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Cross-country evidence on the impact of decentralisation and school autonomy on educational performance

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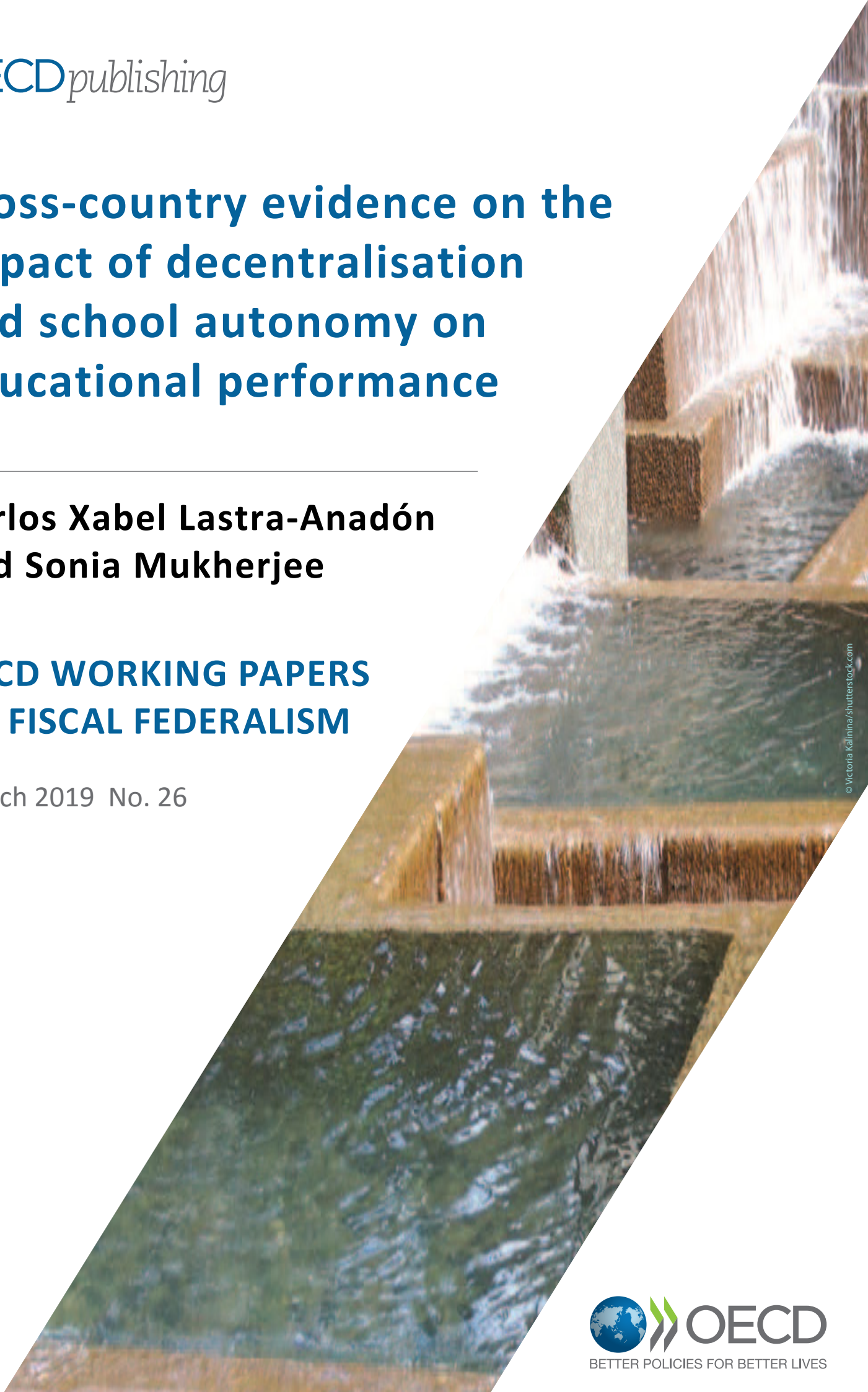
OECD WORKING PAPERS ON FISCAL FEDERALISM

March 2019 No. 26



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Abstract

Cross-country evidence on the impact of decentralisation and school autonomy on educational performance

How do administrative and fiscal decentralisation relate to education system performance? The question is answered by exploiting a panel with several different measures of fiscal decentralisation: a measure of administrative decentralisation, as well as a measure of school autonomy (using six waves of PISA). These measures are related to educational outcomes, measured by PISA score country averages. The panel includes year fixed effects and multiple country covariates. Overall, a positive relationship is found linking administrative and fiscal decentralisation with performance, as measured by PISA tests. School autonomy is also positively related with educational outcomes, strengthening the estimated effects of administrative and fiscal decentralisation.

Keywords: Educational performance, public governance, public sector productivity, intergovernmental relations

JEL classification: H75, I28, O43

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Résumé

Impact de la décentralisation et de l'autonomie des établissements scolaires sur les performances en matière d'éducation : données factuelles recueillies dans plusieurs pays

Quel est le lien entre la décentralisation administrative et budgétaire et les performances d'un système d'enseignement ? Pour répondre à cette question, on a exploité les résultats d'un panel comprenant quatre mesures différentes de la décentralisation budgétaire, une mesure de la décentralisation administrative ainsi qu'une mesure de l'autonomie des établissements (à partir de six exercices PISA). Ces mesures sont liées aux résultats en matière d'éducation tels que mesurés par les scores moyens obtenus par les pays au PISA. Le panel tient compte d'effets fixes par année et de covariables multiples par pays. Globalement, on observe qu'une corrélation positive relie la décentralisation administrative et budgétaire et les performances, telles que mesurées par les tests PISA. On observe également une corrélation positive entre l'autonomie des établissements scolaires et les résultats en matière d'éducation, confortant par là même les estimations des effets de la décentralisation budgétaire et administrative.

Mots-clés : Résultats en matière d'éducation, gouvernance publique, productivité du secteur public, relations inter-administrations

Classement JEL : H75, I28, O43

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Cross-country evidence on the impact of decentralisation and school autonomy on educational performance

By Carlos Xabel Lastra-Anadón and Sonia Mukherjee[1]

1. Introduction and main findings

1. This paper analyses the impact of fiscal decentralisation, administrative decentralisation and school autonomy on educational performance for 35 OECD countries. It builds and extends previous work, notably by Blöchliger and Égert (2013), Blöchliger et al. (2013) and Fredriksen (2013). The rationale for decentralisation is that lower-level governments, which are responsible for smaller territories are more knowledgeable about their citizens' needs. Through the closeness of citizens to governments, individuals may have more control of their own lives (Brown, 1990; Chapman, 1973). Decentralisation is, for its proponents, seen as bringing countries closer to an optimal intermediate solution between being too small in scale versus being overly large, with policies far removed from the needs of individual constituents. However, despite these promises there is still no consensus on the effects of decentralisation on public service delivery in general, nor in the domain of education (Treisman, 2007).

2. Data on five different measures of decentralisation in education are used to account for the diversity of decentralisation types. Because we benefit from a panel of six PISA waves from 2000 to 2015, we are able to exploit across and within-country variation to establish the relationship between changes in the degree of decentralisation with achievement in education and spending on education.

