University Classes and Student Achievement

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Work in progress

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1

Motivation:

-understanding the (higher) *education production function*

-focus on *classes* (small group teaching): assumed important but little evidence

-analysis of *various components* of classes (**attendance**, **size** – formal and effective –, **peers**, and **TA's**)

-more resources in UK HE: how to spend *fees* income?

-context of increased (international) competition in higher education (*Bologna process*): quality will matter more

2

Related Literature:

-*Attendance*: Romer (JEP, 1993)

-*Class Size*: Krueger (QJE, 1999), Lazear (QJE, 2001), Hanushek (EJ, 2003)

-*Peers*: Sacerdote (QJE, 2001), Hanushek et al (JAppEctrics, 2003), Arcidiacono et al (mimeo, 2004), Vigdor and Nechyba (mimeo, 2004), Burke and Sass (mimeo, 2004)

-*Teachers*: Rivkin et al (Ectrica, 2005)

3

Methodology:

-use of *longitudinal administrative data* from Economics Department at the University of Warwick, UK

-exploit *random allocation* of students to classes (done alphabetically, based on surname)

-use attendance records from class tutors (*no recall bias*)

-exploit *multiple overlap* of students, TA's and modules (no random mobility assumptions, as in AKM literature)

- approach easily replicable in other departments/faculties

4

Some terminology/Warwick background:

-*class*: group of 5 to 25 students; meet typically once a week with a TA (typically a PhD student); exercises, presentations (175)

-*module*: e.g. Microeconomics 2, Math, IO, etc (17)

-*course*: Economics (and variants); modules also attended by students from other departments (but we don't have their grades)

5

Data:

-three years (2001/02, …, 2003/04) – may be extended
-first and second year (Economics) students
-1,700 student-year-module observations (650 students)

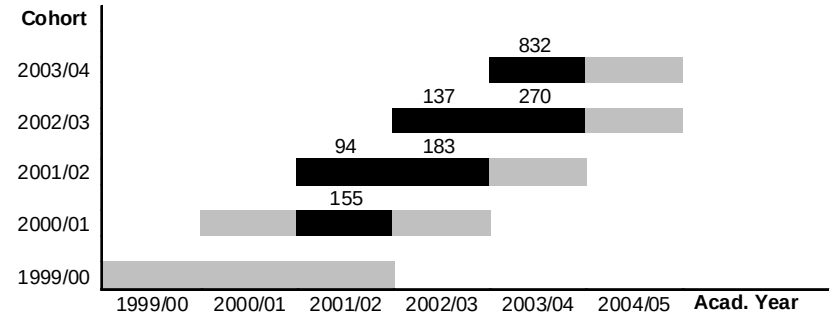
-avg. grade (our dependent variable) =63% (sd=13%)
-avg. size =13 (sd=5)
-avg. attendance rate =80% (sd=12%)

-attendance and peer characteristics based on Economics students; size info based on all students
-peer characteristics are avg of results in 1st year (only for 2nd year students); no data yet but also little heterogeneity in A-levels (equivalent to US SAT's)

6

Data:

Figure 1 – Cohorts/Academic Years Included in Sample Used



Legend: Number indicates size of the cell below the number.
= Included in data
= Not included

