

Are Teachers to Blame?: Two-Level Quantile Regression of Teacher Quality on Student Performance

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April 28, 2013

Acknowledgment

Research funded by a grant from the US Department of Education through the Institute of Education Sciences, award number R305A090094-10.



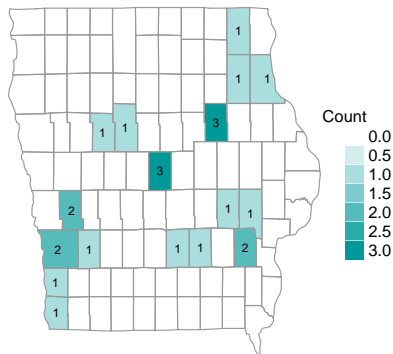
Intervention - Science Writing Heuristic

- Embeds science argument within typical inquiry lessons
- Promotes critical thinking and reasoning
- Uses language as a mediating tool for negotiating the understanding of science
- Students are required to
 - pose questions
 - generate claims and evidence
 - compare their answers to others
 - reflect on changes in their understanding

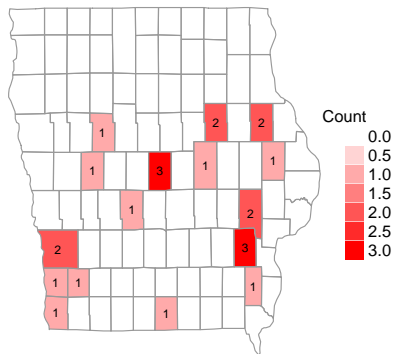
Study

- A cluster randomized experimental design with 48 elementary schools

Location of 24 SWH Schools



Location of 24 Control Schools



Research Question

- How does the quality of implementation affect student outcomes?

Quantile Regression

- Many times the effect of an intervention is not homogenous
- Classical two-stage least squares methods only offer inference about the conditional mean.
- Quantile Regression models the conditional quantile $\tau \in (0, 1)$.

- Provided two estimators for quantile treatment effects in recursive structural equation models
- In the two level setting, these estimators provides a way to estimate the effect of endogenous variables at level-two on all quantiles of the level-one response.
- Both level-1 and level-2 endogenous variables must be observed and continuous.

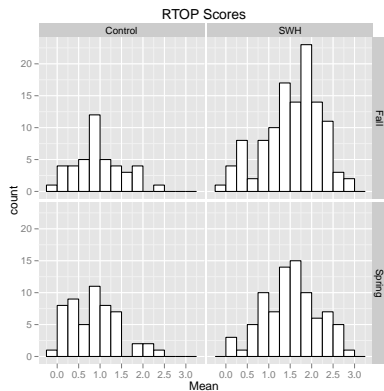
Ma and Koenker 2004

- We collected and rated video data from teachers
- Goal was to use the video ratings to see what effect the quality of teaching had on student test scores
- Student Level: Cornell Critical Thinking Test
- Teacher Level: Modified Reformed Teaching Observation Protocol (RTOP)

Sample

- 2315 fifth grade students from 2010-2011 participated
 - 2051 of the 2315 (88.6%) completed both the pretest and the posttest
- 85 Teachers among the 48 schools
 - 38 of the 85 (44.7%) fifth grade teachers in the study submitted a video for evaluation.
 - Videos have very recently been re-rated and the response rate is much higher (~ 90%).
- Total number of complete cases was 1195 out of 2315 (51.6%)

RTOP



Treatment Group	Semester	Average Rating	<i>n</i>
Control	Fall	0.973	43
Control	Spring	0.870	54
SWH	Fall	1.573	117
SWH	Spring	1.551	84

Statistics reflect video ratings of 3rd, 4th and 5th grade teachers in the study.

