

# Value Added: Estimation, Robustness and Additional Analysis

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## 1 Estimation of Value Added

To estimate school value added, I regress students' test scores on a large set of students' observables, including information on health at birth, demographic composition of the families, parents' employment and educational levels as well as mothers' math and language college-entrance exam scores. I define the relationship between students' achievement  $y_{ijt}$ , the student's characteristics, and the schools' ability to increase achievement  $q_{jt}$  by the following equation:

$$y_{i,j,t} = q_{j,t} + X_{i,t}\gamma + e_{i,j,t} \quad (1)$$

The estimated value of  $q_{j,t}$  is the school value added. It is the component of the average test score in the school that is not explained by the individual characteristics of the students. This measure of school quality captures schools' inputs such as teacher quality, infrastructure, school environment, and any other school-specific characteristic that improves achievement, measured as the average test score. To the extent that the demographic composition of the schools' students matters for test scores, these effects will also be included in the estimated school value added.

Results of the estimation are presented in Table 1, using 4th-grade students' test scores. They are three specifications, one with a basic set of students' characteristics (mother education level, income level, and gender) -**VA1**-, and two others with an extended set of characteristics -**VA2** and **VA3**-. The difference between them is that one has school-by-year fixed effects, and the other has schools fixed effect by two periods (2005-2007 and 2010-2012). The first characteristics considered are mother's level of education, which are dichotomic variables for mother with more than high school, high school, or less than high school. I add covariates that

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indicate if the mother took the college entrance exam (PAA), and in which decile she performed in maths and language tests. Within sociodemographics variables, we have the student's gender, marital status of her parents, quintiles for health characteristics at birth, like weight, length, and gestation weeks; type of birth (single or double), location of birth (hospital, at home), and an index if she was her mother's firstborn. I also consider indexes for the region of the country where the student born. Table 2 show the number of observations over time for the two specifications with the extended set of covariates.

Table 1: School Quality Estimation Regression

	Avg. Test Score (VA1)		Avg. Test Score (VA2)		Avg. Test Score (VA3)	
	Coef.	StdErr	Coef.	StdErr	Coef.	StdErr
Constant	0.016***	(0.000)	-0.092***	(0.000)	-0.151***	(0.000)
Mother High School	0.226***	(0.000)	0.202***	(0.000)	0.208***	(0.000)
Mother More than High School	0.429***	(0.000)	0.276***	(0.000)	0.271***	(0.000)
Male	-0.051***	(0.000)	-0.064***	(0.000)	-0.052***	(0.000)
Parents Married	-	-	0.056***	(0.000)	0.072***	(0.000)
Single Birth	-	-	0.054***	(0.000)	0.058***	(0.000)
First Born	-	-	0.056***	(0.000)	0.074***	(0.000)
Mother Took PAA	-	-	-0.102***	(0.000)	-0.086***	(0.000)
Mother PAA Math D2	-	-	0.012***	(0.006)	0.016***	(0.009)
Mother PAA Math D3	-	-	0.029***	(0.000)	0.021***	(0.001)
Mother PAA Math D4	-	-	0.047***	(0.000)	0.042***	(0.000)
Mother PAA Math D5	-	-	0.068***	(0.000)	0.070***	(0.000)
Mother PAA Math D6	-	-	0.080***	(0.000)	0.082***	(0.000)
Mother PAA Math D7	-	-	0.094***	(0.000)	0.092***	(0.000)
Mother PAA Math D8	-	-	0.096***	(0.000)	0.102***	(0.000)
Mother PAA Math D9	-	-	0.109***	(0.000)	0.113***	(0.000)
Mother PAA Math D10	-	-	0.152***	(0.000)	0.154***	(0.000)
Mother PAA Lang D2	-	-	0.080***	(0.000)	0.081***	(0.000)
Mother PAA Lang D3	-	-	0.130***	(0.000)	0.136***	(0.000)
Mother PAA Lang D4	-	-	0.174***	(0.000)	0.179***	(0.000)
Mother PAA Lang D5	-	-	0.207***	(0.000)	0.223***	(0.000)
Mother PAA Lang D6	-	-	0.236***	(0.000)	0.247***	(0.000)
Mother PAA Lang D7	-	-	0.273***	(0.000)	0.286***	(0.000)
Mother PAA Lang D8	-	-	0.305***	(0.000)	0.318***	(0.000)
Mother PAA Lang D9	-	-	0.349***	(0.000)	0.359***	(0.000)
Mother PAA Lang D10	-	-	0.431***	(0.000)	0.436***	(0.000)
Birth Weigth D2	-	-	0.034***	(0.000)	0.039***	(0.000)
Birth Weigth D3	-	-	0.049***	(0.000)	0.054***	(0.000)
Birth Weigth D4	-	-	0.059***	(0.000)	0.064***	(0.000)
Birth Weigth D5	-	-	0.063***	(0.000)	0.068***	(0.000)
Birth Gestation D2	-	-	-0.008***	(0.000)	-0.007**	(0.035)
Birth Gestation D3	-	-	-0.026***	(0.000)	-0.023***	(0.000)
Birth Gestation D4	-	-	-0.044***	(0.000)	-0.040***	(0.000)
Birth Gestation D5	-	-	-0.057***	(0.000)	-0.054***	(0.000)
Birth Length D2	-	-	0.023***	(0.000)	0.023***	(0.000)
Birth Length D3	-	-	0.030***	(0.000)	0.033***	(0.000)
Birth Length D4	-	-	0.041***	(0.000)	0.046***	(0.000)
Birth Length D5	-	-	0.057***	(0.000)	0.061***	(0.000)
Birth Location D1	-	-	-0.032***	(0.000)	-0.040***	(0.000)
Birth Location D2	-	-	-0.099***	(0.000)	-0.112***	(0.000)
Region Birth FE			✓		✓	
School by Year FE	✓		✓			
School by Group Year FE		3			✓	
$R^2$	0.30		0.31		0.28	
N Obs	2,166,730		2,164,812		1,108,152	

Note: This table presents regression results for estimates of test scores on a large vector of individual student-level characteristics. School quality is estimated as the school and year fixed effect for column (1) and (2), and as the school and year group fixed effect for column (3) (Groups are 2005-2007 and 2010-2012). Estimates of school quality have not been presented in this table.

Table 2: School Quality Estimation Regression - Observations and Missings

Year	Obs in VA Estimation	Missings	Total Obs
2005	188,849	31,702	220,551
2006	189,802	31,989	221,791
2007	187,429	27,852	215,281
2008	184,621	26,789	211,410
2009	173,490	29,898	203,388
2010	185,204	23,856	209,060
2011	178,644	26,606	205,250
2012	178,224	27,367	205,591
2013	176,068	27,655	203,723
2014	175,984	26,426	202,410
2015	173,612	28,970	202,582
2016	172,885	32,984	205,869
2017	179,540	32,771	212,311
School by Year FE	2,344,352	374,865	2,719,217
School by Group of Years FE (05-07 and 10-12)	1,108,152	169,372	1,277,524

Note: This table presents observations by year in regression showed in Table 1 results for estimates of test scores on a large vector of individual student-level characteristics. School quality is estimated as the school and year fixed effect and has not been presented in this table.