7

Table 1a - Descriptive Statistics, Student-Level Data

Variable	Obs	Mean	St. Dev.	Min	Max
Grade	1,694	63.45	13.11	0	97
Academic Year 2001/02	1,694	0.147	0.354	0	1
Academic Year 2002/03	1,694	0.203	0.402	0	1
Academic Year 2003/04	1,694	0.650	0.477	0	1
1st year	1,694	0.628	0.484	0	1
2nd year	1,694	0.358	0.480	0	1
3rd year	1,694	0.014	0.118	0	1
World Economy (code=104)	1,694	0.057	0.232	0	1
Economics 1 (107)	1,694	0.038	0.191	0	1
Macroeconomics 1 (108)	1,694	0.057	0.231	0	1
Microeconomics 1 (109)	1,694	0.123	0.328	0	1
Industrial Economy (112)	1,694	0.021	0.144	0	1
Mathematics (119)	1,694	0.017	0.130	0	1
Mathematical Techniques A (121)	1,694	0.016	0.125	0	1
Statistical Techniques A (122)	1,694	0.011	0.103	0	1
Mathematical Techniques B (124)	1,694	0.088	0.283	0	1
Statistical Techniques B (125)	1,694	0.090	0.286	0	1
Computing and Data Analysis (125)	1,694	0.110	0.313	0	1
Macroeconomics 2 (201)	1,694	0.084	0.278	0	1
Microeconomics 2 (202)	1,694	0.136	0.343	0	1
Statistics and Econometrics (203)	1,694	0.038	0.192	0	1
Economics 2 (204)	1,694	0.004	0.064	0	1
Mathematical Economics (220)	1,694	0.035	0.183	0	1
Econometrics (226)	1,694	0.075	0.263	0	1
Attendance	1,694	7.361	3.833	0	20
Absence	1,694	1.939	2.292	0	18
Attendance (% of total classes)	1,694	0.795	0.220	0	1
Overseas (non UK) Student	1,694	0.285	0.451	0	1
Class Size	1,507	12.891	4.648	2	38
Effective Class Size	1,498	8.306	2.885	1.33	16.42

8

"Grade Equation" Specifications:

(1) $y_{itma} = \beta_1 att_{itm} + \beta_2 size_{itm} + \beta_3 peers_{itm} + \alpha_t + \alpha_a + \alpha_m + \alpha_i + \varepsilon_{itma}$

(2) $y_{itma} = \beta_1 att_{itm} + \beta_2 size_{itm} + \beta_3 peers_{itm} + \alpha_{class} + \alpha_i + \varepsilon_{itma}$

Y=grade; Subscripts: i (student), m (module), a (TA), t (academic year); class

Allow for correlation between attendance and student observed and unobserved characteristics; between size and module (endogenously determined); between peers and other characteristics (in case peers not completely random); etc

9

Results (1): Attendance

Positive and significant returns without student effects, but…

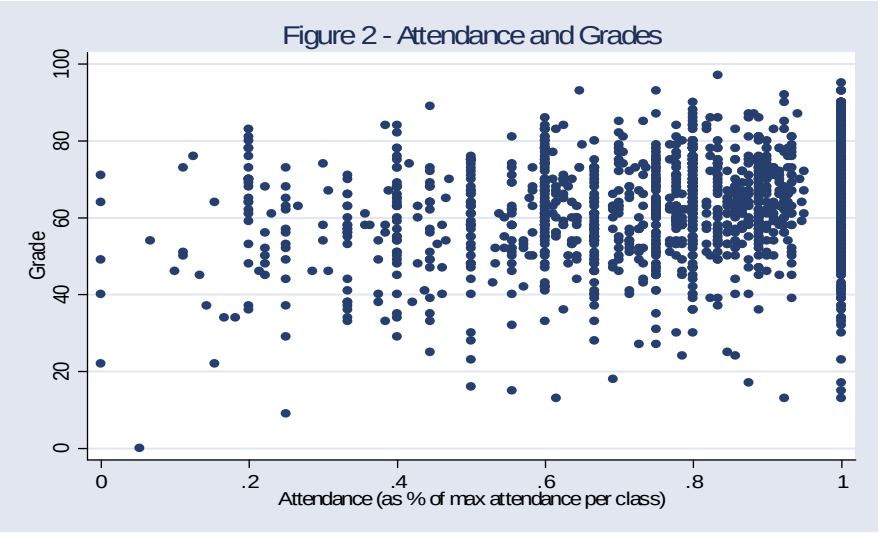
Insignificant returns with student effects:

-not driven by different number of classes per module (same result for % attendance or controlling for module)

-try instruments based on class meeting hours: significant non-linear effect of instruments (prime-time: 12-4pm), but still insignificant returns to attendance

-little variability in attendance? (high) average attendance is already optimal (random variation around that should have no impact)?

