	93.6	93.8	92.0	98.9	96.8
1995	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
1996	99.4	101.6	98.7	105.8	97.6	102.9	99.8	98.9	100.3
1997	98.9	102.4	99.7	112.7	93.3	106.4	99.3	99.0	100.5
1998	99.2	102.9	100.1	114.3	92.0	118.0	119.4	99.2	102.0
1999	98.2	102.7	102.1	114.2	91.3	115.8	111.8	98.5	101.9
2000	121.1	102.0	102.3	114.5	109.0	117.5	115.8	97.6	105.8
2001	142.8	101.3	103.9	115.5	114.5	123.4	129.1	96.6	107.9
SH95	0.48	38.76	23.76	3.88	21.33	9.03	1.88	0.88	100.00
G	5.22	0.37	0.85	2.17	2.88	3.92	4.84	-0.34	1.55

Share in total pupils in 1995

Annual growth rate, 1994-2001

Quality of output I: Test scores

	KS2: > Level 4	GCSE: % 5 + A*-C	A-levels: % 3+	HE: % 1st and 2.1
Per cent of pupils/students				
1994	62.5	46.6	66.1	47.2
1995	62.5	47.8	68.9	47.5
1996	62.5	48.4	70.0	47.8
1997	62.5	49.3	69.0	48.2
1998	62.0	50.9	69.4	49.7
1999	70.0	53.1	70.0	50.2
2000	73.5	54.7	86.2	51.1
2001	73.0	55.7	74.2	52.9
Index 1995=1.00				
1994	1.00	0.98	0.96	0.99
1995	1.00	1.00	1.00	1.00
1996	1.00	1.01	1.02	1.01
1997	1.00	1.03	1.00	1.01
1998	0.99	1.07	1.01	1.05
1999	1.12	1.11	1.02	1.06
2000	1.18	1.14	1.06	1.08
2001	1.17	1.17	1.08	1.11

Pupil effectiveness index

$$PUPE_i = \alpha_i PUP_i \lambda_i + (1-\alpha_i) PUP_i$$

Pupils achieving standard

Value of achieving standard

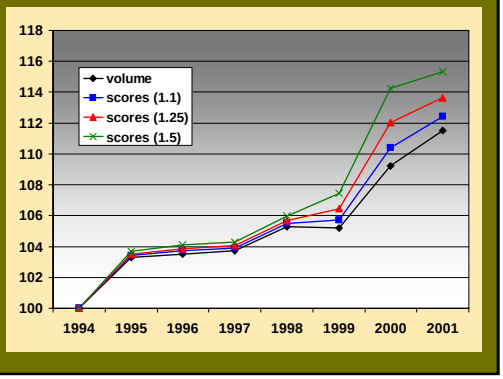
Pupils not achieving standard

- This can be summed over all levels, *i*, of education to get the total quality-adjusted output

$$\Delta QE_t = \sum_i \omega^e_{i,t} \Delta \ln(PUPE_{i,t})$$

- How do we determine λ_i?

Quality adjusted indices based on test scores for UK education



Quality of outcome II: Earnings outcomes

- Education impacts on two types of labour market outcomes:
  - Earnings
  - Economic activity
- Earnings estimated as a function of education, experience and a set of control variables
- Only observe wages for those in work

Quality of outcome II: Earnings outcomes

- Economic activity
  - Employed (earns a wage, *Y*)
  - Unemployed (earns benefit, *U*)
  - Inactive (earns nothing)
- Total effect on lifetime earnings a product of earnings in each state and the probability of being in each state, i.e.

$$E_q = Y_q P_q(emp) + UP_q(unemp) + 0 \times \left[1 - P_q(unemp) - P_q(emp)\right]$$

Rates of return, UK, 2001

	Coefficient	Years of schooling	Rate of Return
Men			
Secondary education up to GCSE	0.03033	Same as for no qualifications	-
Secondary education up to A-Level	0.30196	GCSE+2	0.135815
Further Education qualification	0.19363	GCSE +2	0.08165
Higher education – Undergraduate	0.49970	A-level +3	0.065913
Higher education – Postgraduate	0.58566	HE UG +3	0.028653
Women			
Secondary education up to GCSE	0.00122	Same as for no qualifications	-
Secondary education up to A-Level	0.28150	GCSE+2	0.14014
Further Education qualification	0.11219	GCSE +2	0.055485
Higher education – Undergraduate	0.53961	A-level +3	0.086037
Higher education – Postgraduate	0.65474	HE UG +3	0.038377

Rates of return, US, 2001

	Coefficient	Years of schooling	Rate of Return
Men			
11th Grade	0.0852	<11th grade + 1	0.0852
12th Grade, but no Diploma	0.1693	11th grade + 1	0.0841
12th Grade, High School Diploma	0.38718	11th grade + 1	0.30198
Some college but no degree	0.06029	12th grade + 1	-0.3269
Associate degree	0.5405	12th grade + 2	0.07666
Undergraduate degree	0.94224	Ass deg + 3	0.13391
Postgraduate of professional degree	0.9097	UG + 3	-0.0108
Women			
11th Grade	0.0852	<11th grade + 1	-0.8245
12th Grade, but no Diploma	0.1693	11th grade + 1	0.0841
12th Grade, High School Diploma	0.38718	11th grade + 1	0.30198
Some college but no degree	0.06029	12th grade + 1	-0.3269
Associate degree	0.5405	12th grade + 2	0.07666
Undergraduate degree	0.94244	Ass deg + 3	0.13398
Postgraduate of professional degree	0.9097	UG + 3	-0.0109

