Risk and Spending in Brazilian Municipal School Networks

Which needs predict lower school outcomes, and does municipal education spending follow them?

Bruce D. Baker · University of Miami · October 2026

Summary

This report applies the first step of the framework for evaluating and reforming education finance systems (Baker, Atchison & Levin, 2026) to Brazil, following the parallel analysis of Mexico. **Risk modeling** identifies which measurable student and community characteristics most strongly predict lower school outcomes. **Spending modeling** asks whether spending is higher where those risks are concentrated, after accounting for cost factors that are not student need: network and school size, remoteness, labor costs and the mix of grade levels. Because Brazil reports spending by government network rather than by school, the spending analysis covers the 5,560 municipal school networks that enroll most of the country's preschool and primary pupils. Risk modeling is conducted at the school level.

- **Student socioeconomic status and municipal poverty dominate.** The school-level student SES index produced by INEP from SAEB questionnaires (INSE) alone explains about half of the variation in school outcomes in early primary grades. The share of the municipal population registered as poor in the Cadastro Único explains about a third. A composite need index separates schools at the 10th and 90th percentiles of need by about two standard deviations in outcomes, roughly twice the gap found in Mexico.
- **Nationally, municipal spending is sharply regressive.** Networks at the 90th percentile of need spend about 65% as much per pupil as networks at the 10th percentile, holding grade mix and year constant. Accounting for network and school size, remoteness and local wages raises the ratio to 0.83.
- **The gap is mostly between states.** Comparing networks within the same state, the ratio is 0.96, close to neutral. State averages of need and spending are strongly negatively correlated ($r = -0.78$). FUNDEB pools and redistributes resources within each state but only partly offsets the differences between states.
- **Within states, spending follows revenue capacity, not need.** Even comparing networks in the same state with similar need and costs, each 10% more tax and constitutional-transfer revenue per resident is associated with about 2.6% more spending per pupil. The system is neither progressive nor fiscally neutral.
- **The new FUNDEB moved within-state distributions toward neutrality.** The adjusted within-state ratio rose from 0.91 in 2019 to 1.00 in 2022 and 0.99 in 2023, after the 2021 reform added the VAAT complementation targeted at networks with the lowest total resources. The national gross ratio improved only modestly, from 0.62 to 0.68.

Spending is measured as liquidated basic-education expenditure reported by each municipality to SIOPE (FNDE), divided by municipal network enrollment from the Censo Escolar. State networks, which enroll most lower- and upper-secondary students, are reported only as 27 state totals and are not analyzed here.

1. Framing: Equal Opportunity, Risk and Spending

1.1 The purpose of a school finance system

This report starts from the purpose of school finance systems as Baker, Atchison and Levin (2026) define it: to deliver the resources schools need to give every child an equal opportunity to achieve common, adequate outcome goals. **Equal opportunity** holds when children's chances of reaching common goals do not depend on their backgrounds or where they attend school. **Adequacy** holds when those goals are high enough for children to become productive, self-determined and civically engaged adults. The two objectives are separable, and equal opportunity can be pursued even where adequacy goals are loosely defined or unfunded. The framework rests on the now well-established evidence that money spent on schooling affects children's achievement, attainment and later-life outcomes (Baker & Knight, 2025; Jackson & Mackevicius, 2024).

1.2 From spending parity to equal opportunity

Early school finance standards focused on fiscal neutrality, the principle that the quality of a child's education should not depend on local wealth (Coons, Clune & Sugarman, 1969), and on horizontal and vertical equity, the equal treatment of equals and unequal treatment of unequals (Berne & Stiefel, 1984). As common standards and assessments spread, attention shifted to outcomes (Clune, 1994; Underwood, 1994). Critiques of those frames showed that measured horizontal equity penalizes differentiation, that vertical equity requires arbitrary categories, and that minimal adequacy leaves those who receive only the minimum at a positional disadvantage (Koski & Reich, 2006; Baker & Green, 2008, 2012). The unified framework treats the common outcome goals as the point of equal treatment. Children expected to meet the same standards are similarly situated with respect to them, and equal opportunity requires differentiating resources by the obstacles they face. A group whose chances of meeting common goals are systematically lower has a claim on additional resources, and the evidence for that claim is the relationship between the group's characteristics and its outcomes.

1.3 Brazil's commitments and finance system

Brazil's 1988 Constitution makes education a right of all and a duty of the State (Art. 205) and requires equal conditions for access to and continuation in school and a guaranteed standard of quality (Art. 206). It assigns the Union a redistributive and supplementary role to equalize educational opportunities and ensure a minimum standard of quality (Art. 211, §1). The 2020 amendment that made FUNDEB permanent (EC 108/2020) added that the minimum quality standard should reflect adequate conditions of provision, with the Custo Aluno Qualidade (CAQ) as its reference. These provisions express both an equal-opportunity obligation and an adequacy benchmark of the kind the framework operationalizes.

Brazil's finance system differs from Mexico's centrally financed payroll in ways that matter for the analysis. Municipalities and states must devote at least 25% of their tax and constitutional-transfer revenue to education (maintenance and development of education, MDE). A large share of that revenue is pooled in a FUNDEB fund for each state and redistributed among the state and its municipalities in proportion to weighted enrollment. Federal complementation tops up the poorest state funds (VAAF), and since 2021 also the individual networks with the lowest total per-pupil resources (VAAT), rising to 23% of the fund by 2026. Because FUNDEB equalizes within states but each state's fund reflects its own tax base, the system is designed to produce more equality within

states than between them. Because only part of municipal revenue passes through FUNDEB, spending can also still track local revenue capacity. Both features are tested below.

1.4 Risk and spending analysis

- **Step 1a: risk (needs) analysis.** Construct a comprehensive outcome measure and test which candidate measures of student and community need most strongly predict lower outcomes: Outcomes = f(Needs, Context). Measures must be consistently available across schools and years and usable in policy. Those with the strongest predictive validity carry forward.
- **Step 1b: spending analysis.** Relate current spending to need while accounting for contextual cost factors such as scale, grade level, remoteness and labor costs: Spending = f(Needs, Context). A system in which spending rises with need is progressive; one in which it falls is regressive. Step 1b also includes a fiscal-neutrality analysis relating spending to local revenue capacity: Spending = f(Income, Tax price, Tastes). Unlike Mexico's federally financed payroll, Brazil's municipal networks are financed substantially from local and shared revenue, so that analysis applies here.