10



11

Results (1): Attendance

Table 2a - Returns to Attendance, Different Specifications

	(A)	(B)	(C)	(D)	(E)	(F)	(G)	(H)
Attendance	0.57	1.252	0.961	1.509	1.801	-0.066	0.059	-0.119
	[0.092]**	[0.108]**	[0.099]**	[0.126]**	[0.146]**	[0.089]	[0.156]	[0.193]
Observations	1694	1694	1694	1694	1694	1694	1694	1694
R-squared	0.02	0.21	0.2	0.24	0.32	0.57	0.71	0.74
Fixed effects:								
Academic year	x			x			x	
Tutor		x		x			x	
Module			x	x			x	
Class					x			x
Student						x	x	x

Notes:
Standard errors in brackets
* significant at 5%; ** significant at 1%

12

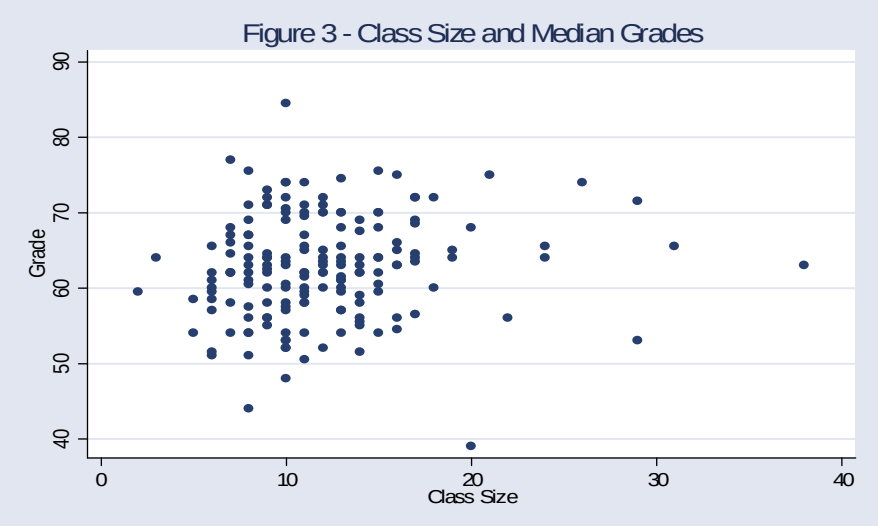
Results (2): Class Size

Variability driven by:
-class type (larger when “more solving and less discussion” and when “expect lower attendance”)
-but also from supply constraints and students timetable clashes

Positive effects at first – possibly consistent with Lazear’s endogenous class size model;
-once controls for module included, effects disappear
-eventually negative returns (but still insignificant)

Broadly similar results for effective class size (taking into account attendance rates; strongly correlated)

13



14

Results (2): Class Size

Table 3a - Returns to Class Size, Different Specifications

	(A)	(B)	(C)	(D)	(E)	(F)	(G)	(H)
Class Size	0.272	0.285	0.14	0.16		-0.048	-0.056	
	[0.073]**	[0.092]**	[0.091]	[0.097]		[0.071]	[0.091]	
Observations	1507	1507	1507	1507		1507	1507	
R-squared	0.01	0.1	0.12	0.14		0.62	0.72	
Fixed effects:								
Academic year	x			x			x	
Tutor		x		x			x	
Module			x	x			x	
Class					x			x
Student						x	x	x