3. The main findings are the following:

- A consistent positive relationship between fiscal and administrative decentralisation and PISA scores is found on average. This is regardless of whether one looks at the sub-central share of taxes collected, revenue, spending, tax autonomy or decision-making power. For the main measure of fiscal decentralisation – the share of revenues collected sub-centrally – 10 percentage points more revenue collected sub-centrally is associated with about a 6 point increase in PISA scores. For the main measure of administrative decentralisation – sub-central decision-making authority – 10 percentage points more decisions taken sub-centrally are associated with a 2 point increase in PISA scores, with organ-isational issues being the most important.
- The paper also looks into how the share of decisions taken at the school level relates to PISA scores. We find a positive relationship between school autonomy and average PISA outcomes. When including school autonomy in the same models, the effects of administrative and fiscal decentralisation are strengthened.

1. This paper was prepared for the OECD Network on Fiscal Relations across Levels of Government, and presented at the 2018 Annual Meeting (19-20 November). The authors are grateful to Hansjörg Blöchliger, Sean Dougherty, Balázs Egert, Peter Hoeller and Jeffrey Mo from the OECD Secretariat, as well as Ihssane Slimani (France) and other Fiscal Network delegates for their useful comments. Layout support from Aman Johal and Celia Rutkoski was much appreciated.

- These results are directionally similar for unitary and federal countries, although slightly stronger and more consistent for unitary countries.
- More decentralisation of taxation and decision-making is associated with higher education spending. However, the size of the effect on education spending is small.

4. The paper is organised as follows: Section 2 discusses the pros and cons of decentralisation and centralisation, then reviews previous findings. Section 3 discusses the methodology, data sources and coverage. Section 4 also presents the main panel results on educational performance for various decentralisation measures, including with covariates. Section 5 analyses robustness issues to the effects by policy sub-domain, school autonomy as well as related educational outcomes on on education inequality and the relationship between spending and decentralisation.

2. Centralisation or decentralisation: The pros and cons

5. There are two distinct types of decentralisation. First, fiscal decentralisation is commonly defined as the transfer of fiscal power and resources from the central government to subordinate or quasi-independent (sub-national) government units. It refers to the amount of independent decision-making power concerning sub-national spending and revenues. Second, administrative decentralisation refers to the shift of decisions that do not involve taxes or revenues, from hiring to curriculum design to lower levels of government. In both cases, the term sub-national represents the levels of government below the national government, both lower level governments (municipalities, communes or local councils) and intermediate tiers (regions, states, provinces, countries, territories or districts).

6. The basic economic arguments in favour of fiscal and administrative decentralisation rest on three premises: (*i*) decentralisation will increase economic efficiency as local governments are capable of providing better services due to proximity and informational advantages; (*ii*) that they will also do it cost-efficiently due to the competition across jurisdictions for taxpayers that arises when fiscal decisions exist at the sub-national level; and (*iii*) that these mechanisms of competition through population mobility across local governments for the delivery of public services will ensure the right matching of preferences between local communities and local government. Arguments in favour of fiscal decentralisation, originally centred around the works of Tiebout (1956), Musgrave (1958), and Oates (1972), claim it promotes higher efficiency, better public service, greater transparency and eventually, economic growth. The literature (*e.g.*, Oates, 1999) posits that numerous economic benefits arise from shifting public finances "closer to the people" including a more efficiently sized (smaller) public sector, improved allocative efficiency (as a result of a better match between the services supplied by the public sector and the needs of local communities) and a more competitive and innovative public sector.

7. The impact of administrative decentralisation on the quality of public service depends on a number of factors. First, it is often argued that decentralisation increases economic efficiency because local governments are better positioned than the national government to deliver public services as a result of proximity and informational advantage (Klugman, 1994). This proximity is particularly important in low-income countries, where, in the absence of market opportunities, vulnerable populations rely heavily on state action for their survival (Besley and Burgess, 2002). Second, decentralisation may lead to greater consumer choice (Thiesen, 2003). As demands are different across territories, resources

can be better deployed by diversifying a government's output in accordance with local demands (Martinez-Vazquez and McNab, 2003). Population mobility and competition among local governments for the delivery of public services contributes to the matching of preferences between local communities and local governments (Tiebout, 1956). Local governments are thus better equipped to provide a more adequate service to the local population than central governments (Tiebout, 1956; Ebel and Yilmaz, 2002). Decentralisation may thus improve not only the potential for achieving Pareto efficiency, but also for achieving greater economic equality across territories (Ezcurra and Pascual, 2008). Third, decentralisation is likely to instigate horizontal and vertical competition (Tiebout, 1956) at the local and regional level, forcing governments to concentrate on the efficient production of public goods and services, and limiting the capacity of bureaucrats to act as revenue maximisers (Brennan and Buchanan, 1980; Breton, 1983; Thiesen, 2003). Finally, decentralisation is frequently seen as a means for increasing democratic participation in the decision-making process (Dabla-Norris, 2006), allowing for greater transparency and accountability (Putnam, 1993; Azfar et al. 1999; Ebel and Yilmaz, 2002). These arguments also apply to school autonomy. After all, responsiveness is higher, as the professionals staffing schools can respond to the conditions only they directly observe. These responses, moreover, can make the system more agile, while avoiding communication breakdowns and delays between different layers of decision-making that would occur even between schools and local governments.

8. There are also reasons to believe that decentralisation may have a negative effect. It may lead to less qualified officials making decisions and it may become more costly to teach students in small jurisdictions, as no economies of scale are achieved. Less sharing of knowledge may occur across jurisdictions, and externalities from one jurisdiction to the other may be ignored. For instance, if education is a public good with effects in a wider area, local education control may optimise for local economic needs rather than those of the national economy. Local financing of public services may also lead to inequity in access to those public services (Bardhan and Mookherjee, 2000, 2005), since different communities would tend to segregate by economic status. Importantly, in the United States, it has been argued by Trounstine (2018) that local officials may be more prone to corruption and to be captured by richer families. In this case, decentralisation may aggravate rather than solve incentive problems.

2.1 Summary of earlier research

9. There is a large body of empirical evidence on the link between decentralisation and educational outcomes. For instance, concerning student performance, Barankay and Lockwood (2007) found that decentralisation in the education sector had a positive impact on student performance in Switzerland. Freinkman and Plekhanov (2009) also concluded that fiscal decentralisation has a positive effect on student performance. Habibi et al. (2003) looked at decentralisation and human capital development in Argentina and concluded that fiscal decentralisation had a positive effect on educational output. Clark (2009) identified a positive effect of a major reform granting more school autonomy in the United Kingdom. Galiani and Schargrodsky (2002) show that the decision to decentralise public education in the early nineties raised student achievement in Argentina. Naper (2010) found that decentralised hiring of teachers increased school effectiveness in Norway. Akai et al. (2007) investigated the effects of decentralisation on performance in primary and secondary education and found positive effects for secondary education while the effects for primary education are mixed. Busemeyer (2008) found that fiscal decentralisation affects education spending positively and public pension spending negatively, while Arze

del Granado et al. (2005) found that both spending on education and health is higher at the expense of spending on pure public goods. For Bolivia, Faguet (2004) shows that decentralisation made public investment in education and other services more responsive to local needs.