Step 2, cost modeling and the translation of costs into allocation weights, is left for subsequent work. In Brazil it would provide an empirical counterpart to the CAQ.

1.5 Data

Table 1. Data sources

Domain	Source	Level / years	Use
Outcomes	INEP SAEB/IDEB school results	School; 2017, 2019, 2021, 2023	SAEB math and Portuguese means; approval rates
Student SES	INEP INSE (SAEB questionnaires)	School; 2019, 2021, 2023	Need measure
School characteristics	INEP Censo Escolar microdata	School; 2019–2023	Enrollment by level, race, location, teachers
Spending	FNDE SIOPE (function 12 by subfunction; indicators)	Municipality; 2019–2023	Basic-education spending; revenue base
Teacher pay	INEP remuneração média dos docentes	Municipal network; 2021	Pay standardized to 40 hours
Community need	IBGE Census 2022; MDS CadÚnico/Bolsa Família	Municipality; 2022–2023	Need measures
Economy and remoteness	IBGE GDP, CEMPRE wages, municipal coordinates	Municipality; 2021–2022	Labor cost, capacity, distance

Note: Monetary values are nominal reais. Year effects absorb inflation and statutory changes.

2. Risk Modeling

2.1 The outcome factor score

Outcomes are summarized in a school outcome factor score. Components are SAEB mean proficiency in mathematics and Portuguese for each test year (2017, 2019, 2021 and 2023; the two subjects are standardized and averaged within year) and the average approval-rate indicator across those years. Weights are Thurstone factor-score weights from a one-factor model on the correlation matrix, and the index is standardized within level. The analysis covers municipal-network schools at two levels: early primary (anos iniciais, grades 1–5) and lower secondary (anos finais, grades 6–9).

Table 2. Outcome factor score: components, loadings and weights

Component	Factor loading	Score weight	Schools with component
Early primary (anos iniciais)			
SAEB 2017	0.88	21.8%	34,263
SAEB 2019	0.92	33.3%	35,146
SAEB 2021	0.88	21.4%	27,371
SAEB 2023	0.85	19.3%	35,501
Approval rate (mean)	0.51	4.1%	45,664
Lower secondary (anos finais)			
SAEB 2017	0.84	19.0%	14,453
SAEB 2019	0.89	31.2%	16,330
SAEB 2021	0.88	27.5%	11,835
SAEB 2023	0.82	19.0%	17,220
Approval rate (mean)	0.36	3.4%	23,784

Note: Municipal-network schools. The index requires at least one SAEB year. Coverage: 35,204 early-primary and 16,016 lower-secondary schools.

In contrast to Mexico, school results are highly consistent across test years: correlations between SAEB years range from 0.67 to 0.84, so the multi-year index is a reliable measure of school performance. Approval rates correlate 0.3–0.46 with achievement and receive about 3–4% of the weight. The equal-weight version correlates 0.97–0.98 with the factor version.

2.2 Candidate need measures

Brazil offers two kinds of need measures that Mexico lacks. INEP's INSE summarizes the family socioeconomic status of each school's tested students, and the Cadastro Único registers low-income families in every municipality. The candidate measures include school-level INSE, enrollment by race (Black and pardo, Indigenous), special-education enrollment and school location (rural, Indigenous land, quilombola area, agrarian settlement). Municipal measures from the 2022 Census include adult literacy, years of schooling, school attendance at ages 4–5 and 15–17, racial composition and urbanization. Others are poverty and extreme-poverty rates from the Cadastro Único, Bolsa Família coverage, GDP per capita, formal wages and employment, density and distance to a city of 100,000. All are oriented so that higher values mean more need.

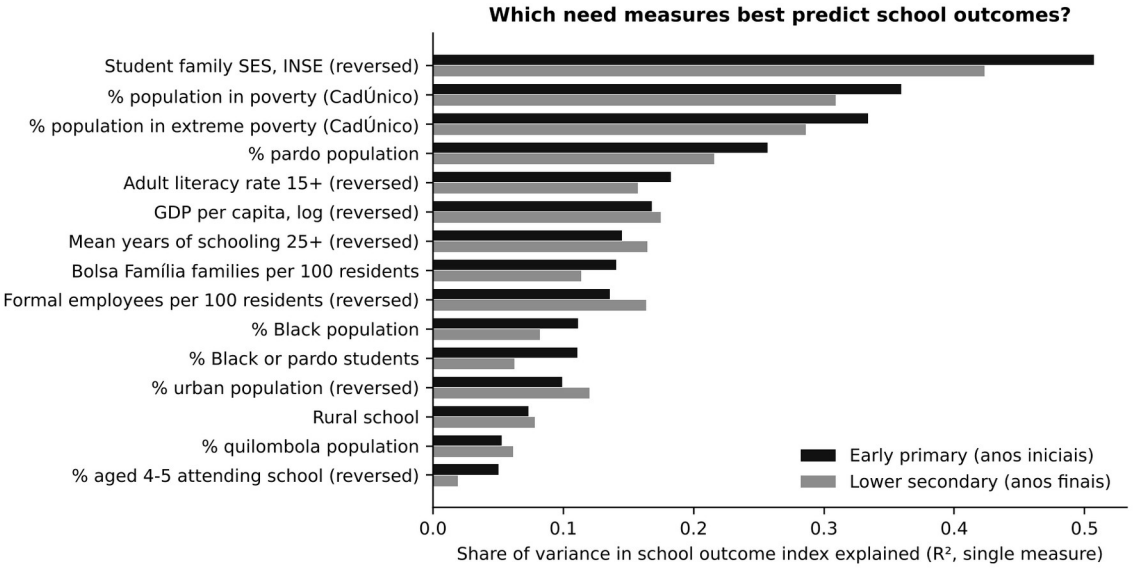
Table 3. Predictive validity of need measures (univariate)

