What do we know about scale & sparsity in state school finance formulas?

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Scale related costs

- Districts (k-12 unified) reach scale economies at about 2,000 pupils
  - Costs rise gradually from 2,000 down to about 300 pupils (up to about 50% greater costs)
  - Costs rise sharply from 300 down to 100 pupils (to greater than double basic costs)
- Schools
  - Elementary schools optimize between 300 and 500
  - High schools optimize between 600 and 900
- Can (how can) consolidation cut these costs?
  - It's not about duplicative administration, it's about staffing ratios more generally (class sizes, especially at the secondary level)
  - Consolidation cuts cost IF schools are consolidated in addition to districts sharing overhead and services
  - School consolidation typically requires up-front capital investment!
    - You can't just squeeze schools & districts into efficient consolidation

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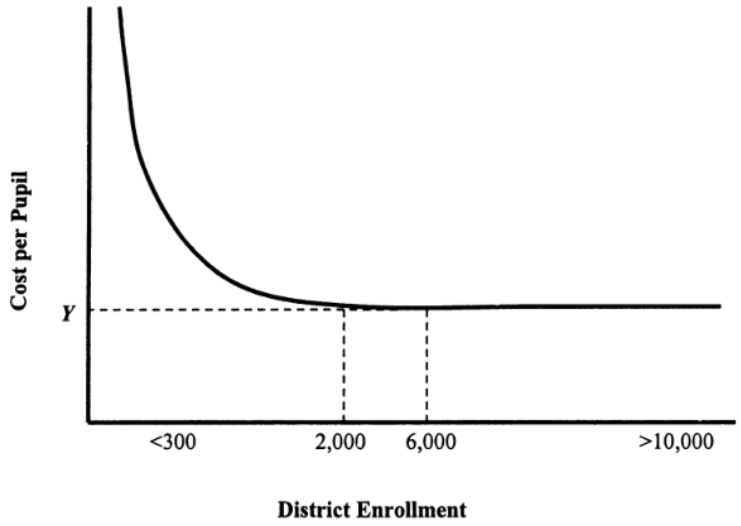

Figure 3. Cost of Achieving Average Outcomes by District Size

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States have small size, scale and sparsity adjustments

- Most are not based on "cost" analysis
- Kansas had a weight based on prior (1991) expenditures
  - That weight has been adjusted according to more recent cost models
  - Original weight was actually too large (because of high wealth* tiny towns spending at very high levels in 1991)
  - Secondary problem was that straight lines (rather than curve) were drawn from 1800 down to 300, then 100 pupils.
- Texas had similar linear (spline) size adjustment, which split for small sparse districts (greater weight on small, remote sparse than small alone)

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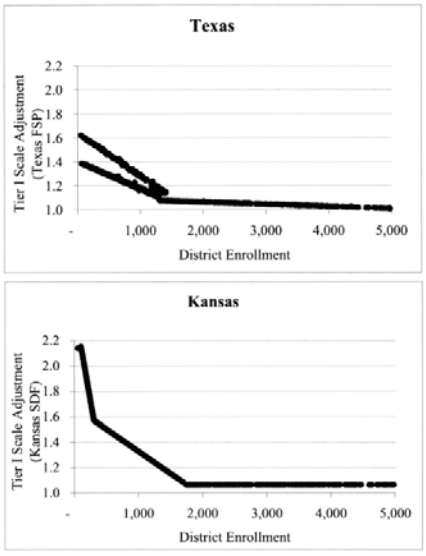
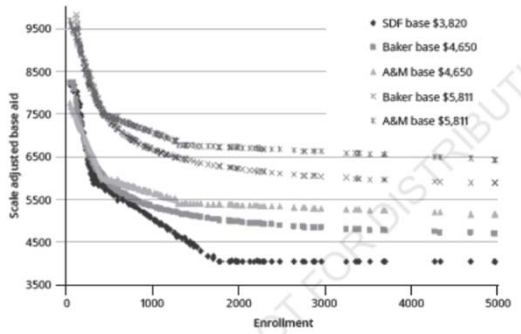
FIGURE 1
SCALE AND SPARSITY ADJUSTMENT



Corrected Kansas scale adjustment

FIGURE 7.3 Application of scale adjustments



Source: Author testimony, *Montoy v. Kansas*.