10. There are also several cross-country studies of the relation between decentralisation and educational outcomes. Fredriksen (2013) concluded that the indicator for education decentralisation is significantly and positively correlated with student performance. Other studies such as Gunnarsoon et al. (2004), OECD (2010), Falch and Fischer (2012) and Blöchliger et al. (2013) also found similar results. Administrative and school decision-making decentralisation have been more widely studied. Cordeiro Guerra and Lastra-Anadón (2019) find a postive effect of administrative decentralisation on measures of wide access to education and a more ambiguous effect on quality measures. Hanushek and Woessman (2013) study the effect of decentralising power to schools and find that the effect is conditional upon the level of development.

11. This study extends the earlier studies. First, the study will use the longest panel available thus far, with six waves of PISA scores. Second, it will use five different measures of fiscal decentralisation, as well as a measure of administrative decentralisation. Third, the study will also combine the study of fiscal and administrative decentralisation with school autonomy as a measure of educational decentralisation and try to assess their impact on educational performance.

3. Methodology, data sources and time period

12. The following questions will be examined:

- Is there a relationship between different measures of decentralisation and student achievement levels and variation in OECD countries?[2]
- What is the effect of school autonomy and is it complementary to fiscal and administrative decentralisation?
- Is there a relationship between fiscal decentralisation and education spending?

13. To test the relationship between levels and forms of fiscal decentralisation and educational performance, a regression model with year fixed effects and country random effects is used. The experiment that we would conceptually seek to conduct is to assign different levels of decentralisation to different country-years at random. Since that cannot be done, and in the absence of sources of exogenous variation in decentralisation that are valid for more than a handful of country-years, we rely on the use of a panel model in order to obtain more robust relationships. This will allow us to use variation in and across countries over time, while removing common time trends. In addition, a rich set of potentially confounding country-year covariates are added.

14. The model adopts the form:

$$Y_{it} = \alpha + \beta X_{it} + \gamma Z_{it} + T_t + \varepsilon_{it} \qquad (1)$$

Where Y are PISA scores in country i at time t: the average level of achievement. X is a measure of decentralisation, Z is a vector of covariates, while T are the time fixed effects. This equation is implemented for the six PISA-years between 2000 and 2015 (2000, 2003, 2006, 2009, 2012 and 2015). The covariates include spending on secondary schools per pupil relative to GDP per capita, the PISA index of Student Economic, Cultural and Social Status in the country, the total population and the GDP per capita, the immigrant share of the population, teacher salary, average student number per class and teacher working time.[3]

15. Several data sources are used. The cross-country dataset on educational performance and its determinants comes from the OECD PISA dataset, which contains average performance as well as student characteristics, school resources and institutional variables. As a key dependent variable, the average national PISA score is the average of the mean score in science, math, reading or sub-set of the three when all three are not available. By design, PISA scores were averaged at 500, with a standard deviation of 100 in its initial cycle. The student characteristics are measured by the Economic, Social and Cultural Status (ESCS) indicator, which is normalised and ranges between -1 and 1, as well as the share of immigrants. School resources are captured by spending per student in secondary schooling as a per cent of GDP per capita, by the average student number per class, teacher salaries (PPP adjusted) and average teacher working hours per week. These data are from the OECD Education at a Glance dataset.

2. There are only limited data on education performance and on public education decentralisation variables for non-OECD countries. They are insufficient to have a panel for those countries.

3. Country fixed effects are not included because of the relatively short time series. As Barro (2015) has argued, in such a context the inclusion of country fixed effects can bias the estimates. For transparency, similar models with country fixed effects are shown in Table A.1.

16. To measure decentralisation, indicators that capture different aspects are used:

- *Administrative decentralisation indicator*: It encompasses the transfer of responsibility for planning, financing and management of certain public functions from central government and its agencies or commissions to lower-level governments. The data come from the OECD Education at a Glance dataset. The OECD dataset shows the percentage of 48 key decisions related to educational services taken at the sub-central level, on the basis of a survey of national policymakers.[4] Also a variant of this indicator will be used, drawing on the same dataset, namely the school autonomy indicator. This variant of the administrative decentralisation variable indicates the percentage of decisions that are taken by the school authorities.

- *Sub-central tax revenue indicator*: The tax revenue indicator captures various aspects of the freedom sub-central governments (SCGs) have over their own taxes. It is the tax revenue raised by state and local governments as a share of total tax revenue. The data are obtained from the OECD Fiscal Network database (see Annex A).

- *Sub-central share of total revenue indicator*: This indicator includes taxes and other sources of revenue; net means after deduction of social insurance scheme service charges, where applicable), sales of goods and services (e.g. market output of establishments in government, entrance fees) and grants and other revenues (e.g. current and capital grants, property income and subsidies). It excludes revenue transfers between the different levels of government.[5] Total general government revenue is defined as the sum of central government and social security revenue, state/regional revenue and local government revenue. The consolidated data come from the OECD Fiscal Network database.

- *Sub-central share of total expenditure indicator*: this indicator is obtained from the Classification of Functions of Government (COFOG) database. The sub-central share of expenditure comes from the OECD's COFOG database.

- *Tax autonomy indicators*: the recently updated sub-central government tax autonomy indicators (from the OECD Fiscal Network database), reflect the degree to which sub-central governments can set the rates and bases for the taxes they collect.[6] We multiply the share of collected taxes under autonomy by the share of taxes collected at different levels of government to develop a measure of taxes collected under autonomy.

4. Neither the institutional indicator of administrative decentralisation, nor the OECD tax autonomy indicators are available for exactly the same years. The decentralisation measures closest to the PISA test years are used.

5. The exclusion of transfers is in order to see the contribution of each sub-sector in general government total revenues. For more details see (www.oecd.org/tax/federalism/-oecdfiscaldecentralisationdatabase.htm).

6. We define tax decisions taken in autonomy as those labelled a through c in the OECD Fiscal Network Dataset, where a state or local government is autonomous if it sets the tax rate, or central governments may set upper and lower limits to taxation levels only, or central and local governments may set tax reliefs. (For more information see www.oecd.org/tax/federalism/42982242.pdf).

17. Lastly, the first cross-section of the OECD Spending Power Survey is used. It measures the sector-share decisions taken in autonomy at the sub-central level in several sectors, including in education (Dougherty and Phillips, 2019). Although it is not possible to include it in the panel models, it will be included in the cross-sectional plots and summary statistics.

18. Table 1 below shows the summary statistics of the variables. Figure 1 shows the relationship between two key variables on fiscal and administrative decentralisation for the latest cross-sections. Table 2 shows the correlation matrix of the key measures of decentralisation and a visual representation of the key measures of fiscal and administrative decentralisation.