Need measure (higher = more need)	EP std. β	EP R^2	EP incr. R^2	LS std. β	LS R^2	LS incr. R^2
Student family SES, INSE (reversed)	-0.71	0.507	0.208	-0.65	0.423	0.188
% population in poverty (CadÚnico)	-0.60	0.359	0.061	-0.56	0.309	0.046
% population in extreme poverty (CadÚnico)	-0.58	0.334	0.055	-0.53	0.286	0.043
% pardo population	-0.51	0.257	0.027	-0.46	0.216	0.020
Adult literacy rate 15+ (reversed)	-0.43	0.182	0.015	-0.40	0.157	0.011
GDP per capita, log (reversed)	-0.41	0.168	0.016	-0.42	0.175	0.012
Mean years of schooling 25+ (reversed)	-0.38	0.145	0.014	-0.41	0.165	0.010
Bolsa Família families per 100 residents	-0.38	0.141	0.023	-0.34	0.114	0.017
Formal employees per 100 residents (reversed)	-0.37	0.136	0.014	-0.40	0.164	0.010
% Black population	-0.33	0.111	0.012	-0.29	0.082	0.015
% Black or pardo students	-0.33	0.111	0.007	-0.25	0.063	0.003
% urban population (reversed)	-0.32	0.099	0.007	-0.35	0.120	0.006
Rural school	-0.27	0.073	0.005	-0.28	0.078	0.006
% quilombola population	-0.23	0.053	0.003	-0.25	0.062	0.005
% aged 4-5 attending school (reversed)	-0.22	0.050	0.022	-0.14	0.019	0.008

Average formal wage (reversed)	-0.19	0.036	0.000	-0.23	0.051	0.000
Distance to city of 100k+, log	-0.18	0.032	0.002	-0.26	0.070	0.003
% Indigenous population	-0.16	0.026	0.008	-0.13	0.016	0.005
% Indigenous students	-0.12	0.014	0.007	-0.10	0.010	0.006
School on Indigenous land	-0.08	0.006	0.003	-0.08	0.006	0.004

Note: EP = early primary; LS = lower secondary. Enrollment-weighted regressions of the outcome index on each measure (34,636 and 15,666 schools). Incr. R^2 = increase over a base model with state fixed effects and log enrollment (and its square). INSE is drawn from questionnaires administered with SAEB, so part of its association with outcomes is shared measurement.

Figure 1. Variance in school outcomes explained by each need measure



Student SES (INSE) is by far the strongest single predictor, explaining 51% of the variance in early-primary outcomes and 42% in lower secondary, and it remains strong after state and size controls (incremental R^2 about 0.2). Among community measures, the Cadastro Único poverty rate is the strongest (R^2 0.36 and 0.31), well ahead of GDP per capita, adult literacy and schooling. A dominance (Shapley) decomposition attributes about 45% of the explained variance among the best measures to INSE and 20% to municipal poverty. Racial composition adds independent information: the share of the municipal population that is pardo or Black, and the share of students who are Black or pardo, remain predictive after poverty is accounted for. Indigenous-land and quilombola schools score lower, conditional on other measures.

2.3 Multivariate risk models and the composite need index

Table 4. Regression models of the school outcome index on need measures

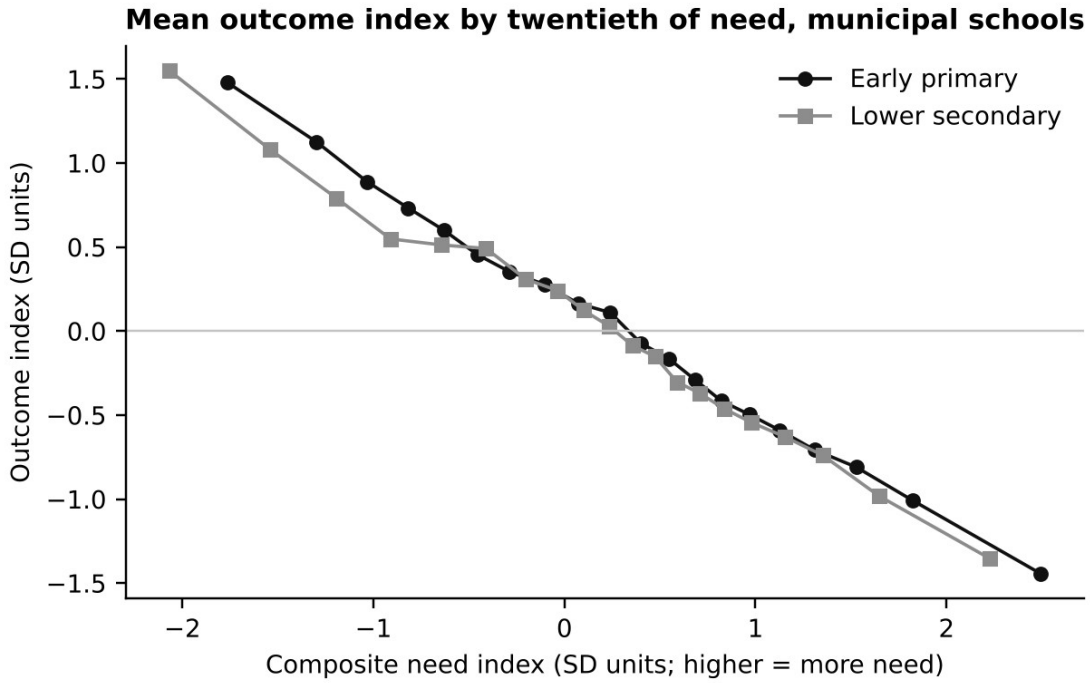
Measure	EP: M1	EP: M2	EP: M3	EP: M4	LS: M1	LS: M2	LS: M3	LS: M4
Student family SES, INSE (SD)	0.865***		0.929***		0.875***		0.878***	
	(0.021)		(0.019)		(0.026)		(0.025)	
% Black or pardo students	0.000				0.001			
	(0.001)				(0.001)			
Rural school	-0.015	-0.187***			0.045	-0.173***		
	(0.024)	(0.025)			(0.027)	(0.026)		
School on Indigenous land	-0.450***	-0.863***			-0.788***	-1.292***		
	(0.106)	(0.127)			(0.184)	(0.353)		

School in quilombola area	-0.121**	-0.241***			-0.220***	-0.319***		
	(0.040)	(0.049)			(0.047)	(0.051)		
% population in poverty (CadÚnico)	-0.013***	-0.022***			-0.010***	-0.017***		
	(0.002)	(0.002)			(0.002)	(0.002)		
Adult literacy rate 15+	-0.024***	-0.004			-0.024***	0.002		
	(0.005)	(0.008)			(0.004)	(0.008)		
Mean years of schooling 25+		-0.024				-0.031		
		(0.026)				(0.027)		
% aged 4–5 attending school	0.013***				0.011***			
	(0.002)				(0.002)			
% Black population (municipality)		-0.026***				-0.029***		
		(0.004)				(0.003)		
% pardo population (municipality)		-0.011***				-0.016***		
		(0.002)				(0.002)		
% Indigenous population (municipality)	-0.006**	-0.021***			-0.005	-0.021***		
	(0.002)	(0.003)			(0.003)	(0.004)		
Composite need index (risk_need)				-0.715***				-0.721***
				(0.017)				(0.022)
R^2	**0.655**	**0.517**	**0.635**	**0.644**	**0.601**	**0.480**	**0.584**	**0.588**
R^2, base (state FE + size)	0.427	0.427	0.427	0.427	0.396	0.396	0.396	0.396
Schools	34,636	34,636	34,636	34,636	15,666	15,666	15,666	15,666