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Our methodological choices

- We selected scale (& density) cuts within the data based on finding statistically significant differences in costs (& sufficient # schools per bin)
  - The data led us to those cuts on school and district size in our models
- Why use a step down, categorical approach when economies of scale operate on a continuum?
  - We have learned that if we use non-linear scale terms (squared or cubed terms) that:
    - They are harder to explain
    - But far more importantly, they often lead to distortions in the predicted costs for larger districts (this was a problem in the 2018 Kansas study)
      - A squared term will swing back up for large districts (U-shaped) even though costs don't (and this also interferes with other cost factors)
      - A third order, cubed term will swing up then back down

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Table 6.2. Scenarios for Applying Alternative Cost Factors and Weights

		Scenario A Apply Weights Estimated Using Models Without Controls for Special Education		Scenario B Apply Weights Estimated Using Models With Controls for Special Education	
	Existing Weights[a]	Simulation A.1 (VT Estimation)	Simulation A.2 (Substitute Regional ELL Weight)	Simulation B.1 (VT Estimation)	Simulation B.2 (Substitute Regional ELL Weight)
Student Needs					
Economically Disadvantaged Student Count	0.25	3.14	3.14	2.97	2.97
ELL Student Count	0.20	0.57	1.33	1.58	1.27
Other Cost Factors					
Grade Range					
% of Students Enrolled in Grades 6–8		1.23	1.23	1.23	1.23
% of Students Enrolled in Grades 9–12	1.13	1.13	1.13	1.20	1.20
Population Density					
<36 persons per square mile		.23	.23	.23	.23
36–54 persons per square mile		.17	.17	.17	.17
55–100 persons per square mile		.11	.11	.11	.11
School Size[b] *(conditional on population density)*					
<100 students		.24	.24	.26	.26
101–250 students		.12	.12	.12	.12
Prekindergarten Student Count[c]	0.46	0.46	0.46	0.46	0.46
Adjustments to Special Education Census Grant		No adjustment to census grant. Adjustments for special education cost are reflected in a district's equalized pupil calculation.		Revise census grant calculation. Change the number of pupils used in the calculation to either (1) the number of equalized pupils (Option 1) or (2) the number of poverty-weighted pupils (Option 2).	

[a]Grade range weights are centered on 1; all other weights are centered on 0.
[b]School size weight is applied only when the population density is <55 persons per square mile and when the number of students in a district who attend a school with ≤250 students in a given academic year.
[c]Simulations assume no change to the existing weight used for prekindergarten students (see 16 VSA § 4010(c)).

New Hampshire

Figure 1. District Size Weights as Originally Estimated Using Model Including Transportation Spending

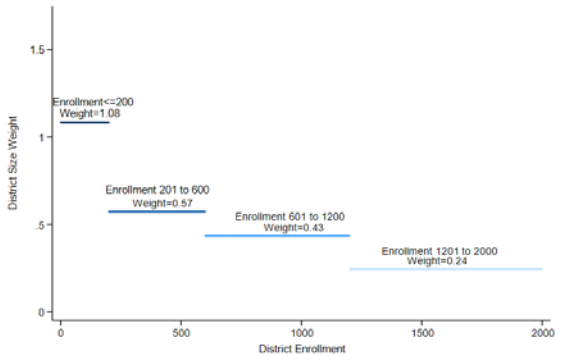
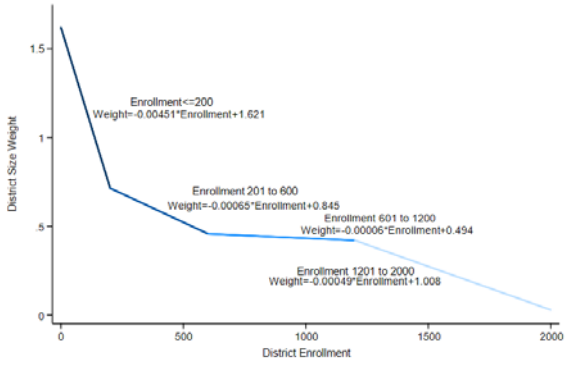


Figure 2. District Size Weights Estimated as Splines Using Model Including Transportation Spending



https://carsey.unh.edu/sites/default/files/media/2020/10/enrollment_weights_-_9.29.20_-_clean_1.pdf

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Additional policy implementation thoughts

- Scale and sparsity adjustments are better applied as weights on a base cost than as categorical or block grants (this applies to most cost adjustments)
  - This is because cost variation runs along continua, not by categories
  - While it's feasible in analyses to use cuts and bins to identify cost differentials, translation to policy often requires smoothing the cliffs between bins (see New Hampshire follow up brief)
- While a state may not want to provide supplemental funding to small schools or districts that could feasibly consolidate with others, the state must recognize the up front costs of making that consolidation possible (capital investment)

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Resources

- Baker, B. D. (2005). The emerging shape of educational adequacy: From theoretical assumptions to empirical evidence. *Journal of Education Finance*, *30*(3), 259-287.
- Baker, B., & Duncombe, W. (2004). Balancing district needs and student needs: The role of economies of scale adjustments and pupil need weights in school finance formulas. *Journal of Education Finance*, *29*(3), 195-221.
- Andrews, M., Duncombe, W., & Yinger, J. (2002). Revisiting economies of size in American education: are we any closer to a consensus?. *Economics of education review*, *21*(3), 245-262.

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