

# Missing data and school assessment measures

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## Outline

- DfES school assessment measures
- Problems with value added measures
- Data
- Descriptive statistics
- Main results
- Conclusions
- Further work

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## DfES school assessment measures

- DfES publishes three main types of school assessment measures

1. Raw attainment (A)  $A_j = \frac{1}{N_{A_j}} \sum_i y_{ij}$

2. Value Added (VA) 2002 onwards  $VA_j = \frac{1}{N_{VA_j}} \sum_i (y_{ij} - \hat{y}_{ij})$   $\hat{y}_{ij} = f(\text{input}_{ij})$

3. Contextualised Value Added (CVA) 2006 onwards  $CVA_j = \frac{1}{N_{CVA_j}} \sum_i (y_{ij} - \hat{y}_{ij})$   $\hat{y}_{ij} = \mathbf{x}'_{ij} \hat{\boldsymbol{\beta}}$

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## Problems with the CVA Measure

- Pupils are only covered by the CVA measure if they have both an output and a predicted output score
- Examples of pupils missing from the CVA measure include:
  - Pupils who transfer between the state and independent education sectors during the CVA period
  - Pupils who immigrate during the CVA period
  - Pupils will have missing scores if they were absent from school at the time of test or who were disapplied from the national curriculum

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## Problems with CVA Measures (cont.)

- The accuracy of the CVA measure depends on whether:
  1. The average progress made by the unmatched pupils in a school differs from that of the matched pupils
    - In these schools, the DfES CVA score is biased
  2. The proportion of unmatched pupils is substantial
    - The magnitude of any bias will, on average, increase with the proportion of unmatched pupils
- Mismeasured CVA scores may affect the CVA rankings for all schools
- It is therefore important to quantify the sensitivity of CVA scores (and ranks) to the missing data

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## Data

- National Pupil Database
  - Key Stage 4 2005 (GCSE Examination results)
    - Capped point score (best eight results at GCSE)
  - Key Stage 2 2000
    - Average point score (in English, Mathematics and Science)
  - PLASC Data 2005
    - Pupil background characteristics for the CVA measure

Academic Year	1999/00	2000/01	2001/02	2002/03	2003/04	2004/05
Age	10-11	11-12	12-13	13-14	14-15	15-16
Year Group	6	7	8	9	10	11
Key Stage Data	KS2 2000					KS4 2005
PLASC Data						PLASC 2005

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## Descriptives

- How many pupils are missing from the CVA measure?
  - England: 5%
  - London: 11%
  - LEA range: 4 - 17%
  - School range: 0 – 50%
- 1/5 of schools in London exclude 15% or more of their GCSE pupils when computing the CVA score

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## Descriptives (cont.)

- All LEAs in London
- Excluded pupils have different characteristics
  - Worse GCSE attainment
  - Disadvantage backgrounds
  - Belong to ethnic minorities
  - English not first language
- Descriptives suggest that many pupils are unmatched as they are new entrants to the English education system

	Included in CVA	Excluded from CVA
5+ A*-C	58 %	44 %
Female	50 %	51 %
FSM	22 %	32 %
SEN	19 %	20 %
Non-White British	51 %	90 %
EAL	29 %	67 %
Joined Late	14 %	79 %
<b>N</b>	<b>65,048</b>	<b>6,606</b>

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## A couple of quotes

- ALG mobility report (2005):
  - “...we don't have SATS results for children from overseas entering the system for the first time, so we don't get the recognition for how much they have improved”
- DfES performance tables website:
  - “... all pupils are capable of making progress and it is important that schools are given recognition for the work that they do with all their pupils”

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## DfES Performance Tables Southwark 2005

	Number of pupils at end of KS4
England Average	
School A	164
School B	145
School C	169
School D	160
School E	175
School F	165
School G	221
School H	126
School I	115
School J	112
School K	113
School L	140
School M	234
School N	143

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## DfES Performance Tables Southwark 2005

	Number of pupils at end of KS4	Attainment % 5+ A*-C
<b>England Average</b>		<b>57%</b>
School A	164	22%
School B	145	32%
School C	169	41%
School D	160	72%
School E	175	57%
School F	165	28%
School G	221	50%
School H	126	60%
School I	115	78%
School J	112	79%
School K	113	57%
School L	140	65%
School M	234	33%
School N	143	34%