*Note: Dependent variable: outcome factor score (SD). M1: school and municipal measures; M2: community measures only (no INSE); M3: INSE only; M4: composite index. All models include state fixed effects and log enrollment (and its square), weighted by enrollment, with standard errors clustered by municipality. Coefficients on individual measures in M1–M2 are conditional on the others and on state effects; several community measures are highly collinear. *** p<.001, ** p<.01, * p<.05.*

Need measures raise explained variance from 0.43 (state and size alone) to 0.66 in early primary and from 0.40 to 0.60 in lower secondary. INSE alone (M3) accounts for most of that gain. Community measures alone (M2) recover a little under half of it. The composite need index used in the spending analysis was built by forward selection on five-fold cross-validated R^2 with folds grouped by municipality. The full model (INSE, preschool attendance, municipal and student racial composition and Bolsa Família coverage) reaches a cross-validated R^2 of 0.56 for early primary and 0.49 for lower secondary. A community-only model (CadÚnico poverty, racial composition, preschool attendance, rurality and Indigenous enrollment) reaches 0.44 and 0.40. Moving from the 10th to the 90th percentile of the composite index is associated with outcomes about 2.0 standard deviations lower at both levels (Figure 2).

Figure 2. Mean outcome index by twentieth of the composite need index



Note: Enrollment-weighted means within 20 equal-count bins. Municipal-network schools with an outcome index.

For the spending analysis, each municipal school is assigned a predicted need value. The early-primary full model is used where INSE is available; elsewhere, including most preschools, the community-only model is used. Inputs are bounded to the support of the estimation sample. The network need index is the enrollment-weighted average across the network's schools.

3. Spending Modeling

3.1 The spending measure

Municipal spending is measured as liquidated expenditure in education function 12 reported to SIOPE for the subfunctions serving basic education: Ensino Fundamental (361), Educação Infantil (365), youth and adult education (366), special education (367), school meals (306), school transport (782) and general administration (122). This total is divided by municipal-network enrollment from the Censo Escolar. Secondary, vocational and higher-education subfunctions, pensions and culture or sport are excluded. Network-years with fewer than 100 pupils, or with spending per pupil below 40% or above 300% of the state-year median, are excluded (about 0.2% of observations). The analytic sample contains 27,718 network-years for 5,560 municipalities, 2019–2023. Pupil-weighted mean spending per pupil is R$ 9,619.

SIOPE also publishes a calculated indicator of investment per pupil. It correlates 0.92–0.95 with the measure used here for 2019–2022 but only 0.58 in 2023, when its definition appears to have changed, so the report uses the directly computed measure.

3.2 Descriptive patterns

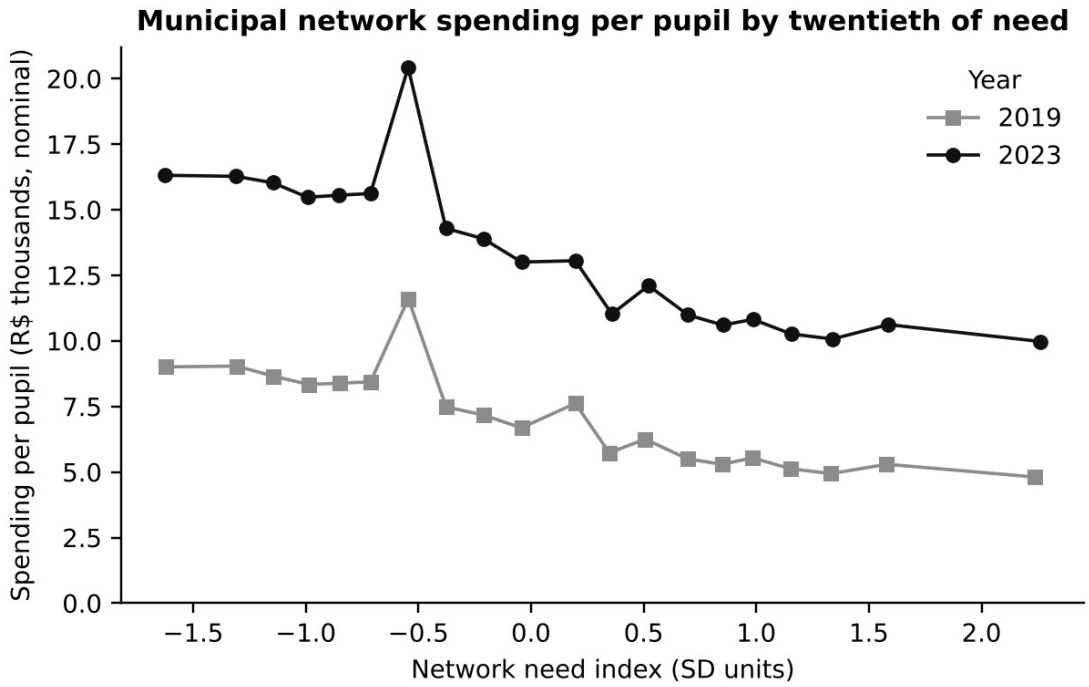
Table 5. Municipal networks by quintile of need, 2023

Need quintile	Mean need	Spending per pupil (R$)	Pupils per teacher	Median enroll.	Pupils in rural schools	Revenue base per resident (R$)	GDP per capita (R$)	Avg. formal wage (R$)
Q1 (lowest need)	-1.22	15,999	14.1	912	4%	4,317	51,294	2,942
Q2	-0.61	17,078	16.2	1,172	5%	4,063	46,158	3,097
Q3	0.14	12,510	19.0	1,224	12%	3,136	32,803	2,756
Q4	0.75	11,179	18.6	1,984	27%	2,542	20,305	2,226
Q5 (highest need)	1.61	10,247	17.4	2,927	44%	2,255	13,624	2,175

Note: Quintiles contain equal numbers of networks; other figures pupil-weighted except median enrollment. Revenue base = tax and constitutional-transfer revenue subject to the 25% MDE requirement.