Table 1. Summary statistics for the main variables

Variable	Obs	Mean	Std.Dev.	Min	Max
Pct sub-central decision making	739	42.44	41.69	0	100
Sub-central revenue as pct of total revenue	459	19.32	13.29	2.471	56.40
Sub-central tax as pct of total tax	704	22.10	23.34	0	88.80
Sub-central tax autonomy (%)	754	7.701	11.05	0	48.27
Sub-central spending share	345	53.53	34.69	0	100
Pct decisions taken at the school level	81	42.85	21.02	0	90
Sub-central budget decisions in autonomy (Spending power index)	21	33.95	30.95	0	100
Spending in secondary school per student as a share of GDP per capita	449	25.08	4.705	11	39
ESCS Index (normalized)	222	-0.222	0.550	-1.903	0.783
GDP per capita	560	11.60	32.73	0.106	181.4
Population	560	34802	56064	281.2	321173
Immigrant share	773	0.890	0.313	0	36
Teacher salaries (PPP adjusted)	147	605281	20870	9320	11402500
Average student number per class	209	23.66	5.782	0	51.80
Upper secondary teacher working time	349	637.5	147.0	364	1157
Federation (dummy)	35	0.260	0.439	0	1

Source: For data sources, see Annex A.

Figure 1. Relation between sub-central revenue, decision-making and school autonomy

Left Panel plots sub-central share of total government revenue against sub-central decision-making while Right Panel plots sub-central revenue as a share of total government revenue against school decision-making

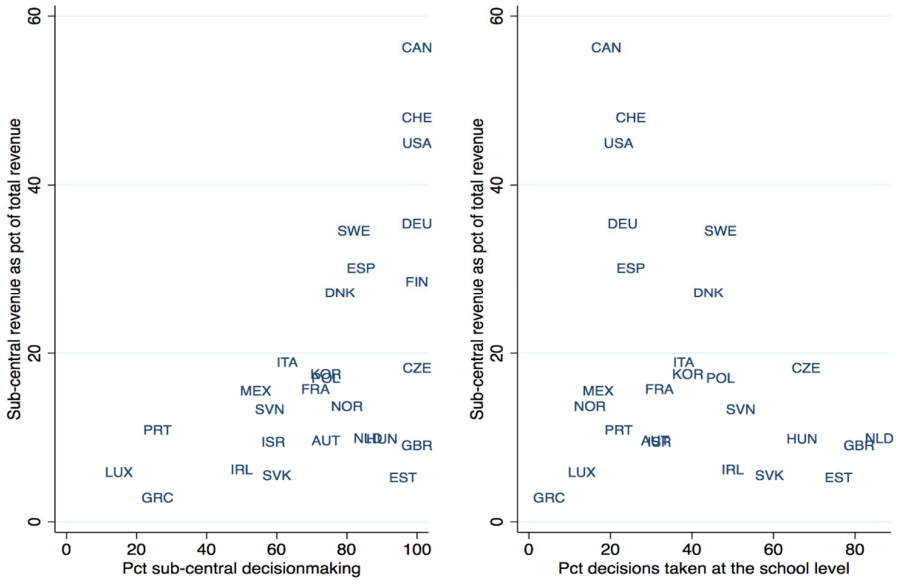


Table 2. Correlation matrix between key independent variables

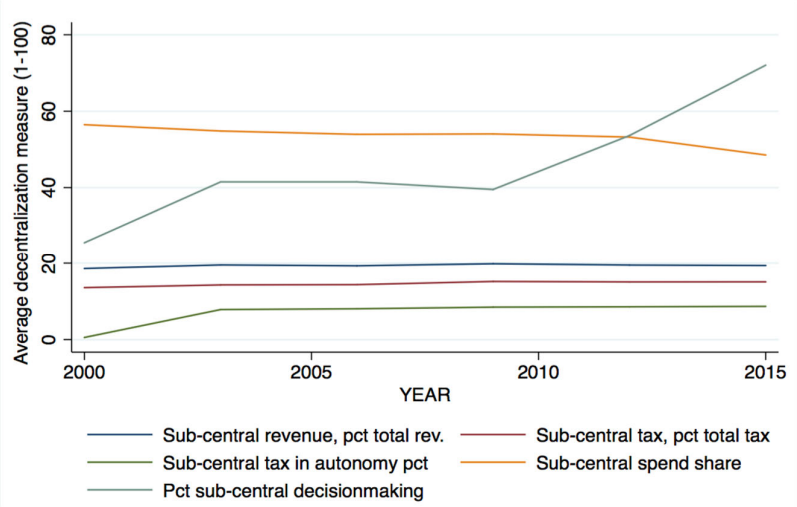
Decentralisation indicator	(1)	(2)	(3)	(4)	(5)	(6)	(7)
(1) Pct sub-central decision-making	1						
(2) Sub-central tax as pct of total tax	0.059	1					
(3) Sub-central revenue as pct of total revenue	0.141	0.942	1				
(4) Sub-central tax autonomy (%)	0.167	0.914	0.890	1			
(5) Sub-central spending share (%)	0.323	0.307	0.446	0.312	1		
(6) Pct decisions taken at the school level	0.454	-0.473	-0.332	-0.357	0.081	1	
(7) Spending power index	0.751	0.434	0.520	0.419	0.573	0.191	1

4. Main results: education performance in OECD countries

19. To provide context for the results, Figure 2 shows the evolution of the decentralisation indicators for the 35 OECD countries. There is little change in decentralisation between 2000 and 2015, except for the tax autonomy indicator, which increases throughout the period. In all regressions, the outcome is the average of PISA scores in math, reading and science, each of which is calibrated to have an average of 500 and a standard deviation per subject of 100 in 2000.

Figure 2. Trends in decentralisation for different measures

Simple average of panel countries for PISA years (2000, 2003, 2006, 2009, 2012, 2015)



4.1 Administrative and fiscal decentralisation

20. Five estimation results are shown in Table 3. Column 1 is a simple OLS estimation with no controls. Column 2 adds year fixed effects. Column 3 and 4 reproduce the same models as in columns 1 and 2, with country-year covariates, including spending on secondary schools per student relative to GDP per capita, the PISA index of student economic, cultural and social status, total population and GDP per capita, as well as some characteristics of the education system, such as the immigrant share, the average student number per class, teacher salaries and average teacher working hours per week. Model 4, with covariates and year fixed effects is the preferred estimate, as it accounts for potential time trends in decentralisation and PISA scores.

