Australian Conference of Economists 2023

The Impact of School Autonomy on Student Outcome: Evidence from PISA Data

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July 2023

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Aim

To investigate:

- The impact of school autonomy on math scores
- How the decision-power of various school actors, including the principal, teachers, and the school board versus that of regional and national authorities, affect student achievement
- How the autonomy by task, such as budgetary decisions, affect student scores
- How the impact of school autonomy vary across countries of different development/governance/corruption levels

Literature Review on Institutional Impact on Student Achievement

- School type: Uysal & Dincer (2009), Dronkers & Avram (2008)
  - Public versus private are a 'crude' measure.
  - Schools of the same type could have gov't funding and associated constraints.
- Government funding on schools: Toma (1996)
  - It does not spell out any associated constraints.
- Schools' operational autonomy: Hanushek et al. (2013), Contreras (2015)
  - Decision making may be correlated with other school autonomy elements, such as funding.

Contribution

- Considers three different aspects of school autonomy, i.e. legal, financial, and operational, simultaneously
- Creates several indexes to measure schools' operational autonomy.
- Examines the autonomy impact of the principal, teachers, and the school board collectively as well as individually

Data

- Programme for International Student Assessment (PISA) student and school questionnaire
- PISA sample year coverage: 2009, 2012 and 2015
- PISA panel sample size: 1,318,241 students, in 15,541 schools from 56 countries
  - Dependent variable: Math scores
  - Coefficient of interest: financial, legal and operational autonomies
  - Control variables: Gender of the student, student immigration status, grade, highest educational level of parents, highest occupational status of parents, language spoken at home, owning a computer at home, having an internet connection at home, number of books at home, school size, the square of school size

Data:Measuring School Actors' Responsibility Shares

1. Creating binary indicator for each decision maker on each task.
   - $A_{iskt} = 1$ if actor i in school s is given a responsibility in task area k in year t
   - 0 otherwise
   - $i = \{1, 2...5\}$ and $k = \{1, 2..., 12\}$
2. Aggregating the total number of responsibilities T_{ist} for actor i in school s and total number of responsibilities for all actors together in school s as T_{st}:
   - $T_{ist} = \sum_{k=1}^{12} T_{iskt}$
   - $T_{st} = \sum_{i=1}^{5} \sum_{k=1}^{12} T_{iskt}$
3. Each actor i's responsibility share in school s: $RS_{ist} = \frac{T_{ist}}{T_{st}}$
4. School actors' total responsibility share in school s: $RS_{st} = \frac{\sum_{i=1}^{3} T_{ist}}{T_{st}}$
5. Regional and national authorities' total responsibility share in school s: $RS_{st} = \frac{\sum_{i=4}^{5} T_{ist}}{T_{st}}$

Data: Summary Statistics

Panel A: Student Level	Mean	Std. Dev	Min.	Max.
Female	0.504	0.500	0	1
Immigrant	0.118	0.322	0	1
Highest education level of parents	13.054	3.407	3	18
Highest occupational status of parents	49.063	20.490	11	90
Owning computer at home	0.853	0.354	0	1
Having internet connection at home	0.842	0.365	0	1
Books at home: 1-25	0.385	0.487	0	1
Books at home: 25-100	0.278	0.448	0	1
Books at home: 100-200	0.144	0.351	0	1
Books at home: 200-500	0.104	0.306	0	1
Books at home: more than 500	0.062	0.241	0	1
Panel B : School Level				
Private school	0.194	0.395	0	1
Share of government funding	80.313	31.162	0	100
School responsibility share	0.606	0.142	0	1
Principal responsibility share	0.239	0.119	0	1
Teacher responsibility share	0.178	0.071	0	1
School board responsibility share	0.189	0.089	0	1
Regional authority responsibility share	0.189	0.108	0	1
National authority responsibility share	0.205	0.122	0	1
School responsibility share: Personnel matters	0.513	0.314	0	1
School responsibility share: Admin. & Discip. matters	0.708	0.241	0	1
School responsibility share: Course matters	0.618	0.191	0	1
School responsibility share: Budgetary matters	0.520	0.231	0	1
School size	861	787	0	17,805