In 2023 the lowest-need fifth of networks spent R$ 15,999 per pupil and the highest-need fifth R$ 10,247, about 64% as much. Higher-need networks also have far less revenue per resident, lower GDP and wages, and more pupils in rural schools. Figure 3 shows the gradient in 2019 and 2023.

Figure 3. Municipal network spending per pupil by twentieth of need, 2019 and 2023



Note: Pupil-weighted means within 20 equal-count bins. The spike near −0.5 reflects the São Paulo city network.

3.3 Model specification

Spending per pupil(m,t) = f(Need(m), Grade mix(m,t), Size(m,t), Remoteness(m), Labor cost(m), Year(t), State(s))

- **Need:** the network need index. Alternatives use the CadÚnico poverty rate or the community-only index.
- **Grade mix:** shares of enrollment in creche, pre-school, lower secondary, EJA and exclusive special education (early primary is the reference).
- **Scale:** network enrollment bands (under 500 to 25,000 or more) and average school-size bands (under 50 to 400 or more pupils).

- **Remoteness:** log distance to the nearest city of 100,000 or more, log population density and the share of pupils in rural schools.
- **Labor cost:** log average formal monthly wage in the municipality (CEMPRE). In Brazil this measure also reflects local prosperity and capacity, so its coefficient should not be read as a pure cost effect.
- **Year and state fixed effects.** State effects (Model S4) limit comparisons to networks in the same state, which share a FUNDEB fund.

Models are estimated by enrollment-weighted least squares on the network-year panel, with standard errors clustered by municipality, in levels and in logs. Progressiveness is summarized as predicted spending at the 90th percentile of need divided by that at the 10th (pupil-weighted percentiles), with other variables at their means.

3.4 Results

Table 6. Spending models: municipal spending per pupil (R$) on need and cost factors

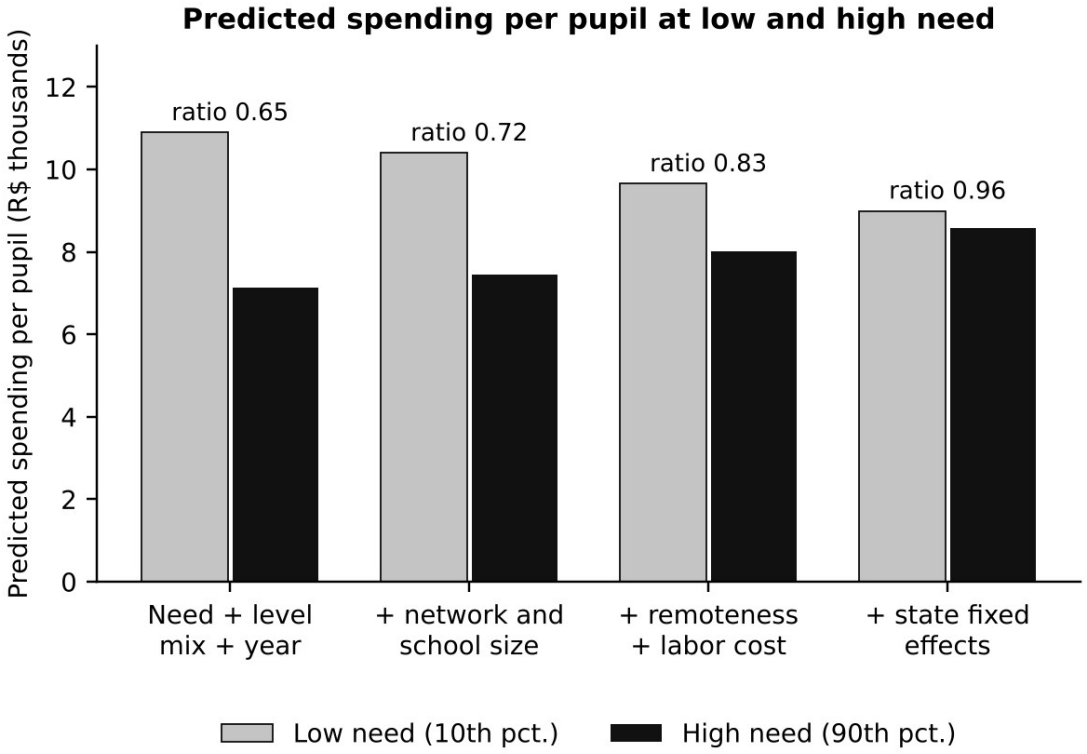
	S1: Need, grade mix, year	S2: + Size	S3: + Remoteness, labor cost	S4: + State FE
Network need index (per SD)	-1,669***	-1,304***	-721***	-81
% creche	-45	13	4	17
% pre-school	330	309*	242*	209**
% lower secondary	68	67	46	67*
% EJA	60	61	44	51*
% special education	21	10	58	153***
Network < 500 pupils (vs. 25,000+)		752	3,787***	3,229***
Network 500–999		-1,249**	1,628***	1,044**
Network 1,000–2,499		-1,902***	613*	39
Network 2,500–4,999		-1,997***	71	-503
Network 5,000–9,999		-1,985***	-170	-633*
Network 10,000–24,999		-2,138***	-442	-832**
Avg. school < 50 pupils (vs. 400+)		1	1,548*	1,709**
Avg. school 50–99		-99	1,248**	1,409***
Avg. school 100–199		-465	731*	848**
Avg. school 200–399		-600	326	400
Log distance to city ≥100k			237**	198***
Log density			426***	286***
% pupils in rural schools			2	3
Log average formal wage			6,177***	5,449***
Year fixed effects	Yes	Yes	Yes	Yes
State fixed effects	No	No	No	Yes
R^2	0.59	0.64	0.74	0.77
Predicted R$ per pupil, p10 need	11,815	11,334	10,568	9,726
Predicted R$ per pupil, p90 need	7,488	7,955	8,699	9,516
Ratio, p90 ÷ p10 (linear)	**0.63**	**0.70**	**0.82**	**0.98**
Ratio, p90 ÷ p10 (log model)	**0.65**	**0.72**	**0.83**	**0.96**
Implicit need weight, p10→p90	**-45%**	**-35%**	**-19%**	**-2%**

*Note: 27,718 network-years, 5,560 municipalities, 2019–2023. Enrollment-weighted least squares; standard errors clustered by municipality (*** p<.001, ** p<.01, * p<.05). Need percentiles are pupil-weighted (p10 = -1.12, p90 = 1.47). Implicit weight = coefficient × (p90 − p10) ÷ mean spending per pupil (R$ 9,619).*

Holding only grade mix and year constant (S1), networks at the 90th percentile of need spend 0.65 times as much per pupil as those at the 10th, an implicit need weight of -45%. Unlike Mexico, accounting for scale makes the picture less regressive rather than more: small networks and small schools receive more per pupil, but high-need networks in Brazil tend to be larger, not smaller (median enrollment of about 2,900 in the highest-need quintile against 900 in the lowest). The ratio rises to 0.72. Adding remoteness and local wages raises it to 0.83. Wages carry a large positive coefficient, which largely reflects the greater fiscal capacity of high-wage municipalities.