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## DfES Performance Tables Southwark 2005

	Number of pupils at end of KS4	Attainment % 5+ A*-C	VA
<b>England Average</b>		<b>57%</b>	<b>1000</b>
School A	164	22%	987
School B	145	32%	1004
School C	169	41%	990
School D	160	72%	1016
School E	175	57%	991
School F	165	28%	978
School G	221	50%	975
School H	126	60%	1030
School I	115	78%	1050
School J	112	79%	1013
School K	113	57%	1008
School L	140	65%	1006
School M	234	33%	987
School N	143	34%	999

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## DfES Performance Tables Southwark 2005

	Number of pupils at end of KS4	Attainment % 5+ A*-C	VA	CVA
<b>England Average</b>		<b>57%</b>	<b>1000</b>	<b>1000</b>
School A	164	22%	987	1016
School B	145	32%	1004	1027
School C	169	41%	990	1015
School D	160	72%	1016	1043
School E	175	57%	991	1022
School F	165	28%	978	1002
School G	221	50%	975	1026
School H	126	60%	1030	1026
School I	115	78%	1050	1070
School J	112	79%	1013	1035
School K	113	57%	1008	1019
School L	140	65%	1006	1024
School M	234	33%	987	1022
School N	143	34%	999	1012

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## DfES Performance Tables Southwark 2005

	Number of pupils at end of KS4	Attainment % 5+ A*-C	VA	CVA	Coverage Indicator (%)
<b>England Average</b>		<b>57%</b>	<b>1000</b>	<b>1000</b>	
School A	164	22%	987	1016	85%
School B	145	32%	1004	1027	82%
School C	169	41%	990	1015	83%
School D	160	72%	1016	1043	98%
School E	175	57%	991	1022	98%
School F	165	28%	978	1002	73%
School G	221	50%	975	1026	57%
School H	126	60%	1030	1026	98%
School I	115	78%	1050	1070	94%
School J	112	79%	1013	1035	93%
School K	113	57%	1008	1019	96%
School L	140	65%	1006	1024	93%
School M	234	33%	987	1022	77%
School N	143	34%	999	1012	63%

# Methodology

- Examine whether CVA scores are valid in the presence of missing data:
  1. Examine how sensitive CVA scores potentially are to the unknown predicted output of all the unmatched pupils
  2. Impute the missing data for each pupil and recalculate the CVA scores
  3. Sensitivity analysis on the imputed datasets to examine departures from MAR

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## Initial sensitivity analysis

1. What predicted output would the unmatched pupils have to have in order for the DfES CVA scores to be valid?

$$\bar{y}' = \frac{1}{N_A - N_{CVA}} \left[ \sum_{N_A} y_i - \sum_{N_{CVA}} \hat{y}_i \right] - \frac{N_A}{N_A - N_{CVA}} CVA$$

2. How would schools CVA scores vary as a function of the unmatched pupils' predicted output?

$$CVA = \frac{1}{N_A} \left[ \sum_{N_A} y_i - \sum_{N_{CVA}} \hat{y}_i \right] - \frac{N_A - N_{CVA}}{N_A} \bar{y}'$$

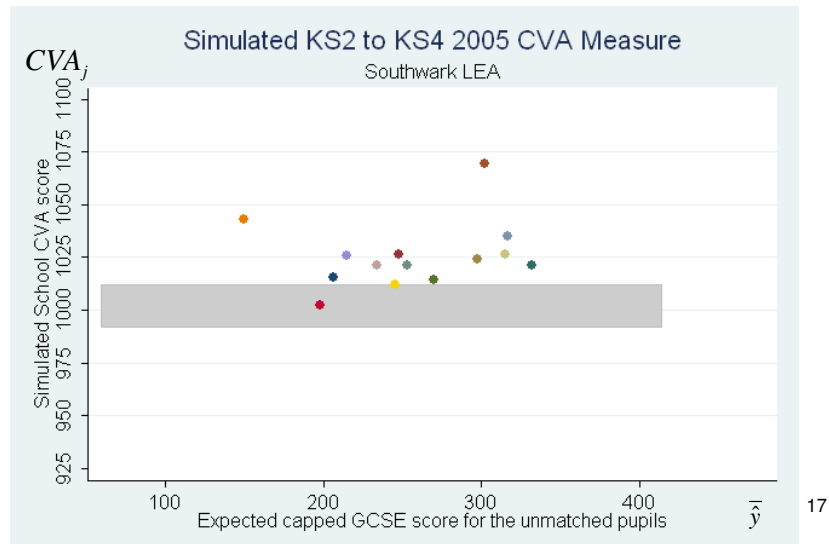
3. How do the ranks of schools' CVA scores vary as a function of the unmatched pupils' predicted output?