Data: Summary Statistics on PISA Math Scores

	Mathematics
Pooled mean score	**452.6**
Pooled mean score over gender	
Female	446.9
Male	458.3
Pooled mean score by legal autonomy	
Private School	459.9
Public School	450.6
Pooled mean score by operational autonomy	
School responsibility share above median	459.5
School responsibility share below median	451.0
Pooled mean score by financial autonomy	
Share of government funding below median	455.2
Share of government funding above median	450.6

Methodology

Fixed Effects (FE)

$$Y_{csti} = \alpha A_{icst} + \beta_T T_{icst} + \beta_F F_{icst} + \beta_S S_{icst} + \delta_c + \delta_t + u_{icst}$$

- Student i in country c in school s in year t

Coarsened Exact Matching (CEM)

1. Coarsening the data using country ID and student grades
2. Matching treated and untreated cases for each of the autonomy measures
3. The estimation includes using FEs and CEM weights

Fixed Effects Estimation Results

Dep. Variable : Math Scores	(1)	(2)
Private school	-7.085***	-6.100***
	(1.536)	(1.521)
Share of government funding (0%)	24.693***	24.369***
	(2.388)	(2.389)
Share of government funding (0.01-33.3%)	10.352***	10.360***
	(2.138)	(2.140)
Share of government funding (33.4-66.6%)	11.176***	11.174***
	(2.096)	(2.099)
Share of government funding (66.7-99.9%)	6.958***	6.931***
	(1.265)	(1.266)
School responsibility share	18.908***	
	(3.415)	
School responsibility share (20.1-40%)		4.809
		(5.472)
School responsibility share (40.1-60%)		14.353***
		(4.464)
School responsibility share (60.1-80%)		16.283***
		(4.419)
School responsibility share (80.1-100%)		17.476***
		(4.555)
N	933899	933899
R-squared	0.462	0.462

* $p < 0.10$; ** $p < 0.05$; *** $p < 0.01$
Robust standard errors are estimated by Balanced Repeated Replication (BRR)

Fixed Effects Estimation Results (2)

Dep. Variable : Math Scores	(1)	(2)
Private school	-6.803***	-7.148***
	(1.551)	(1.556)
Share of government funding (0%)	24.220***	24.367***
	(2.402)	(2.408)
Share of government funding (0.01-33.3%)	10.235***	10.856***
	(2.157)	(2.187)
Share of government funding (33.4-66.6%)	11.082***	11.121***
	(2.098)	(2.129)
Share of government funding (66.7-99.9%)	6.891***	6.760***
	(1.270)	(1.286)
Principal responsibility share	16.965***	
	(4.842)	
Teacher responsibility share	21.454***	
	(7.767)	
School board responsibility share	-8.035	
	(6.817)	
Regional authority responsibility share	-15.046***	
	(5.767)	
School responsibility share on:		
Personnel matters		-0.321
		(1.938)
Administrative and Disciplinary matters		-0.851
		(2.105)
Course matters		0.497
		(2.457)
Budget matters		11.230***
		(2.694)
N	933899	929864
R-squared	0.463	0.462

* $p < 0.10$; ** $p < 0.05$; *** $p < 0.01$

Robust standard errors are estimated by Balanced Repeated Replication (BRR)

Coarsened Exact Matching Estimation Results

Dep. Variable : Math Scores	(1)	(2)	(3)
Private school	-4.742***		
	(1.614)		
Share of government funding (0%)		14.074***	
		(1.963)	
School responsibility share (40.1-100%)			3.154
			(21.295)
N	629538	367456	318072
R-squared	0.524	0.407	0.458
L_1 (Balance Test Before Matching)	0.624	0.460	0.651
L_2 (Balance Test After Matching)	0.280	0.335	0.422

* $p < 0.10$; ** $p < 0.05$; *** $p < 0.01$

Robust standard errors are estimated by Balanced Repeated Replication (BRR)

Fixed Effects Estimation Results by Governance Efficiency

	World Bank Government Efficiency Index		
	(1)	(2)	(3)
Dep. Variable : Math Scores	Rank 25-50	Rank 50.1-75	Rank 75.1-100
Private school	-13.578***	1.017	-3.816*
	(3.591)	(3.223)	(1.944)
Share of government funding (0%)	36.582***	25.383***	23.745***
	(6.106)	(3.444)	(3.388)
Share of government funding (0.01-33.3%)	12.028**	19.254***	11.206***
	(5.331)	(3.483)	(2.613)
Share of government funding (33.4-66.6%)	15.889***	19.163***	9.365***
	(4.642)	(4.215)	(2.378)
Share of government funding (66.7-99.9%)	2.611	9.596***	8.163***
	(2.827)	(1.818)	1.626
School responsibility share	-8.536	13.011***	8.853
	(9.918)	(4.597)	(6.165)
N	68891	218241	646767
R-squared	0.420	0.364	0.435