Notes:
Standard errors in brackets
* significant at 5%; ** significant at 1%

15

Results (3): Peers effects

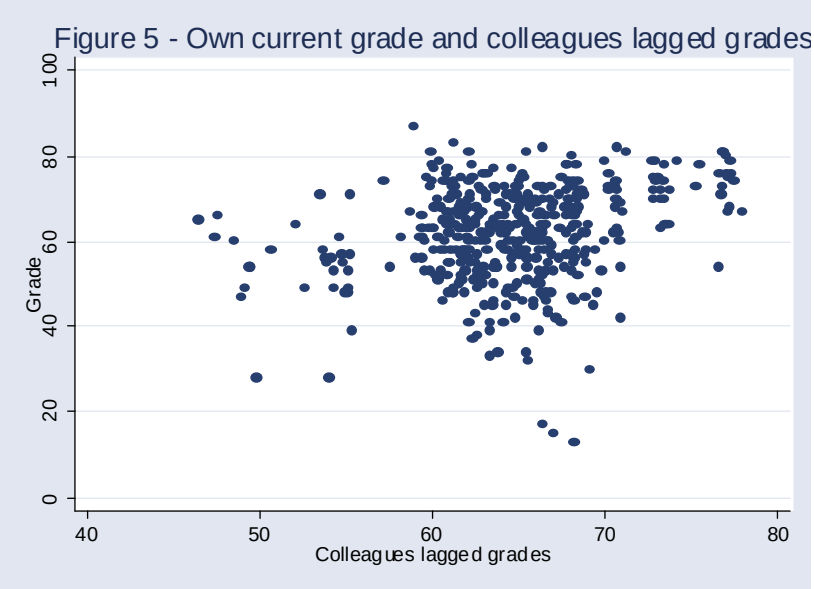
Analysis restricted to 2nd year students
Measure of peer quality: average of 1st year results (in modules available) of class colleagues (from economics)

Strong positive own correlation but *insignificant peer effects* (means and standard deviations)
(Endogenous peer effects very significant though but difficult to interpret)

Similar results when all variables considered simultaneously

No impact of presence of non-UK students in class (not even when splitting the sample into UK and non-UK students)

16



17

Results (3): Peer Effects

Table 5a - Exogenous Peer Effects, Different Specifications (2nd year students only)

	(A)	(B)	(C)	(D)	(E)	(F)	(G)	(H)
Own grade (1st year)	0.705	0.709	0.709	0.703	0.604			
	[0.046]**	[0.044]**	[0.044]**	[0.045]**	[0.085]**			
Mean 1st-year	0.033	0.06	0.059	0.013	-0.7	0.092	0.007	0.577
classmates' grade	[0.092]	[0.097]	[0.090]	[0.107]	[0.531]	[0.111]	[0.149]	[1.540]
StDev 1st-year	-0.145	-0.076	-0.031	-0.065	-1.156	-0.113	0.019	0.853
classmates' grade	[0.133]	[0.145]	[0.138]	[0.146]	[0.719]	[0.166]	[0.190]	[0.570]
Observations	441	441	441	441	441	441	441	441
R-squared	0.4	0.47	0.46	0.47	0.51	0.79	0.81	0.85
Fixed effects:								
Academic year	x			x			x	
Tutor		x		x			x	
Module			x	x			x	
Class					x			x
Student						x	x	x

Notes:
Standard errors in brackets
* significant at 5%; ** significant at 1%

18

Results (4): Attendance, Size and Peers

Table 5b – Attendance, Size and Peer Effects, Different Specifications (2nd year students only)

	(A)	(B)	(C)	(D)	(E)	(F)	(G)	(H)
Attendance	0.36	0.441	0.486	0.413		-0.165	-0.507	
	[0.169]*	[0.214]*	[0.151]**	[0.223]		[0.216]	[0.326]	
Class Size	0.305	-0.029	-0.052	-0.026		0.071	-0.049	
	[0.081]**	[0.117]	[0.114]	[0.117]		[0.106]	[0.135]	
Own grade (1st year)	0.672	0.67	0.67	0.67				
	[0.047]**	[0.048]**	[0.045]**	[0.048]**				
Mean 1st-year	0.028	0.063	0.092	0.04		0.04	-0.02	
classmates' grade	[0.094]	[0.098]	[0.090]	[0.109]		[0.117]	[0.157]	
St Dev 1st-year	-0.191	-0.037	-0.045	-0.035		-0.133	-0.022	
classmates' grade	[0.132]	[0.146]	[0.137]	[0.146]		[0.167]	[0.196]	
Observations	441	441	441	441		441	441	
R-squared	0.42	0.48	0.47	0.48		0.79	0.81	
Fixed effects:								
Academic year	x			x			x	
Tutor		x		x			x	
Module			x	x			x	
Class					x			x
Student						x	x	x