The decisive step is the state fixed effects (S4). Comparing networks within the same state, the ratio is 0.96. Most of the national gap therefore arises because high-need networks are concentrated in states (mainly in the North and Northeast) where spending per pupil is lower overall. Within states, spending is close to neutral with respect to need. It is neither markedly regressive nor progressive.

Figure 4. Predicted spending per pupil at the 10th and 90th percentiles of need, by model

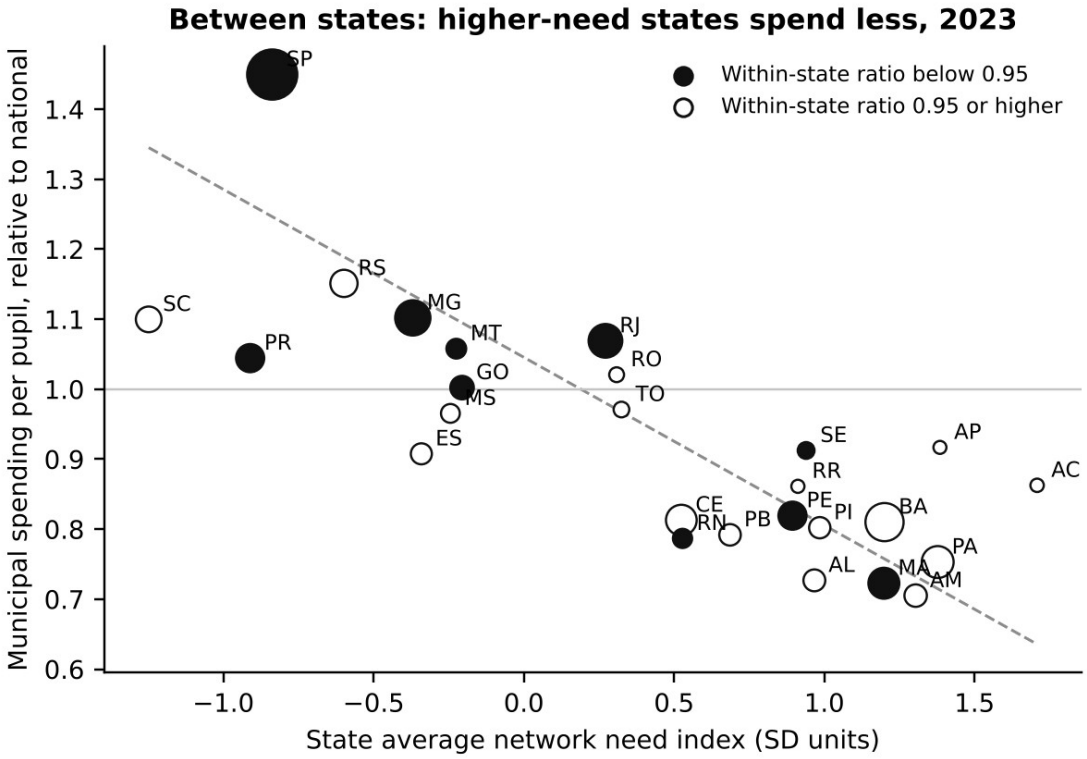


Note: Log models; predicted values at pupil-weighted means of other covariates.

3.5 Between states

Figure 5 places each state by average network need and average spending per pupil in 2023. The relationship is strongly negative (r = −0.78). São Paulo's municipal networks spend about 45% more per pupil than the national average, and Santa Catarina, Rio Grande do Sul and Minas Gerais about 10–15% more. Maranhão, Amazonas, Alagoas and Pará, among the highest-need states, spend 25–30% less. Federal complementation through the VAAF and VAAT raises the floor, but the remaining between-state disparities are large.