$$\text{rank}(CVA) = f(\bar{y}')$$

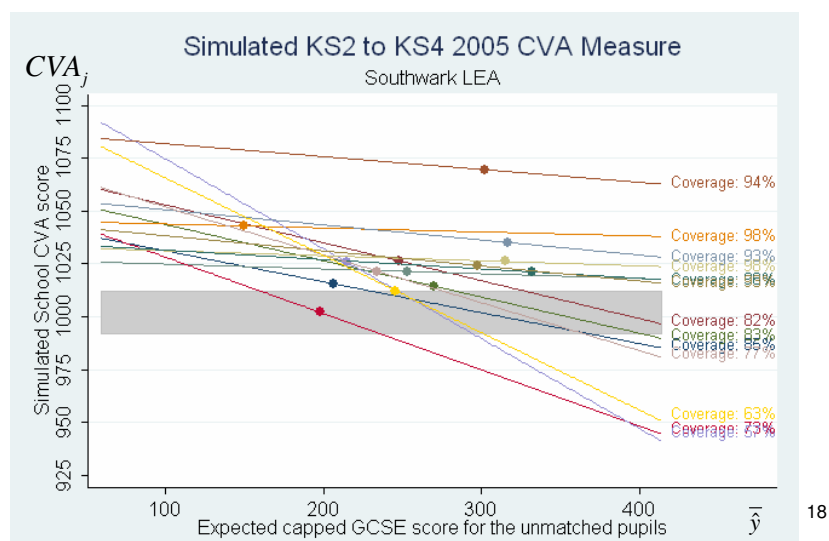
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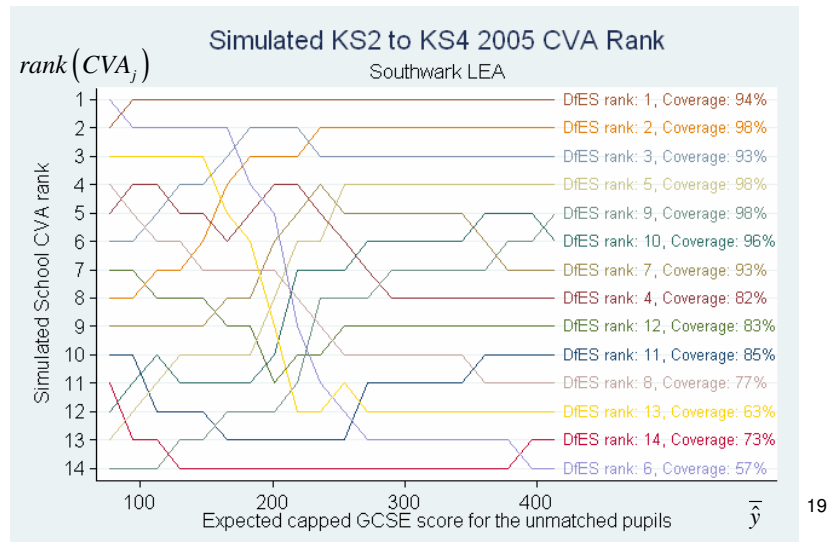
## Initial sensitivity analysis (cont.)



