ESTIMATING TEACHER QUALITY: OBJECTIVE AND SUBJECTIVE MEASURES

MIRA POTTER-SCHWARTZ

International Atlantic Economic Society (IAES) Best Undergraduate Paper Competition

October 8, 2022

Penn

UNIVERSITY of PENNSYLVANIA

BACKGROUND

- **Teacher quality** is an important contributor towards student academic success
- However, there is no universally agreed upon method for **measuring teacher quality**

RESEARCH QUESTION

Do subjective and objective measures of teacher quality capture similar information about teacher performance?

EXISTING LITERATURE

Evidence for differences between the information captured by:

- **Subjective measures of quality** (e.g., principal or student evaluations of teacher)
- **Objective measures of teacher quality** (e.g., value-added measures)
- Recent Research: Beg, Fitzpatrick, & Lucas (2021) study in Ghana

DATA

- **Country:** Mexico
- **Students:** 72,434
  - **Grade:** Six
  - **Year:** 2009
- **Teachers:** 3,650
  - **Subjects**: Math & Spanish

- **Context Questionnaires:**
  - Capture student, teacher, and parent demographics
- **ENLACE Test Scores:**
  - **Years:** 2008 & 2009
  - Nationwide standardized test scores
  - Collected by the Mexican Ministry of Education

METHODS: SUBJECTIVE MEASURE

Principal Component Analysis (PCA) to Summarize Student Evaluations of Teachers (Data Source: Context Questionnaires)

- PCA1: Teachers' respect and concern for students and their learning
- PCA2: Teachers' physical classroom presence and attention to students
- PCA3: Teachers' academic rigor and pedagogy style

METHODS: OBJECTIVE MEASURE

Value-Added Regressions to Identify an Objective Measure of Teacher Quality (Data Source: ENLACE Test Scores)

$$Math_{2009} = \alpha + \beta_1 Dad\_Education + \beta_2 Dad\_atHome + \beta_3 Mom\_Education$$
$$+ \beta_4 Mom\_atHome + \beta_5 Female\_Student + \beta_6 Math_{2008} + \beta_7 Spanish_{2008}$$
$$+ \beta_8 Teacher\_Effect + \varepsilon$$

METHODS: COMPARISON BETWEEN OBJECTIVE & SUBJECTIVE MEASURES

Regression Comparing **PCA Factors** and **Fixed Effects**

$$Fixed\ Effect = \propto\ + \beta_1 PCA1 + \beta_2 PCA2 + \beta_3 PCA3$$

RESULTS

- **Positive, statistically significant** when regressing fixed effects on PCA factors
- But, **low R^2 value**

Objective and subjective measures capture some similar aspects of teacher quality, but also differ considerably

ADDITIONAL FINDINGS: GENDER

Female teachers receive higher ratings from students

- Higher PCA scores for female teachers
- Contrary to most existing literature

Female teachers contribute more to students' academic achievement

- Female teachers have greater fixed effects

CONCLUSION

Support for **comprehensive evaluations of teachers**

- Modest alignment between subjective and objective measures of teacher quality
- Findings imply student perspective can be utilized to evaluate teachers, but it should be used in conjunction with other measures of teacher quality

AREAS FOR FUTURE RESEARCH

- **Identify circumstances** where subjective and objective measures of teacher quality capture the same information and when they are less consistent measures

- **Design questions** that can be posed to students that accurately assess a teacher's ability to convey material to students and prepare them for academic assessments

THANK YOU

Thank you to the IAES for hosting the Best Undergraduate Paper Competition!

Thank you to Dr. Jere Behrman & Dr. Petra Todd for their continued support!