Two-Level Quantile Regression

Level-2:

$$\begin{aligned} \text{Average Teacher Rating} = & \text{Treatment} + \text{Communicative Interaction} \\ & + \text{Procedural Knowledge} \\ & + \text{Lesson Design and Implementation} \\ & + \text{Student Teacher Relationship} \end{aligned}$$

Level-1:

$$\begin{aligned} \text{Improvement} = & \text{Average Teacher Rating} + \text{Treatment} \\ & + \text{Demographics} + \text{Hispanic} + \text{Black} \\ & + \text{Free and Reduced Lunch} + \text{Pretest Score} \end{aligned}$$

Teacher Level Regression Parameters

Teaching Dimension	Quantile Level				
	$\tau = 0.1$	$\tau = 0.25$	$\tau = 0.5$	$\tau = 0.75$	$\tau = 0.9$
Procedural Knowledge	0.2944	0.3014	0.3425	0.3659	0.3885
Communicative Interactions	0.2974	0.2891	0.2354	0.2597	0.2707
Student-Teacher Relationships	0.1854	0.1923	0.1777	0.1826	0.1981
Lesson Design and Implementation	0.2203	0.1971	0.2174	0.1927	0.1907

Table : The quantile regression coefficient estimates for teacher level at the five diff considered quantiles.

Student Level Treatment Effect

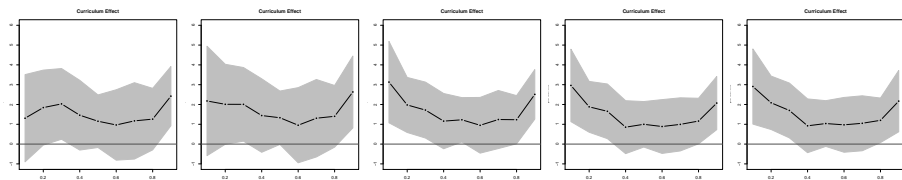
$\tau = 0.1$

$\tau = 0.25$

$\tau = 0.50$

$\tau = 0.75$

$\tau = 0.90$



(a) Effect of the SWH approach

Student Level Socio-Economic Indicator

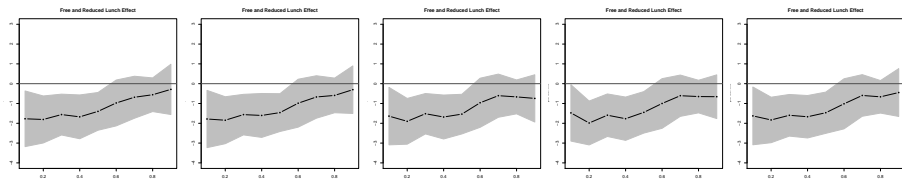
$\tau = 0.1$

$\tau = 0.25$

$\tau = 0.50$

$\tau = 0.75$

$\tau = 0.90$



(b) Free and Reduced Lunch Effect

Student Level Demographic Variables

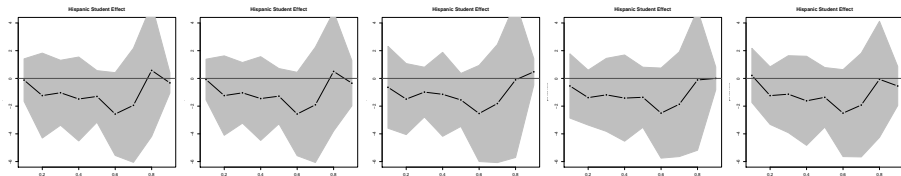
$\tau = 0.1$

$\tau = 0.25$

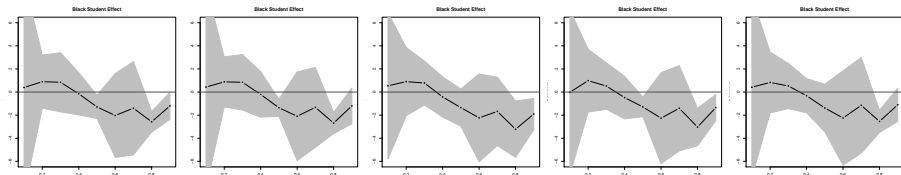
$\tau = 0.50$

$\tau = 0.75$

$\tau = 0.90$



(c) Hispanic Student Effect



(d) Black Student Effect

Conclusions

- After one year, the growth rate is greater among student learning with SWH.
- The quality of the teacher has its greatest impact on the students in the bottom quantiles.
- The largest teacher predictor is the factor for procedural knowledge.