* $p < 0.10$; ** $p < 0.05$; *** $p < 0.01$

Robust standard errors are estimated by Balanced Repeated Replication (BRR)

Additional Subgroup Analysis, Heterogeneity and Robustness Tests

Subgroup Analysis and Heterogeneity

- Across genders Go to Table Gender
- Across country income groups Go to Table Income
- Across country control for corruption index Go to Table Corruption

Robustness Tests

- Measuring student achievement with reading scores Go to Table Reading
- Measuring student achievement with science scores Go to Table Science
- Estimation without school control variables Go to Table Without Controls

Conclusion

- Attending a school with legal autonomy lead to decreased student test scores; while operational and financial autonomy increase them
- Among the three aspects of autonomy, financial autonomy matters the most
- Among the three school actors, the principal's and teachers' responsibilities influence student performance the most
- Among the four task areas of a school, only the budgetary responsibility improves student achievement

Conclusion

- The estimated impact of operational autonomy is negative in countries with lower income/government efficiency/control for corruption levels, whereas positive in higher country groups
- Students attending schools with complete financial dependence on the government are negatively affected, independent of their country group
- Students from countries with the lowest government efficiency rankings benefit from full financial independence more than those from higher government efficiency rankings

Thank you !

Fixed Effects Estimation Results (3)

	Est. Coef.	S.E.
Private school	-7.835***	(1.594)
Share of government funding (0%)	23.748***	(2.391)
Share of government funding (0.01-33.3%)	10.033***	(2.183)
Share of government funding (33.4-66.6%)	10.811***	(2.121)
Share of government funding (66.7-99.9%)	6.648***	(1.275)
Personnel matters:		
Principal	8.583**	(3.725)
Teacher	10.529	(7.033)
School board	2.114	(4.812)
Regional authority	5.077	(3.848)
Course matters:		
Principal	0.503	(4.808)
Teacher	1.587	(3.800)
School board	-2.495	(4.561)
Regional authority	-7.129	(4.752)
Administrative and disciplinary matters:		
Principal	-6.637	(4.238)
Teacher	-5.031	(4.518)
School board	-16.353***	(4.086)
Regional authority	-13.682***	(4.867)
Budget matters:		
Principal	6.123	(4.763)
Teacher	17.449**	(8.258)
School board	2.058	(4.253)
Regional authority	-8.047*	(4.234)
Constant	488.225***	(40.087)
N	929864	
R-squared	0.463	

* $p<0.10$; ** $p<0.05$; *** $p<0.01$

Robust standard errors are estimated by Balanced Repeated Replication (BRR)

Heterogeneity Across Students' Gender

Dependent Variable: Math Score	Male	Male	Male	Female	Female	Female
Private school	-6.824***	-6.522***	-7.743***	-7.332***	-7.083***	-8.010***
	(1.887)	(1.896)	(1.956)	(1.593)	(1.614)	(1.647)
Share of government funding (0%)	27.756***	27.264***	27.504***	21.425***	20.969***	20.670***
	(2.913)	(2.922)	(2.922)	(2.262)	(2.270)	(2.295)
Share of government funding (0.01-33.3%)	10.136***	10.007***	10.225***	10.470***	10.360***	10.415***
	(2.679)	(2.701)	(2.717)	(2.301)	(2.326)	(2.317)
Share of government funding (33.4-66.6%)	10.761***	10.660***	10.696***	11.281***	11.187***	11.151***
	(2.353)	(2.350)	(2.357)	(2.243)	(2.245)	(2.249)
Share of government funding (66.7-99.9%)	6.521***	6.466***	6.381***	7.330***	7.247***	7.201***
	(1.381)	(1.388)	(1.387)	(1.379)	(1.382)	(1.393)
School responsibility share	17.709***			19.996***		
	(4.260)			(3.943)		
Principal responsibility share		17.023***			16.559***	
		(5.321)			(6.046)	
Teacher responsibility share		21.515**			21.000**	
		(8.687)			(8.597)	
School board responsibility share		-8.812			-7.233	
		(7.698)			(7.488)	
Regional authority responsibility share		-13.425**			-16.933***	
		(6.376)			(7.488)	
Personnel matters			2.726			0.400
			(2.381)			(2.062)
Administrative and disciplinary matters			-0.779			0.106
			(3.043)			(2.725)
Course matters			3.209			5.473*
			(2.932)			(2.930)
Budget matters			10.372***			12.804***
			(3.123)			(3.235)
N	455581	455581	453541	478318	478318	476323
R-squared	0.459	0.460	0.460	0.464	0.464	0.464