Table 3. Relation between PISA outcomes and different measures of decentralisation

Coefficient estimates (with fixed effects and covariates)

Model: main explanatory variable	(1)	(2)	(3)	(4)
A: Sub-central decision-making share	0.359***	0.330***	0.205**	0.182*
Standard error	(0.114)	(0.0944)	(0.104)	(0.105)
Observations	196	196	188	188
R-squared	0.089	0.117	0.350	0.372
B: Sub-central revenue as pct of total	0.755***	0.765***	0.501***	0.618***
Standard error	(0.155)	(0.162)	(0.153)	(0.226)
Observations	162	162	160	160
R-squared	0.074	0.113	0.263	0.285
C: Sub-central tax as pct of total	1.041***	1.041***	0.270	0.406*
Standard error	(0.189)	(0.193)	(0.189)	(0.224)
Observations	203	203	189	189
R-squared	0.008	0.052	0.329	0.357
D: Sub-central tax autonomy (%)	1.109***	0.964***	0.168	0.0597
Standard error	(0.212)	(0.150)	(0.189)	(0.180)
Observations	199	199	189	189
R-squared	0.081	0.097	0.327	0.350
E: Sub-central spending share (%)	0.119	0.132*	0.0181	0.0380
Standard error	(0.0900)	(0.0777)	(0.112)	(0.104)
Observations	119	119	118	118
R-squared	0.021	0.098	0.155	0.205
Country-year covariates			X	X
Year fixed effects		X		X

Note: All linear regressions of average PISA scores in 2000, 2003, 2006, 2009, 2012, 2015 on measures of decentralisation scaled from 0-100. Covariates are spending on secondary school per pupil relative to GDP per capita, the PISA index of Student Economic, Cultural and Social Status, the immigrant share, the average student number per class, teacher salaries (PPP adjusted), average teacher working hours per week, total population and GDP per capita. Significance levels: * p<0.10 ** p<0.05 *** p<0.01.

21. All of the decentralisation variables, in nearly every specification, are associated with positive effects, although not all are statistically significant.[7] Since by design one standard deviation in PISA scores is equivalent to 100 points, one can also read the coefficients in Table 3 as a percentage of the standard deviation of the PISA score.

22. First, we look at administrative rather than fiscal decentralisation (model A) using the share of decisions taken at the sub-central level (below we exploit the share of decisions by policy sub-domain). A positive relationship is found: an increase by 10 percentage points is associated with a 1.8 point rise in the PISA score, and this is statistically significant at the 10% level.

23. Turning to each of the different fiscal decentralisation measures, for sub-central revenues (model B), the most conservative estimates with year fixed effects and covariates in column 4 suggests that a 10 percentage point increase in sub-central tax revenue is associated with 6.2 more PISA points. These are statistically significant at the 1% level. The magnitude of the estimates is about the same when the share of total taxes that is collected locally is used (model C).

7. Results that include country and year fixed effects are presented for completeness in Annex Table B.1. Results for each of the specific subjects are very similar in magnitude and significance and shown in Annex Table B.2.

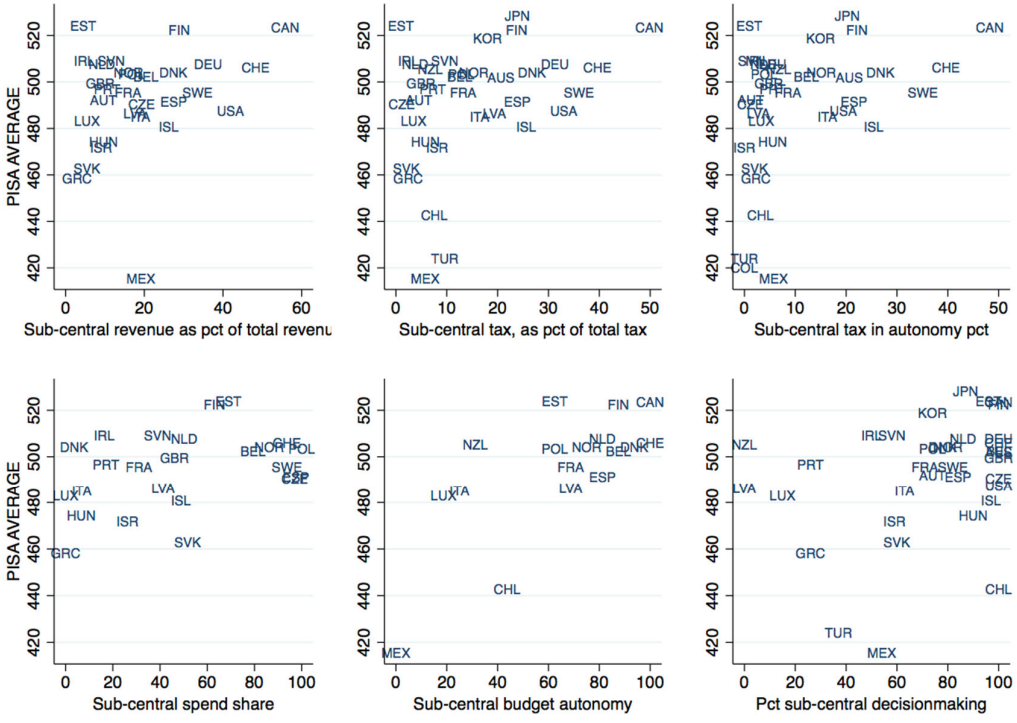
24. Next, we use the degree of autonomy sub-central entities have in setting tax rates (model D). This measure yields a similar estimate of the effect of fiscal decentralisation in the more simplified models, But is not significant in our preferred estimate, with year fixed effect and country covariates.

25. When one focuses on spending rather than revenue, the estimates are noisier, with a positive but not significant effect of the sub-central spending share (model E).

26. These results are similar in magnitude to the results of fiscal and administrative decentralisation found in Frederiksen (2013: Table 4), who found a positive effect of all types of decentralisation. However, she found the strongest effect for administrative decentralisation, while we find even stronger effects for revenue and tax collection decentralisation to sub-central governments.

27. The cross-sectional relationship for 2015 between PISA outcomes and the independent variables are also displayed visually in Figure 3, where one can see a positive relationship in the cross section for most variables and identify the positions of the countries in the decentralisation/PISA score space.

Figure 3. Relation between sub-central decentralisation measures and average PISA scores in the 2015 cross-section



4.2 Covariates

28. In Table 4 below we show a series of covariates for the preferred model of fiscal decentralisation (model B above). Column 1 is the model with covariates and year fixed

effects (a version of column 2, model B above). In columns 2 to 4 different types of covariates are added as controls: "natural" reasons for countries to be decentralised, such as the geographical dimension (area) and the federal character of countries (column 2), measures of democratisation, such as the strength of civil liberties and political rights (from Freedom House, column 3) and a combination of the basic covariates and those about country democratisation (column 4). The positive association between sub-central revenue as a share of total revenue is unaltered in any of these models with additional covariates, which suggests that the results in Table 3 are robust.