Translating lifetime earnings to education outcome measures

- Combine earnings with volume measure to obtain education outcomes

$$EO_{i,t} = \sum_i \frac{1}{k} LTE_i PUP_{i,t}$$

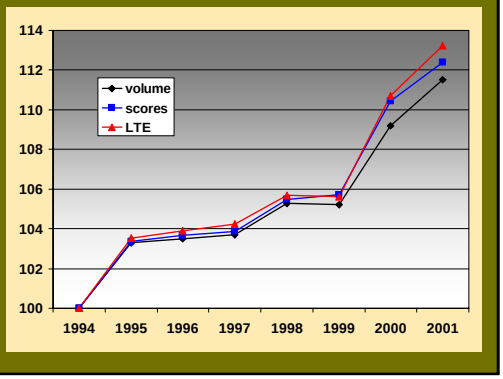
- These can be combined to obtain Tornqvist index

$$\Delta QO_t = \sum_i \omega^O{}_{i,t} \Delta \ln(PUP_{i,t})$$

where

$$\omega^O_{i,t} = 0.5 \left[\frac{EO_{i,t}}{\sum_i EO_{i,t}} + \frac{EO_{i,t-1}}{\sum_i EO_{i,t-1}} \right]$$

Output and outcome measures for UK education, 1994-2001



Growth in effectiveness

- How to incorporate growth in effectiveness of education? (quality adjusted deflators)
  1. Test scores
     - how to weight?
  2. Indirect through impact of economic growth
  3. Age cohort effects on earnings

Education and economic growth

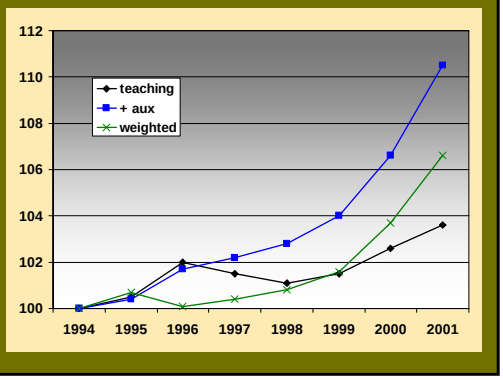
- Over time, earnings have risen because of increases in productivity
- 1990-2001 2.1% in UK, 1.5% in US
- How much of this is due to education?
  - Estimates by O'Mahony, Robinson and Vecchi (2003) suggest 0.5% in UK and 0.2% in US
  - To add these figures to earnings growth assumes
    - Increase in productivity constant over period
    - Impact is equal across education groups

Inputs and productivity

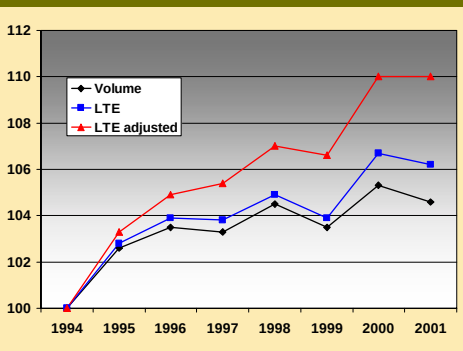
Inputs

- Measurement similar to outputs
  - Use cost share weighted changes in inputs (labour, capital, intermediate purchases)
  - Result is a quality-adjusted aggregate input measure
  - Few conceptual problems specific to public service provision since we have market information on input costs

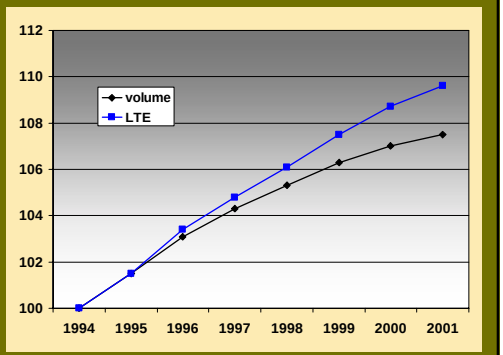
Labour input in education, UK



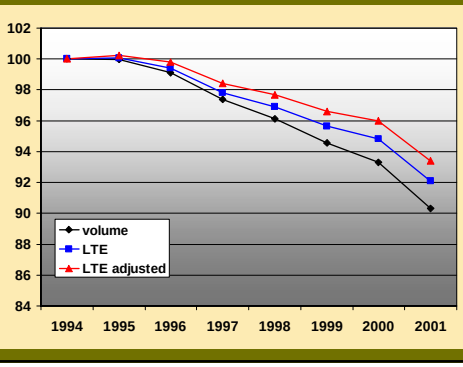
UK labour productivity



US output growth, 1994-2001

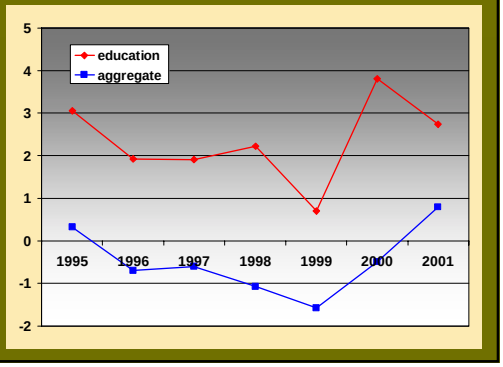


US productivity growth, 1994-2001



Annual differences in labour productivity growth rates, (UK-US)

Education and the aggregate economy



Conclusions and extensions

- First analysis suggests UK labour productivity growth in education higher than in US in period 1994-2001
- Estimate for longer period – 1979 to present
- Estimate TFP rather than labour productivity
  - requires estimates of capital & intermediate inputs
- Use annual data to derive returns to Ed
- Estimate relative productivity levels
- Estimate age cohort effects