* $p < 0.10$; ** $p < 0.05$; *** $p < 0.01$
Robust standard errors are estimated by Balanced Repeated Replication (BRR)

Go back

Heterogeneity Across Country Income Groups

Dependent Variable: Math Score	World Bank Country Income Groups		
	(1)	(2)	(3)
	Lower Middle Income	Upper Middle Income	Higher Income
Private school	-19.267***	14.943***	-8.213**
	(3.525)	(3.598)	(2.346)
Share of government funding(0%)	30.947***	17.272***	26.194***
	(10.445)	(3.561)	(7.241)
Share of government funding(0.01-33.3%)	16.892**	12.122***	18.670***
	(7.320)	(3.632)	(3.269)
Share of government funding(33.4-66.6%)	17.412***	11.815**	9.096**
	(5.223)	(4.954)	(3.566)
Share of government funding(66.7-99.9%)	0.868	8.129***	6.780***
	(4.220)	(2.336)	(1.660)
School responsibility share	-17.774	24.844***	3.124
	(12.247)	(4.958)	(6.284)
N	35038	185967	380114
R-squared	0.273	0.364	0.297

* $p < 0.10$; ** $p < 0.05$; *** $p < 0.01$
Robust standard errors are estimated by Balanced Repeated Replication (BRR)

Heterogeneity Across Corruption Index

Dependent Variable: Math Score	World Bank Control for Corruption Index			
	(1)	(2)	(3)	(4)
	Rank 0-25	Rank 25.1-50	Rank 50.1-75	Rank 75.1-100
Private school	-18.000***	5.704**	-6.446*	-3.237
	(4.419)	(2.896)	(3.504)	(2.225)
Share of government funding (0%)	37.708***	11.238***	40.148***	23.704***
	(12.368)	(2.899)	(5.757)	(3.503)
Share of government funding (0.01-33.3%)	17.477**	0.313	19.795***	13.257***
	(7.061)	(2.829)	(3.940)	(2.964)
Share of government funding (33.4-66.6%)	20.793***	2.049	22.395***	8.154***
	(5.625)	(3.234)	(4.987)	(2.498)
Share of government funding (66.7-99.9%)	3.138	0.280	9.151***	8.379***
	(3.474)	(2.317)	(1.861)	(1.681)
School responsibility share	-15.802	6.248	14.992***	9.627
	(14.023)	(5.027)	(5.721)	(6.351)
N	19251	102794	208892	602962
R-squared	0.437	0.279	0.471	0.439

* $p < 0.10$; ** $p < 0.05$; *** $p < 0.01$

Robust standard errors are estimated by Balanced Repeated Replication (BRR)