Table 4. Relation between PISA outcomes, sub-central revenues and country-year covariates

	(1)	(2)	(3)	(4)
Pct sub-central decisionmaking	0.182*	0.192		
	(0.105)	(0.121)		
Sub-central revenue as pct of total revenue			0.618***	0.618*
			(0.226)	(0.324)
Spend in secondary school	1.747**	1.581**	1.100*	-0.0841
	(0.674)	(0.825)	(0.586)	(0.509)
ESCSIndex	48.16***	38.77**	33.83***	13.83
	(11.72)	(15.65)	(9.054)	(10.78)
GDP per capita	-0.107	-0.137**	-0.0834	-0.129***
	(0.0701)	(0.0660)	(0.0612)	(0.0418)
Population	-0.0000217	-0.000000567	-0.000132***	-0.000205***
	(0.0000427)	(0.0000713)	(0.0000260)	(0.0000606)
Immigrant pct	0.153	0.210	-0.264	0.0527
	(0.447)	(0.564)	(0.317)	(0.317)
Teacher salary	-0.00000343	-0.00000328	-0.00000549*	0.000000523
	(0.00000208)	(0.00000245)	(0.00000279)	(0.00000331)
Class size	1.128	0.499	0.631	0.641
	(0.733)	(1.052)	(0.975)	(0.976)
Teacher working time	-0.00666	-0.0128	0.0426*	0.0313
	(0.0355)	(0.0395)	(0.0236)	(0.0233)
Area		-7.917		-11.22
		(10.64)		(11.79)
Federation		-0.000170		0.000581
		(0.000349)		(0.000378)
Total jurisdictions		0.00000157		-2.812
		(0.00000138)		(11.44)
Political rights		-17.55		-30.24**
		(27.77)		(9.978)
Civic liberties		-18.24*		0.00000152*
		(10.57)		(0.000000830)
Observations	188	180	160	158
R-squared	0.372	0.372	0.285	0.369
Year fixed effects	X	X	X	X

Note: All linear regressions of average PISA scores in 2000, 2003, 2006, 2009, 2012, 2015 on 1-100 measures of decentralisation. Significance levels: * p<0.10 ** p<0.05 *** p<0.01.

4.3 Federal and unitary countries

29. The structure of the government, namely whether countries are unitary or federal.[8] These models are analogous to Fredriksen (2013: Table 4). In Table 5, we show models analogous to columns 2 and 4 of Table 3, with country covariates and year fixed effects. Echoing Fredriksen's findings we tend to find more consistent effects for unitary countries, with effects of mixed signs for federal countries for spending decentralisation. These should be interpreted with caution, however, as there are far fewer federal than unitary countries in our sample (26% of the country-years in our sample are federations).

Table 5. Relation between PISA outcomes and decentralisation measures for unitary and federal countries

Model		Unitary		Federal	
A	Sub-central	0.421***	0.210	0.128	0.289
	decision making share	(0.122)	(0.153)	(0.161)	(0.287)
	Observations	144	136	53	53
	R-squared	0.148	0.336	0.147	0.561
B	Sub-central revenue	1.019***	1.120**	1.478***	0.713
	as pct of total revenue	(0.328)	(0.507)	(0.487)	(0.839)
	Observations	116	114	46	46
	R-squared	0.114	0.218	0.261	0.539
C	Sub-central tax	1.099***	0.00120	1.581***	0.453
	as pct of total tax	(0.290)	(0.354)	(0.426)	(0.546)
	Observations	144	136	53	53
	R-squared	0.093	0.320	0.548	0.563
D	Sub-central tax	1.053***	-0.440	1.105***	-0.398
	autonomy (%)	(0.265)	(0.450)	(0.296)	(0.671)
	Observations	144	136	53	53
	R-squared	0.084	0.324	0.368	0.561
E	Sub-central spend share	0.226***	0.146**	-1.860*	-10.80
		(0.0495)	(0.0586)	(0.986)	(8.033)
	Observations	101	100	18	18
	R-squared	0.173	0.442	0.346	0.922
	Country-year covariates		**X**		**X**
	Year fixed effects	**X**	**X**	**X**	**X**

Note: All linear regressions of average PISA scores in 2000, 2003, 2006, 2009, 2012, 2015 on 1-100 measures of decentralisation. Significance levels: * p<0.10 ** p<0.05 *** p<0.01.

8. Federal countries in our sample are Australia, Austria, Belgium, Canada, Germany, Mexico, Spain (considered a quasi-federal country), Switzerland and the United States.

5. Robustness and related outcomes

30. In this section, we look further at the main channels of decentralisation's effects on education, to see which policy sub-domains of administrative decentralisation matter most, and examine the role of school autonomy. In addition, we examine the effect of the same fiscal variables on the distribution of educational outcomes and on related expenditure.

5.1 Administrative decentralisation by policy domain

31. Using the *Education at a Glance* datasets on the locus of decision-making, one can estimate the effects of different policy domains of administrative decentralisaiton. These domains involve decisions on personnel, organisation, planning and resources. We examine both the main effect of decision-making by domain, as well as its interaction with the fiscal decentralisation measures. In Table 6, sub-central decision-making is found to be positively associated with the PISA outcomes for each of the policy domains (consistent with the overall findings of model A of Table 3). Notably, organisation decisions, followed by personnel decisions are the types of decisions with the strongest positive effect on PISA outcomes. The right-most columns contain the interaction effects from the same regression. They suggest that in none of these domains is decentralisation a complement of fiscal decentralisation: almost all the interaction terms are negative and none are significant.

Table 6. Relationship between PISA outcomes and sub-central decision making by policy domain

Model	Policy domain	Main effect of sub-central decision share by domain	Interaction effect of sub-central decision share by domain and sub-central tax share
1	Personnel	0.231*	-0.280
		(0.132)	(0.947)
	Observations	97	97
	R-squared	0.652	0.652
2	Organisation	0.709***	0.177
		(0.190)	*(1.752)*
	Observations	92	92
	R-squared	0.704	0.704
3	Planning	0.329***	-0.00749
		(0.0920)	(0.00515)
	Observations	98	98
	R-squared	0.669	0.669
4	Resources	0.306*	2.243
		(0.160)	*(1.486)*
	Observations	88	88
	R-squared	0.617	0.617
	Country-year covariates	**X**	**X**
	Year fixed effects	**X**	**X**

Note: All linear regressions of average PISA scores in 2003, 2006, 2012, 2015 on 1-100 measures of decentralisation (data by domain for 2000 and 2009 not available). Covariates are spending on secondary school relative to GDP per capita, the PISA index of Student Economic, Cultural and Social Status , the immigrant share, the average student number of students per class, teacher salaries, average teacher working hours per week, the total population and GDP per capita. The columns for each model shows coefficients from the same regression. Significance levels: * p<0.10 ** p<0.05 *** p<0.01.

5.2 School autonomy

32. Making use of the PISA school-level data, we can examine how the share of decisions that are taken at the school level relates to PISA scores and, moreover, how such autonomy interacts with the remaining fiscal and administrative decentralisation variables, in part building on Hanushek et al.'s (2013) work.

33. In Table 7, a measure of school autonomy (% of decisions taken at the school level) is included, which is interacted with the measures of decentralisation. Like OECD (2013: Table 3.3), a positive relation between school autonomy and average PISA outcomes is found in a model with no other regressors except the covariates. In the remaining models A-E, we interact the school autonomy variable with each of the other measures of decentralisation, similar to Table 3.

34. School autonomy is found to have a positive effect on average PISA outcomes in all models, although only significantly with the fiscal decentralisation measures. Intriguingly, the effect of administrative and fiscal decentralisation is consistently positive and of a larger magnitude and significance than in the specifications without school autonomy included. This suggests that the effects of fiscal and administrative decentralisation may complement school autonomy, similar to what OECD (2013: Table 3.3) found. However, when the different variables are interacted directly, the coefficents on the interaction are *negative* and often significant, albeit small, suggesting that the increase in the estimated effects of the decentralisation measures may be more related to simultaneity issues in the estimation rather than an complementarity *per se*.[9]

35. Thus, we should be cautious about interpreting models that include school autonomy as a regressor in the same equations as the main decentralisation variables. Much like other decentralisation variables, school autonomy is partially co-linear with the other decentralisation measures. For that reason, including school autonomy in the regressions of decentralisation may reduce the reliability of our estimates by increasing their variance. For transparency, we include Annex Table B.3, which shows models equivalent to columns 3 and 4 of Table 3, but which also include the school autonomy variable.