Figure 5. State average need vs. municipal spending per pupil, 2023

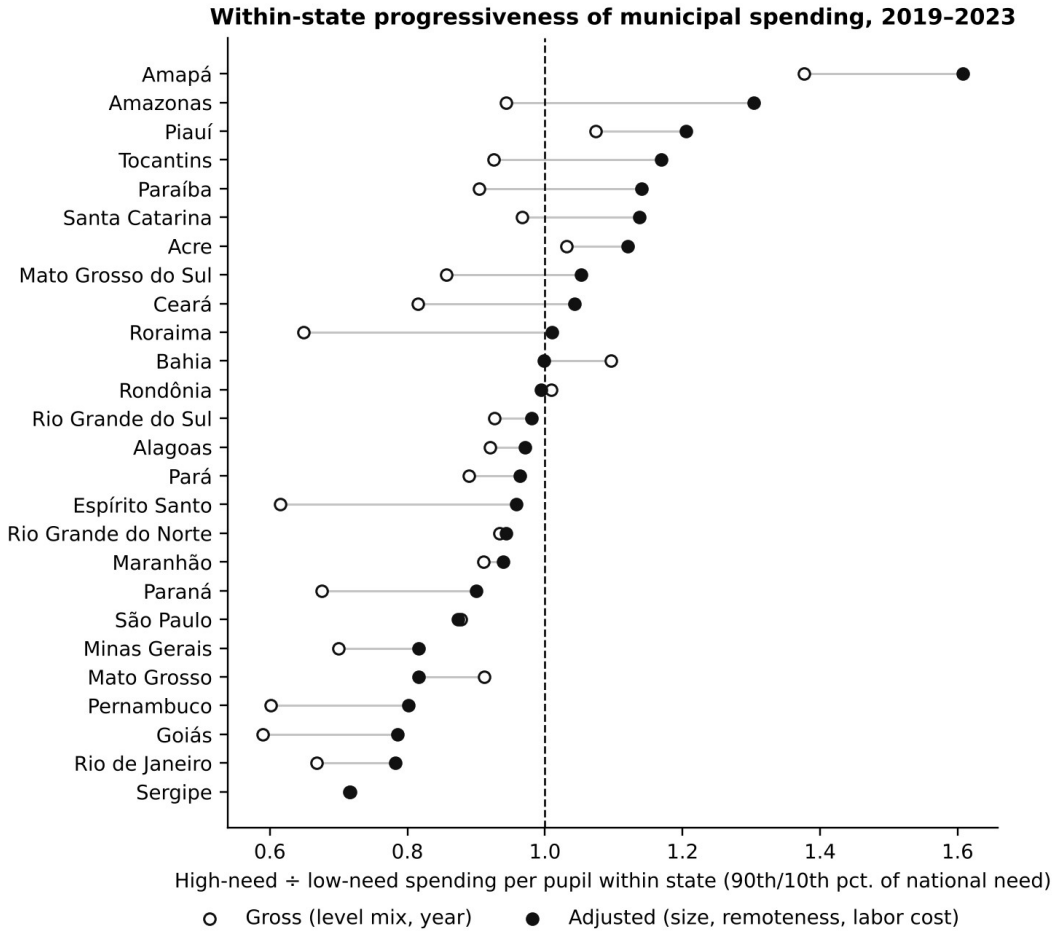


Note: Circle size proportional to municipal-network enrollment. The Federal District has no municipal network.

3.6 Within states

Estimating a separate need slope for each state shows wide variation within states (Figure 6). Adjusted ratios range from 0.72 in Sergipe to 1.61 in Amapá. 10 of 26 states show ratios at or above 1.0, mostly in the North and Northeast, where VAAT complementation is concentrated. The most regressive within their borders are Sergipe (0.72) and Pernambuco (0.80) in the Northeast, together with Rio de Janeiro (0.78), Goiás (0.79), Mato Grosso (0.82) and Minas Gerais (0.82).

Figure 6. Within-state progressiveness of municipal spending, by state, 2019–2023

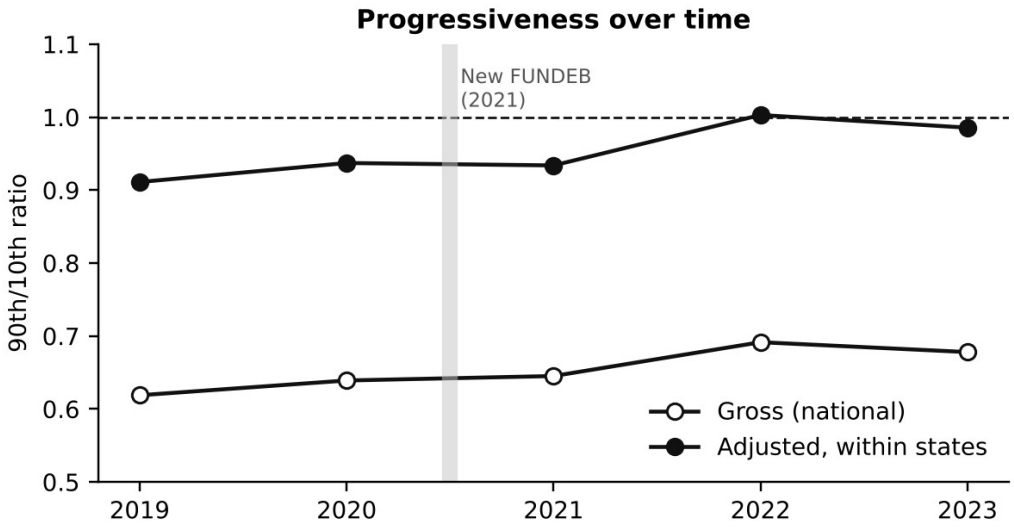


Note: Need-by-state interactions in Model S4 (adjusted) and in a model with grade mix, year and state effects only (gross). National need percentiles.

3.7 Changes over time

The new FUNDEB took effect in 2021, adding the VAAT complementation directed at the networks with the lowest total per-pupil resources and increasing federal complementation each year. The adjusted within-state ratio rose from 0.91 in 2019 and 0.93 in 2021 to 1.00 in 2022 and 0.99 in 2023. The national gross ratio improved from 0.62 to 0.68. The timing is consistent with the reform moving within-state distributions toward neutrality, though the analysis is descriptive and other changes in the same years (the teacher salary floor increases and the 2022 revenue surge) also affected spending.

Figure 7. Progressiveness of municipal spending over time

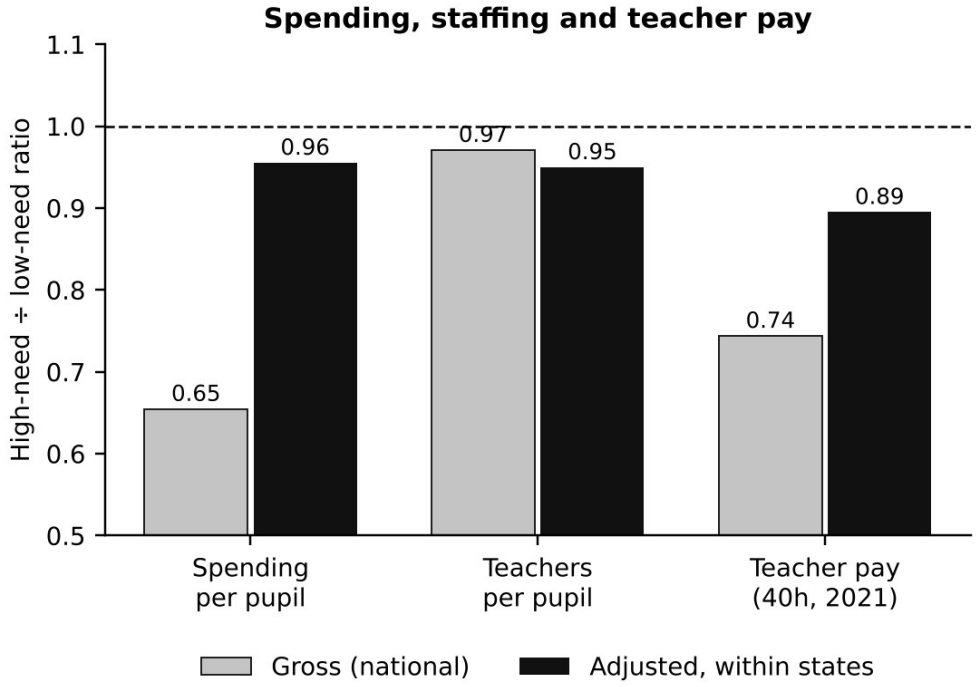


Note: Need-by-year interactions; gross = grade mix and year only; adjusted = Model S4.