Go back

Robustness Test: Fixed Effects Estimation Results on Reading Scores

Dependent Variable: Reading Score	(1)	(2)	(3)	(4)	(5)
Private school	-5.024***	-4.014***	-3.624**	-4.575***	-5.943***
	(1.516)	(1.482)	(1.530)	(1.569)	(1.545)
Share of government funding (0%)	27.376***	27.055***	27.056***	27.115***	27.102***
	(2.444)	(2.428)	(2.416)	(2.429)	(2.518)
Share of government funding (0.01-33.3%)	10.851***	10.780***	11.025***	10.877***	11.193***
	(1.869)	(1.859)	(1.853)	(1.862)	(1.919)
Share of government funding (33.4-66.6%)	11.261***	11.217***	11.355***	11.256***	11.188***
	(1.946)	(1.942)	(1.931)	(1.960)	(1.982)
Share of government funding (66.7-99.9%)	7.591***	7.551***	7.622***	7.553***	7.342***
	(1.268)	(1.262)	(1.268)	(1.266)	(1.290)
School responsibility share	17.326***				
	(3.421)				
School responsibility share (20.1-40%)		9.325*			
		(4.866)			
School responsibility share (40.1-60%)		16.216***			
		(3.697)			
School responsibility share (60.1-80%)		18.732***			
		(3.787)			
School responsibility share (80.1-100%)		18.772***			
		(3.871)			
School responsibility share (40.1-100%)			11.604***		
			(2.128)		
Principal responsibility share				26.040***	
				(4.655)	
Teacher responsibility share				27.348***	
				(7.982)	
School board responsibility share				9.235	
				(6.103)	
Regional authority responsibility share				8.632*	
				(5.166)	
Share of school responsibility on:					
Personnel matters					4.219**
					(1.928)
Administrative and disciplinary matters					0.772
					(1.949)
Course matters					-1.670
					(2.591)
Budget matters					7.634***
					(2.872)
N	933899	933899	933899	933899	929864
R-squared	0.411	0.411	0.411	0.411	0.411

* $p < 0.10$; ** $p < 0.05$; *** $p < 0.01$

Robust standard errors are estimated by Balanced Repeated Replication (BRR)

Robustness Test: Fixed Effects Estimation Results on Science Scores

Dependent Variable: Science Score	(1)	(2)	(3)	(4)	(5)
Private school	-8.043***	-7.148***	-6.418***	-7.441***	-8.484***
	(1.496)	(1.478)	(1.519)	(1.542)	(1.559)
Share of government funding (0%)	24.332***	24.031***	24.027***	24.023***	23.709***
	(2.702)	(2.687)	(2.677)	(2.677)	(2.769)
Share of government funding (0.01-33.3%)	7.636***	7.689***	7.861***	7.557***	7.714***
	(2.002)	(2.006)	(2.001)	(1.999)	(2.034)
Share of government funding (33.4-66.6%)	10.351***	10.358***	10.491***	10.312***	10.223***
	(1.974)	(1.973)	(1.966)	(1.973)	(1.997)
Share of government funding (66.7-99.9%)	6.592***	6.582***	6.636***	6.550***	6.438***
	(1.305)	(1.302)	(1.305)	(1.301)	(1.320)
School responsibility share	19.938***				
	(3.077)				
School responsibility share(20.1-40%)		5.636			
		(4.901)			
School responsibility share(40.1-60%)		14.406***			
		(3.915)			
School responsibility share(60.1-80%)		15.928***			
		(3.987)			
School responsibility share(80.1-100%)		18.525***			
		(4.025)			
School responsibility share(40.1-100%)			12.388***		
			(1.845)		
Principal responsibility share				21.330***	
				(4.655)	
Teacher responsibility share				33.559***	
				(7.562)	
School board responsibility share				2.741	
				(6.282)	
Regional authority responsibility share				-1.168	
				(5.027)	
School responsibility share on:					
Personnel matters					-0.875
					(1.885)
Administrative and disciplinary matters					-0.744
					(1.999)
Course matters					0.318
					(2.633)
Budget matters					15.029***
					(2.563)
N	933899	933899	933899	933899	929864
R-squared	0.434	0.434	0.433	0.434	0.434

* $p < 0.10$; ** $p < 0.05$; *** $p < 0.01$

Robust standard errors are estimated by Balanced Repeated Replication (BRR)

Robustness Test: Fixed Effects Estimation Results without Control Variables on Schools

Dependent Variable: Math Score	(1)	(2)	(3)	(4)
Private school	4.335***			-8.481***
	(1.190)			(1.519)
Share of government funding (0%)		22.355***		27.681***
		(1.933)		(2.235)
Share of government funding (0.01-33.3%)		17.006***		19.701***
		(2.171)		(2.261)
Share of government funding (33.4-66.6%)		15.014***		17.114***
		(1.853)		(2.052)
Share of government funding (66.7-99.9%)		9.107***		9.513***
		(1.247)		(1.240)
School responsibility share			16.143***	10.866***
			(3.353)	(3.385)
N	1041000	962822	1054000	958072
R-squared	0.427	0.429	0.427	0.430

* $p < 0.10$; ** $p < 0.05$; *** $p < 0.01$

Robust standard errors are estimated by Balanced Repeated Replication (BRR)

Go back