9. The negative relation with most fiscal decentralisation variables used in Table 3 above suggests that the relation between school autonomy and these measures is in fact negative, so places with more sub-central fiscal decentralisation tend to give less power to schools. Including school autonomy in the regression may therefore bias our coefficient estimates ("post-treatment" bias) of the relation with decentralisation measures. This is because school autonomy can also be understood to be part of the bundle of consequences of decentralisation measures. In those cases, when we estimate the effect by including several of the regressors, we are implicitly attempting to estimate the relation of decentralisation and outcomes for places for whom school autonomy does not change.

Table 7. Relation between PISA outcomes and decentraliation indicators with school autonomy

Model			Model		
0	School autonomy	0.197**	**C**	Sub-central tax	2.412***
		(0.08)		as pct of total tax	(0.476)
				School autonomy	0.648***
					(0.101)
				Subcentral tax X	**-0.0566*** **
				school autonomy	**(0.0108)**
	Observations	142		Observations	142
	R-squared	0.583		R-squared	0.674
A	Sub-central	0.522***	**D**	Sub-central tax autonomy (%)	2.280***
	decision-making share	(0.152)			(0.50)
	School autonomy	0.528		School autonomy	0.541***
		(0.347)			(0.09)
	Sub-central decision-making	**-0.00538**		Sub-central tax autonomy pct X	**-0.0571*** **
	share X school autonomy	**(0.00379)**		school autonomy	**(0.01)**
	Observations	142		Observations	142
	R-squared	0.627		R-squared	0.661
B	Sub-central revenue as pct of total	1.890***	**E**	Sub-central spend share	0.173
	revenue	-0.414			(0.148)
	School autonomy	0.800***		School autonomy	0.264
		-0.138			(0.219)
	Sub-central revenue X	**-0.0417*** **		Sub-central spending share X	**-0.00172**
	school autonomy	**(0.01)**		school autonomy	**(0.00315)**
	Observations	123		Observations	94
	R-squared	0.667		R-squared	0.426

Note: All models include country-year covariates as in Table 3 and year fixed effects. * p<0.10 ** p<0.05 *** p<0.01.

5.3 Differences in the effect of decentralisation by socioeconomic status

36. One claim that has been made in the United States in the context of locally provided public services (Trounstine, 2018) is that they exacerbate differences in socioeconomic gradients. Local bureaucracies, it is argued, are more easily captured by elites and so, to the extent that they have more influence, they will likely result in greater inequality in the performance of those public services. This is a concern that may apply to the case of education. While there are only limited cross-country outcome data on differences in performance, PISA 2015 provides the average results for members of each socioeconomic quartile. We implement models analogous to those in Table 3 using as a dependent variable the variation (measured in standard deviations) within country PISA scores. We show the results for mathematics (for other subjects, they are similar) in Table 8. The coefficients of the fiscal decentralisation variables are positive, but not significant. However, the link with administrative decentralisation (Model A) is positive and significant, with a small effect.

Table 8. Relation between PISA math standard deviations and different measures of decentralisation to sub-central entities

Model: main explanatory variable	(1)	(2)	(3)	(4)
A: Sub-central decision-making share	0.0433***	0.0471***	0.0433***	0.0471***
Standard error	(0.0145)	(0.0149)	(0.0145)	(0.0149)
Observations	179	179	179	179
R-squared	0.057	0.091	0.057	0.091
B: Sub-central revenue as pct of total	-0.00702	-0.00994	-0.00702	-0.00994
Standard error	(0.0335)	(0.0333)	(0.0335)	(0.0333)
Observations	140	140	140	140
R-squared	0.000	0.024	0.000	0.024
C: Sub-central tax as pct of total	0.0378	0.0356	0.0378	0.0356
Standard error	(0.0376)	(0.0375)	(0.0376)	(0.0375)
Observations	182	182	182	182
R-squared	0.004	0.039	0.004	0.039
D: Sub-central tax autonomy (%)	0.0378	0.0356	0.0378	0.0356
Standard error	(0.0376)	(0.0375)	(0.0376)	(0.0375)
Observations	182	182	182	182
R-squared	0.004	0.039	0.004	0.039
E: Sub-central spending share	0.0159	0.0150	0.0159	0.0150
Standard error	(0.0152)	(0.0150)	(0.0152)	(0.0150)
Observations	106	106	106	106
R-squared	0.008	0.029	0.008	0.029
Country-year covariates			X	X
Year fixed effects		X		X

Note: All linear regressions of the standard deviation in math PISA scores in 2003, 2006, 2009, 2012, 2015 on 1-100 measures of decentralisation. Covariates are spending on secondary school per pupil relative to GDP per capita, the PISA index of Student Economic, Cultural and Social Status in the country, the Immigrant share, the average student number per class, teacher salaries (PPP adjusted), average teacher working hours per week, total population and GDP per capita. Significance levels: * p<0.10 ** p<0.05 *** p<0.01.

5.4 Effects on education spending

37. A hypothesis that echoes some of the findings in the health care literature (OECD, 2018) is that more decentralised taxation and decision-making is associated with higher education spending. To test this hypothesis, we use spending per student as a share of GDP per capita as the dependent variable. In Table 9 we fit models similar to the main panel models A-D. All measures of decentralisation are associated with higher levels of education spending, although the size of the effect is relatively small: notably, in the specification with controls and fixed effects, the size of the effect on education spending is negligible and only significant for the decision-making share and tax autonomy.

Table 9. Relation between education spending per student and measures of decentralisation

Model		(1)	(2)	(3)	(4)
A	Sub-central decision-making share	0.0170*	0.00493	0.0224**	0.000239**
		(0.00912)	(0.00916)	(0.00901)	(0.0000926)
	Observations	152	152	152	158
	R-squared	0.021	0.797	0.144	0.093
B	Sub-central revenue as % of total	0.0355	0.0866	0.0365	0.000322
		(0.0353)	(0.188)	(0.0386)	(0.000352)
	Observations	122	122	122	160
	R-squared	0.011	0.772	0.083	0.610
C	Sub-central tax as % of total	0.0656**	0.209*	0.0597*	0.0000924
		(0.0330)	(0.123)	(0.0340)	(0.000356)
	Observations	149	149	149	153
	R-squared	0.030	0.795	0.132	0.061
D	Sub-central tax autonomy (%)	0.0797**	0.00503	0.0842**	0.000755*
		(0.0365)	(0.0294)	(0.0391)	(0.000400)
	Observations	153	153	153	189
	R-squared	0.039	0.793	0.147	0.719
	Country-year covariates			**X**	**X**
	Year fixed effects		**X**		**X**

Note: Linear regressions of average PISA scores in 2000, 2003, 2006, 2009, 2012, 2015 on 1-100 measures of decentralisation. Covariates are the PISA index of Student Economic, Cultural and Social Status, the immigrant share, the average student number per class, teacher salaries, average teacher working hours per week, total population and GDP per capita. Significance levels: * p<0.10 ** p<0.05 *** p<0.01.