## Initial sensitivity analysis (cont.)



## Initial sensitivity analysis (cont.)



## Imputation

- All secondary schools in London
- Variable of interest
  - Expected capped GCSE score ( $\hat{y}_{ij}$ )
- Other variables included in multiple imputation model are:
  - KS2, KS3 and KS4 test score measures
  - Time invariant pupil characteristics
    - Gender, age within academic year, EAL, ethnicity
  - Time varying pupil characteristics
    - FSM, SEN, IDACI, date of earliest recorded entry into secondary school
- Multiple imputation assumes MAR
  - A sensitivity analysis is required to test departures from this assumption

## Results from Imputation

### CVA band transition matrix

- How does the categorisation of schools into “below”, “same as” and “above” the national average change as we include the unmatched pupils

- Schools CVA scores improve slightly
- Implies that unmatched pupils are making slightly more progress than the matched pupils

%	Below	Same	Above
Below	92	8	0
Same	2	92	6
Above	0	3	97

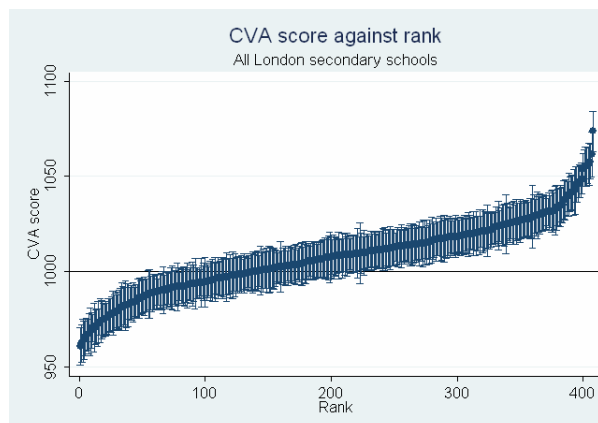
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## Results from Imputation (cont.)

### Do schools CVA scores change significantly?

- How many schools DfES CVA scores are invalid in the sense that they are significantly biased?

- 0 out of 408
- Not necessarily surprising given the wide confidence intervals about CVA scores



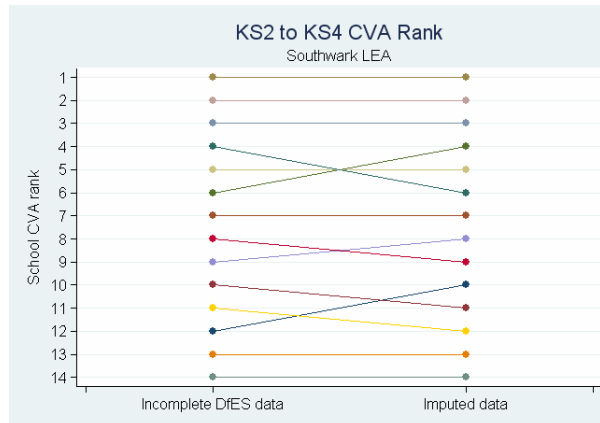
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## Results from Imputation (cont.)

### The danger of looking solely at ranks

- How are the ranks affected?

- The ranks of schools in Southwark are sensitive to the missing data even though no schools scores change significantly
- Ranks should be used very cautiously since most schools are not significantly different from each other



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## Conclusions

- Pupils with missing data are a London problem
- These pupils are very different in terms of their background characteristics
- Pupils with missing data have to have relatively high prior attainment for many schools' DfES CVA scores to remain accurate
- CVA scores of low coverage schools are very sensitive to the unknown prior attainment of the missing pupils
- This suggests that some schools CVA scores are underestimated
- The CVA ranks of low and high coverage schools may change considerably with low coverage schools improving and high coverage often falling
- All of the above conclusions also apply to VA measure

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## Conclusions (cont.)

- Multiple imputation (MI) suggests that low coverage schools' CVA scores are biased downwards by a small amount
  - However these biases are not statistically significant
- Potential problem is that MI assumes MAR
  - In which case, imputed values are incorrect
  - Need to explore departures from MAR
  - Alternative methods to MI can also be explored

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## Further work

- Take into account all pupils who spend time in secondary schools:
  - pupils who have output scores but not input scores
  - pupils who have input but no output scores
  - pupils who have neither input nor output scores

	No output	output	Total
No input	10,109	31,509	41,618
input	39,909	563,247	603,156
Total	50,018	594,756	644,774

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## Further work (cont.)

- **Weights are required:**
  - to reflect the differing lengths of time the unmatched pupils have spent in the English education system
    - PLASC 2005 variable - Date of entry into GCSE school
  - to reflect the differing lengths of time that mobile pupils spend in each of their secondary schools
    - Requires that we know the complete school history of each pupil
    - Multiple membership multilevel models can do this

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