3.8 Staffing and teacher pay

High-need networks do not have markedly fewer teachers per pupil: the ratio is 0.97 gross and 0.95 within states. Teacher pay differs much more. In 2021 municipal teachers' pay standardized to 40 hours in high-need networks was 0.74 times that in low-need networks nationally and 0.89 within states. The national spending gap is therefore largely a salary gap between richer and poorer states and municipalities. Mexico's gap, by contrast, was mainly in the number of positions.

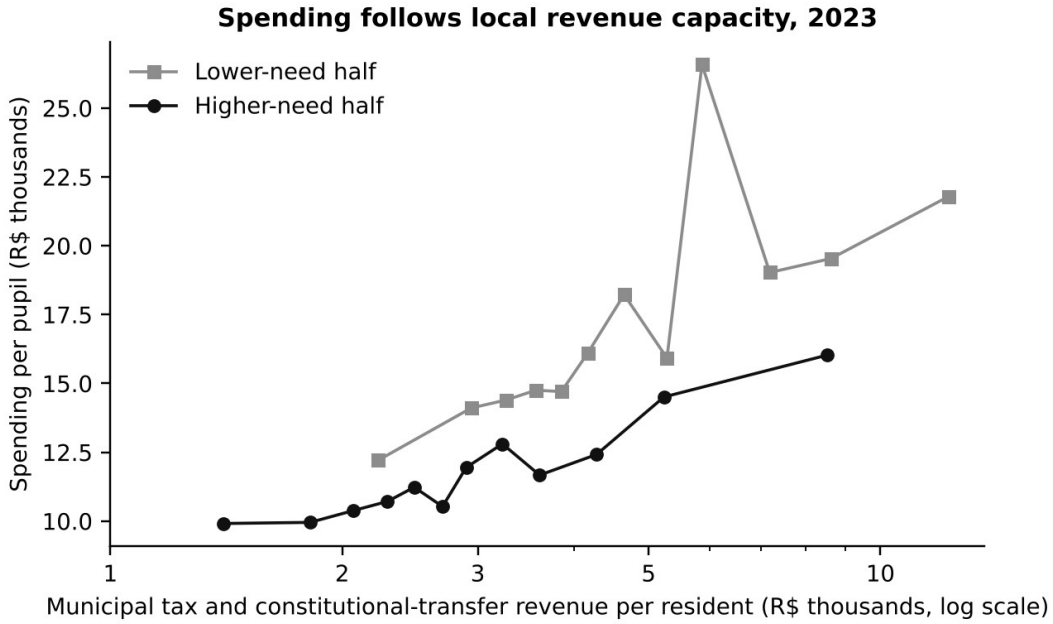
Figure 8. Spending, staffing and teacher pay: high-need ÷ low-need ratios



3.9 Fiscal neutrality

Step 1b of the framework also asks whether spending depends on local capacity to raise revenue. Regressing log spending per pupil on log tax-and-transfer revenue per resident and log GDP per capita (with grade mix and year) yields elasticities of 0.26 and 0.13. Adding need, cost factors and state fixed effects leaves the revenue elasticity essentially unchanged at 0.26 (SE 0.025), while GDP per capita and need become negligible. Among networks in the same state with similar need, size and remoteness, those with more revenue per resident spend more per pupil. The 10th and 90th percentiles of revenue per resident are R$ 1,211 and R$ 4,445, implying about 41% more spending per pupil at the 90th percentile. The share of municipal revenue that remains outside FUNDEB, and royalties and other transfers concentrated in particular municipalities, keep spending tied to local capacity.

Figure 9. Spending per pupil by revenue per resident, higher- and lower-need networks, 2023



3.10 Robustness

- **Weighting.** Weighting networks equally gives an adjusted ratio of 0.90, against 0.96 pupil-weighted.
- **Need measure.** Using the CadÚnico poverty rate instead of the composite gives an adjusted within-state ratio of 0.87. Using the community-only index gives 0.89. Both are somewhat more regressive than the composite.
- **Functional form.** Linear and log models give similar ratios (Table 6).
- **Coverage.** State networks, which enroll most secondary students, are not included, and SIOPE reporting quality varies across municipalities. Brazil has no national school-level spending data, so differences between schools within a network cannot be assessed.

4. Conclusions and Implications

Risk in Brazil is strongly concentrated and well measured. Student socioeconomic status, municipal poverty and racial composition together account for half or more of the variation in school outcomes,

and a composite index identifies a gap of about two standard deviations between low- and high-need schools. Municipal spending does not respond to that need. Nationally it is sharply regressive, because high-need networks are concentrated in states with less revenue per pupil. Within states, where FUNDEB redistributes, spending is roughly neutral with respect to need and continues to track local revenue capacity. In the framework's terms, Brazil's system achieves partial fiscal equalization within states but no vertical differentiation for need, and large between-state disparities remain.

The new FUNDEB has moved within-state distributions toward neutrality, and its federal complementation is the only component explicitly designed to reach the networks with the least. Moving from neutrality to progressiveness would require weighting FUNDEB and VAAT allocations by measured need, such as INSE or the Cadastro Único poverty rate, in addition to enrollment, together with a larger and more need-targeted federal role between states. Cost modeling, which would estimate how much more high-need networks need to reach common goals, would give the Custo Aluno Qualidade an empirical basis.

Technical Notes

- Outcome index: one-factor model on the pairwise correlation matrix of standardized components; Thurstone weights, negatives set to zero and normalized. Schools need at least one SAEB year and at least half of the total weight available.
- Risk models: enrollment-weighted least squares on municipal-network schools with an outcome index; state fixed effects and a quadratic in log enrollment; standard errors clustered by municipality.
- Composite need index: forward selection on 5-fold cross-validated R^2 (folds by municipality), stopping when the gain falls below 0.002; index = minus predicted outcome, standardized; inputs bounded to the 0.5th–99.5th percentiles of the estimation sample.
- Spending: SIOPE function 12 liquidated expenditure (subfunctions 361, 365, 366, 367, 306, 782, 122) ÷ municipal-network enrollment (Censo Escolar, schools in operation). Revenue base = SIOPE indicator 8.1 (required MDE application) ÷ 0.25, available 2020–2023.
- Remoteness: great-circle distance from the municipal seat to the nearest municipality of 100,000+ residents (2022).
- Data files: br_network_panel.dta (municipality-year) and br_school_file.dta (school, by level), with variable labels.

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