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Annex A. Data sources

Table A 0.1. Sources of main variables

Data	Sources	Links
Sub-national spending, tax and revenue share	OECD Fiscal Decentralisation database	www.oecd.org/tax/federalism/fiscal-decentralisation-database.htm
SCH (School resources spending per student as percentage of GDP per capita)	OECD Education at a Glance (various years 2000-2015)	www.oecd.org/education/education-at-a-glance-19991487.htm
Percentage of decisions related to the production of educational services at the non-central government level	OECD Education at a Glance (various years 2000-2015)	www.oecd.org/education/education-at-a-glance-19991487.htm
Tax autonomy of decisions at different government levels	OECD Fiscal Decentralisation database	Data: www.oecd.org/tax/federalism/fiscal-decentralisation-database.htm See taxonomy here www.oecd.org/tax/federalism/42982242.pdf
IND (Economic Social and Cultural Status Indicator)	OECD PISA database (2000, 2003, 2006, 2009, 2012, 2015)	www.oecd.org/pisa/data/
PISA (Mean score, reading writing and arithmetic)	OECD PISA database (2000, 2003, 2006, 2009, 2012, 2015)	www.oecd.org/pisa/data/
Tax revenue as percentage of total tax revenue (State, central and local government)	OECD Revenue Statistics database	www.oecd.org/tax/
Tax revenue as percentage of total tax revenue (State, central and local government)	OECD Fiscal Decentralisation database	www.oecd.org/tax/federalism/fiscal-decentralisation-database.htm
Net teaching time	OECD	OECD.Stat
Average class size	OECD	OECD.Stat
Immigrant share	OECD	OECD.Stat
Teacher's teaching and working time	OECD	OECD.Stat
Average annual teachers' salaries	OECD	OECD.Stat

Annex B. Supplementary tables

Table A 0.1. Relation between PISA outcomes and different measures of decentralisation, including country fixed effects

Coefficient estimates (with country and year fixed effects and covariates)

Model		(1)	(2)
A	Sub-central	0.205*	0.204
	decision making share	(0.104)	(0.174)
	Observations	188	188
	R-squared	0.350	0.718
B	Sub-central revenue	0.501**	3.590
	as pct of total revenue	(0.153)	(3.001)
	Observations	160	160
	R-squared	0.263	0.610
C	Sub-central tax	0.270	2.959
	as pct of total tax	(0.189)	(2.707)
	Observations	189	189
	R-squared	0.329	0.710
D	Sub-central tax	0.157	-1.342*
	autonomy (%)	(0.192)	(0.647)
	Observations	189	189
	R-squared	0.326	0.719
E	Sub-central spend share	0.0181	-0.190
		(0.112)	(0.241)
	Observations	118	118
	R-squared	0.155	0.493
	Country-year covariates		X
	Country fixed effects	X	X
	Year fixed effects	X	X

Note: All linear regressions of average PISA scores in 2000, 2003, 2006, 2009, 2012, 2015 on measures of decentralisation scaled from 0-100. Covariates are spending on secondary schools per student relative to GDP per capita, the PISA index of Student Economic, Cultural and Social Status, the immigrant share, the average student number per class, teacher salaries, average teacher working hours per week, total population and GDP per capita. Significance levels: * p<0.10 ** p<0.05 *** p<0.01.

Table A 0.2. Relation between PISA outcomes and different measures of decentralization to sub-central entities, for math, reading and science

Model: main explanatory variable	Average	Math	Reading	Science
A: Sub-central decision-making share	0.330***	0.330***	0.205**	0.182*
Standard error	(0.0944)	(0.0944)	(0.104)	(0.105)
Observations	*196*	*190*	*199*	*138*
B: Sub-central revenue as pct of total	0.765***	0.649***	0.579***	0.476***
Standard error	(0.162)	(0.124)	(0.0994)	(0.128)
Observations	*162*	*157*	*163*	*116*
C: Sub-central tax as pct of total	1.041***	0.916***	0.726***	0.599***
Standard error	(0.193)	(0.148)	(0.122)	(0.163)
Observations	*199*	*191*	*202*	*140*
D: Sub-central tax autonomy (%)	0.964***	1.011***	0.822***	0.752***
Standard error	(0.150)	(0.144)	(0.121)	(0.159)
Observations	*198*	*191*	*200*	*139*
E: Sub-central spending share	0.132*	0.233***	0.154***	0.200***
Standard error	(0.0777)	(0.0538)	(0.0405)	(0.0442)
Observations	*119*	*116*	*120*	*89*
Country-year covariates				
Year fixed effects	X	X	X	X

Note: All linear regressions of average PISA scores in 2000, 2003, 2006, 2009, 2012, 2015 on 1-100 measures of decentralization. Covariates are spending levels in secondary school relative to GDP per capita, the PISA index of Student Economic, Cultural and Social Status in the country, the Immigrant share, the average student number per class, teacher salaries, average teacher working hours per week the total population and the GDP per capita. Significance levels: * p<0.10 ** p<0.05 *** p<0.01.

Table A 0.3. Relation between PISA outcomes and different measures of decentralisation, including school autonomy variable

Model: main explanatory variable	(1)	(2)
A: Sub-central decision-making share	0.370***	0.355***
	(0.109)	(0.109)
School autonomy	0.0159	0.0551
	(0.0853)	(0.0899)
Observations	188	188
R-squared	0.350	0.372
B: Sub-central revenue as pct of total	0.425**	0.416**
	(0.165)	(0.166)
School autonomy	0.221**	0.266***
	(0.09)	(0.08)
Observations	162	162
R-squared	0.586	0.615
C: Sub-central tax as pct of total	0.336*	0.349*
	(0.181)	(0.176)
School Autonomy	0.230**	0.278***
	(0.0914)	(0.0919)
Observations	198	198
R-squared	0.578	0.593
D: Sub-central tax autonomy (%)	0.136	0.220
	(0.147)	(0.157)
School Autonomy	0.172**	0.234***
	(0.0836)	(0.0845)
Observations	199	199
R-squared	0.571	0.587
E: Sub-central spending share	0.0897*	0.107**
	(0.0520)	(0.0496)
School Autonomy	0.165	-0.116
	(0.102)	(0.120)
Observations	119	119
R-squared	0.383	0.424
Country-year covariates		X
Year fixed effects	X	X

Note: All linear regressions of average PISA scores in 2000, 2003, 2006, 2009, 2012, 2015 on measures of decentralisation scaled from 0-100. Covariates are spending on secondary schools per student relative to GDP per capita, the PISA index of Student Economic, Cultural and Social Status, the immigrant share, the average student number per class, teacher salaries, average teacher working hours per week, total population and GDP per capita. Significance levels: * p<0.10 ** p<0.05 *** p<0.01.