Notes: Standard errors in brackets; * significant at 5%; ** significant at 1%

19

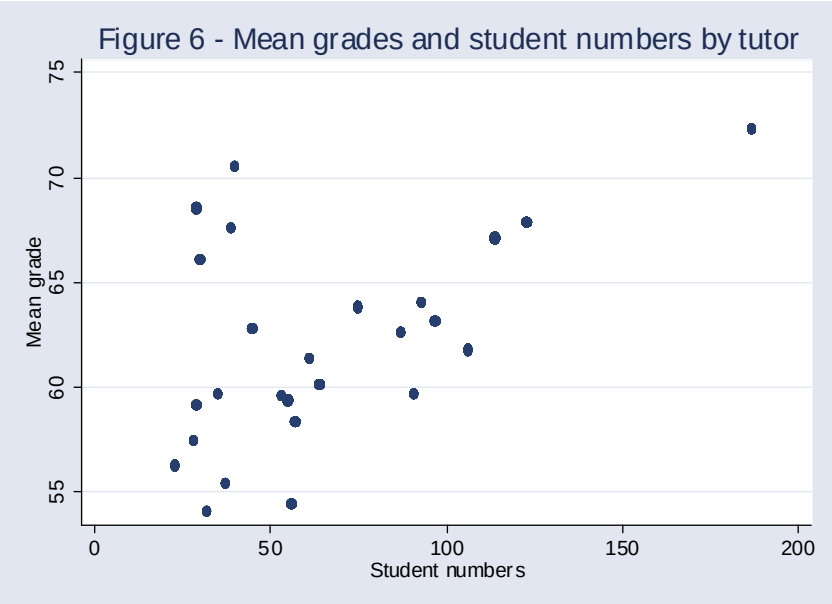
Results (4): TA's effect

Considering specification including attendance and size (with or without student effects): 28 tutors (18 have their effect identified)

-large dispersion of effects: F statistic that all effects equal easily rejected
-inclusion of student effects: F no longer rejected

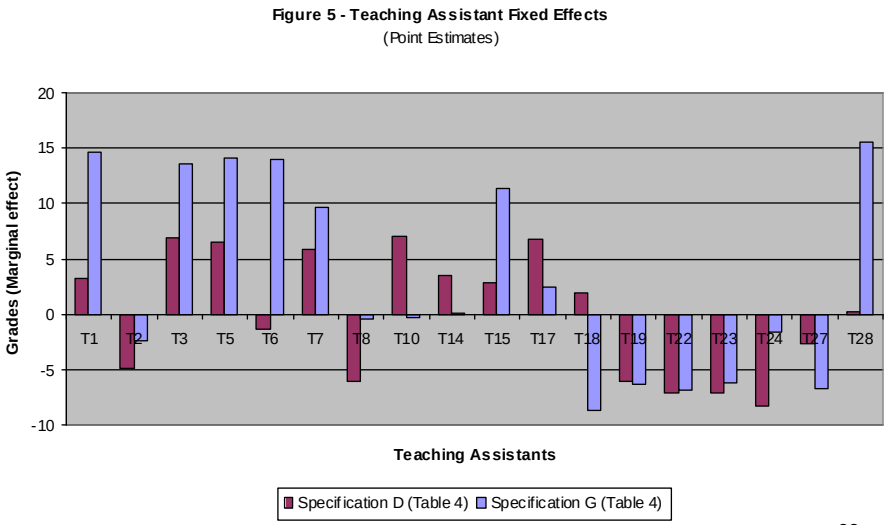
-some evidence of poor correlation between TA effects and student evaluations of TA's

20



21

Results (5): Teaching Assistants



22

(Preliminary) Conclusions:

-returns to ***attendance*** disappear with student fixed effects: attendance doesn't matter?
-alternative possibilities: students choose optimally (avg. attendance rate=80%); attendance differences endogenous; too little variability left in data

-no significant ***class size*** effects: scope for increasing class size? (avg. class size=13)
-but negative coefficients with student effects…

23

(Preliminary) Conclusions:

-no evidence of ***peer effects***: consistent with other results about low spillovers in mathematical courses;
-alternative possibilities: homogenous groups; measurement error
-strong effect played by students' lagged results (and student effects in general): evidence of considerable unobserved heterogeneity, even within single department

-large dispersion of ***TA effects***, but insignificant differences between TA's when student effects included (and low correlation with student evaluations)

24