Please feel free to reach out with any questions: miraps@sas.upenn.edu

APPENDIX

Table 1: Subjective Evaluation Regressions

	Dependent variable:		
	PCA1: teachers' respect and concern for students and their learning	PCA2: teachers' physical classroom presence and attention to student	PCA3: teachers' academic rigor and pedagogy style
	(1)	(2)	(3)
Female_Teacher	0.121***	0.120***	0.063***
	(0.017)	(0.015)	(0.016)
Teacher_Bachelors_Degree	0.023	0.00000	0.051***
	(0.021)	(0.019)	(0.020)
Teacher_Graduate_Degree	0.063*	0.027	0.021
	(0.034)	(0.030)	(0.032)
Teacher_Age	-0.008	-0.002	0.014*
	(0.008)	(0.007)	(0.008)
Teacher_Age_Squared	0.0001	0.00005	-0.0002*
	(0.0001)	(0.0001)	(0.0001)
Teacher_Years_Experience_Grupo	0.034	0.044**	-0.009
	(0.022)	(0.020)	(0.021)
Teacher_Years_Experience_Grupo_Squared	-0.002	-0.003**	0.0001
	(0.002)	(0.001)	(0.002)
Teacher_Years_Experience_School	0.020	-0.013	-0.007
	(0.013)	(0.012)	(0.013)
Teacher_Years_Experience_School_Squared	-0.001	0.001	0.001
	(0.001)	(0.001)	(0.001)
Constant	-0.117	-0.209	-0.274*
	(0.170)	(0.154)	(0.164)
Observations	2,523	2,523	2,523
R^2	0.030	0.035	0.018
Adjusted R^2	0.026	0.032	0.014
Residual Std. Error (df = 2513)	0.416	0.376	0.401
F Statistic (df = 9; 2513)	8.583***	10.157***	4.980***
Note:			*p<0.1; **p<0.05; ***p<0.01

Table 2: Value-Added Models

	Dependent variable:	
	Math_Score_2009	Spanish_Score_2009
	(1)	(2)
Mom_Primary_or_Secondary_Education	0.767	1.293
	(1.047)	(0.982)
Mom_Post_Secondary_Degree	4.270***	6.362***
	(1.322)	(1.240)
Dad_Primary_or_Secondary_Education	3.418***	3.333***
	(1.051)	(0.985)
Dad_Post_Secondary_Degree	7.178***	9.137***
	(1.282)	(1.202)
Mom_Home	4.915**	4.008**
	(2.135)	(2.002)
Dad_Home	1.558	0.407
	(0.967)	(0.907)
Female_Student	6.400***	24.419***
	(0.688)	(0.645)
Math_Score_2008	0.633***	0.286***
	(0.005)	(0.005)
Spanish_Score_2008	0.195***	0.452***
	(0.005)	(0.005)
Observations	42,375	42,375
R^2	0.703	0.675
Adjusted R^2	0.683	0.654
Residual Std. Error (df = 39793)	67.519	63.315
Note:		*p<0.1; **p<0.05; ***p<0.01

APPENDIX

Table 3: Fixed Effects Regressed on Teacher Characteristics

	Dependent variable:	
	fixed_effect_math	fixed_effect_spanish
	(1)	(2)
Female_Teacher	1.637***	5.457***
	(0.445)	(0.374)
Teacher_Bachelors_Degree	3.648***	3.204***
	(0.546)	(0.459)
Teacher_Graduate_Degree	-0.698	2.587***
	(0.880)	(0.740)
Teacher_Age	0.399*	1.138***
	(0.221)	(0.186)
Teacher_Age_Squared	-0.006**	-0.015***
	(0.003)	(0.002)
Teacher_Years_Experience_Grupo	2.648***	2.010***
	(0.610)	(0.512)
Teacher_Years_Experience_Grupo_Squared	-0.111**	-0.110***
	(0.043)	(0.037)
Teacher_Years_Experience_School	4.035***	3.213***
	(0.345)	(0.290)
Teacher_Years_Experience_School_Squared	-0.220***	-0.166***
	(0.026)	(0.022)
Constant	49.674***	63.645***
	(4.620)	(3.882)
Observations	58,769	58,769
R^2	0.014	0.017
Adjusted R^2	0.014	0.017
Residual Std. Error (df = 58759)	53.284	44.772
F Statistic (df = 9; 58759)	95.038***	114.312***
Note:		*p<0.1; **p<0.05; ***p<0.01

Table 4: Comparing Objective and Subjective Measures

	Dependent variable:	
	fixed_effect_math	fixed_effect_spanish
	(1)	(2)
PCA1: teachers' respect and concern for students and their learning	2.886***	2.663***
	(0.222)	(0.186)
PCA2: teachers' physical classroom presence and attention to student	3.658***	3.299***
	(0.220)	(0.185)
PCA3: teachers' academic rigor and pedagogy style	2.093***	1.745***
	(0.223)	(0.188)
Constant	86.441***	108.647***
	(0.220)	(0.185)
Observations	58,769	58,769
R^2	0.009	0.010
Adjusted R^2	0.009	0.010
Residual Std. Error (df = 58765)	53.426	44.929
F Statistic (df = 3; 58765)	177.507***	202.315***
Note:		*p<0.1; **p<0.05; ***p<0.01

APPENDIX

Table 5: Teacher/Student Gender Match in Value-Added Model

	Dependent variable:	
	Math_Score_2009	Spanish_Score_2009
	(1)	(2)
Mom_Primary_or_Secondary_Education	0.834	1.288
	(1.048)	(0.982)
Mom_Post_Secondary_Degree	4.264***	6.337***
	(1.323)	(1.241)
Dad_Primary_or_Secondary_Education	3.397***	3.312***
	(1.052)	(0.986)
Dad_Post_Secondary_Degree	7.191***	9.105***
	(1.284)	(1.204)
Mom_Home	4.975**	3.924*
	(2.137)	(2.004)
Dad_Home	1.525	0.455
	(0.968)	(0.907)
Math_Score_2008	0.633***	0.286***
	(0.005)	(0.005)
Spanish_Score_2008	0.196***	0.452***
	(0.005)	(0.005)
MaleTeacher_MaleStudent	-8.470***	-25.077***
	(1.045)	(0.980)
FemaleTeacher_FemaleStudent	4.939***	23.991***
	(0.908)	(0.851)
Observations	42,282	42,282
R^2	0.703	0.676
Adjusted R^2	0.684	0.655
Residual Std. Error (df = 39706)	67.512	63.297
Note:		*p<0.1; **p<0.05; ***p<0.01

APPENDIX

Principal Component Analysis

```
Principal Components Analysis
Call: principal(r = mergegr62009_withSETdata_excludeSET_NA[, c("help_students_when_not_understanding",
    "allow_students_to_express_opinions", "facilitate_classroom_respect_for_students",
    "listen_to_student_opinions_to_improve", "motivate_students_to_learn",
    "time_spent_teaching", "review_previous_tasks", "maintain_group_discipline",
    "correct_homework_errors", "participate_in_outside_activities",
    "stay_in_classroom_during_school_hours", "assign_homework",
    "provide_students_recommendations_for_problems")], nfactors = 3)
Standardized loadings (pattern matrix) based upon correlation matrix
                                          RC1   RC3   RC2   h2   u2 com
help_students_when_not_understanding     0.73  0.16 -0.02 0.56 0.44 1.1
allow_students_to_express_opinions       0.77  0.13  0.00 0.61 0.39 1.1
facilitate_classroom_respect_for_students 0.60  0.07  0.11 0.38 0.62 1.1
listen_to_student_opinions_to_improve    0.72  0.26 -0.05 0.59 0.41 1.3
motivate_students_to_learn               0.63  0.31 -0.10 0.51 0.49 1.5
time_spent_teaching                      0.03 -0.05  0.74 0.55 0.45 1.0
review_previous_tasks                    0.22  0.73  0.03 0.58 0.42 1.2
maintain_group_discipline                0.43  0.57  0.03 0.51 0.49 1.9
correct_homework_errors                  0.34  0.52 -0.11 0.39 0.61 1.8
participate_in_outside_activities        0.25  0.26 -0.49 0.38 0.62 2.1
stay_in_classroom_during_school_hours    0.08  0.20  0.68 0.51 0.49 1.2
assign_homework                          0.07  0.75  0.02 0.57 0.43 1.0
provide_students_recommendations_for_problems 0.57  0.33 -0.16 0.46 0.54 1.8

                       RC1  RC3  RC2
SS loadings           3.15 2.12 1.31
Proportion Var        0.24 0.16 0.10
Cumulative Var        0.24 0.40 0.51
Proportion Explained  0.48 0.32 0.20
Cumulative Proportion 0.48 0.80 1.00

Mean item complexity =  1.4
Test of the hypothesis that 3 components are sufficient.

The root mean square of the residuals (RMSR) is  0.08
 with the empirical chi square  76959.19  with prob <  0

Fit based upon off diagonal values = 0.91
```

APPENDIX

Student Questions about Teacher Behaviors

Questions posed to students, used to form the subjective evaluation measure:

How often does your teacher…?

Code	Teacher Behavior	Never	Almost Never	Sometimes	Almost Always	Always
R113	Help me when I don't understand some subject	1	2	3	4	5
R114	Allow me to express freely my opinions	1	2	3	4	5
R115	Respect students and not allow a student to insult or hit another	1	2	3	4	5
R116	Take opinions into account of the students to improve their teaching	1	2	3	4	5
R117	Motivate me to learn more and keep studying	1	2	3	4	5
R118	Spend less than half the class time on teaching	5	4	3	2	1
R119	Review the tasks we have done previously	1	2	3	4	5
R120	Maintain group discipline during class	1	2	3	4	5
R121	Correct the errors that are found in the homework	1	2	3	4	5
R122	Participate with us in activities outside of school	1	2	3	4	5
R123	During school hours leave the room	5	4	3	2	1
R124	Assign homework	1	2	3	4	5
R125	Listen to me and give me recommendations when I have a problem	1	2	3	4	5