Research in Rural Education, Volume 5, Number 1, 1988

School Size and Unit Costs: International Evidence and its Usefulness

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Despite the importance of the topic, surprisingly little information exists on the unit costs of schools of different sizes. Educational planners therefore have to base this aspect of their work on assumptions rather than facts. This paper reviews the research that has been conducted in different countries, both advanced and less developed. It observes the diversity and inconsistency of findings, but notes that they are at least useful in methodological terms.

In 1977, Sher & Tompkins observed [22, p. 48] that "there is a remarkable paucity of research that systematically examines cost/size relationships in rural . . . schools." They challenged the conventional wisdom that small schools were necessarily economically and educationally inferior to large schools, and in the process highlighted the many knowledge gaps. Over a decade later, however, the information available to decision-makers has barely improved.

The lack of information does not reflect a lack of importance. It is true that the debate in North America and Europe has lost some vigor following the widespread triumph of many school consolidation plans of the 1960s and 1970s. But many small schools still exist, and continued depopulation of many rural areas has kept the issue very much to the fore in a wide range of settings. Moreover, the global economic crisis of the early 1980s made the need to find cost-effective strategies for rural school provision even more urgent than before.

If the lack of data does not reflect a lack of importance, one should ask what it *does* reflect. In most contexts, the answer is the construction of the budget. Very rarely do budgets show the expenditure in individual schools; usually they show only the aggregate expenditure on salaries, equipment, maintenance, etc. In some contexts it also reflects the lack of a research tradition. Sher & Tompkins' comment was made in the context of the world's richest nation. In the Third World, the lack of information is even more acute.

It is also worth noting that First World administrators may have different preoccupations than their Third World counterparts. Whereas the former face falling birth rates and often have to decide whether to close small schools in rural areas, the latter are more likely to ask whether to *open* small schools in order to achieve universal primary and secondary education. However, basic determinants of costs, and the severe pressures on budgets, are likely to be fairly similar in both settings. And both need more adequate information on which to base their decisions.

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I. The Studies

1. United Kingdom

One of the best investigations of costs in relation to school size has been conducted by the Commission for Local Authority Accounts in Scotland [6]. The Commission examined 85 schools in the Borders Region, ranging from institutions with just eight pupils to one with 457. The Commission found sharply escalating costs in schools with fewer than 25 pupils, although wide cost variation among schools of similar size were also reported. This was especially true of the very small schools, among which some institutions with 20 pupils, for example, had double the unit costs of institutions of the same size. Wide variation also existed among larger schools, and ones with more than 200 pupils found their costs varying by as much as 65 percent. Because of these variations, unit costs in some small schools were substantially lower than in many larger institutions.

Three principal factors accounted for this picture. First, because education is relatively labor intensive, teachers' salaries commonly consumed over 60 percent of annual recurrent expenditures. Scottish salary scales allowed significant differences in teacher costs, with an experienced teacher at the top of the scale earning nearly £3,000 more than a newly-appointed colleague. In this system, a two-teacher school with a recently appointed head and a young assistant could have a salary bill £5,500 less than a similar school with experienced staff. Spread across 30 pupils, the difference would cause a unit cost variation of £150.

Second, variation was caused by the system of cut-off points beyond which schools qualified for extra staff. Whereas a two-teacher school with just under 50 pupils would have a pupil:teacher ratio close to the average, a slightly larger school would be entitled to three teachers and a much lower ratio. Confirming this feature in another part of the United Kingdom, a survey in Norfolk (reported in [2], p. 188) indicated substantially lower

average unit costs in schools with 40 to 50 pupils than in either smaller two-teacher schools or three-teacher schools with up to 60 pupils.

Thirdly, unit costs vary because of factors specific to each institution and community. Transportation costs may vary widely according to population density and other geographic features, and many schools inherit high costs from the nature of their buildings, the existence of large playing fields, etc.

In the United Kingdom context, it is worth noting that the Scottish Commission echoed those of other researchers:

- Cumming [7, p. 116 ff] surveyed 74 primary and 41 secondary schools in Scotland. The scatter diagram of his findings is similar to that of the Scottish Commission. His primary school sample contained a rather small proportion of institutions with over 100 pupils, but regression analysis suggested that doubling the school roll would reduce unit costs by approximately 17 percent. Cumming also noted that primary schools with fewer than 60 pupils displayed a much greater cost range than larger institutions.
- Coatesworth [5] found that schools in Norfolk with fewer than 20 pupils had unit costs three times higher than average.
- In Suffolk, unit costs in a sampling of 10 schools with less than 30 pupils on roll were between 18 and 95 percent higher than the average [1].
- In Warwickshire, unit costs in schools with fewer than 50 pupils were about 60 percent above the county average [1].
- In Salop, unit costs were 50 percent above the county average for schools with 30 pupils, almost double in schools with 25 pupils, and nearly treble in schools with 20 pupils [2, p. 184].

These studies vary in their estimates of the size of school below which unit costs were particularly high, but generally emphasize watersheds around 60-80 pupils. At the other end of the scale, Curry & West [4] found evidence of diseconomies caused by administrative costs once enrollments reached 200. However, for the reasons noted above, these precise cut-off points should be viewed with considerable caution. It is clear that individual circumstances can lead to wide variation.

2. United States

Many studies from the USA focus on school *districts* rather than individual institutions [e.g. 13; 19; 21; 23]. Some, however, are based on individual schools, and thus merit closer attention. One of the first and best was conducted by Riew [18] in Wisconsin.

Riew began by noting a need to control for school quality. In the absence of such control, he suggested, variations in costs might merely reflect variations in quality. Riew's attempt to control for quality makes his study stand out from the majority of others.

However, Riew's methodology remains questionable. As a first step to standardize the sample, Riew selected only schools which were accredited by the North-Central Association. He omitted indication of the reasons why schools might seek such accreditation, of the basic criteria for accreditation, or of its general implications, but the reader is left to assume that the accreditation system sets a minimum baseline of quality. To narrow the qualitative range still further, Riew excluded all schools at which average teacher salaries exceeded an arbitrary number. This procedure was based on the rather questionable assumption that teachers' salaries were "in general significantly associated with the quality of teachers." It appears that no attempt was made to assess or control for quality in terms of pupil achievements or attitudes.

Nevertheless, Riew did reach some interesting conclusions. Per-pupil expenditures declined fairly steadily from $531 to $374 as enrollment rose from below 200 to 701-900 (Table 1). They then rose to $433 in the next size-category, 901-1,100. However, this rise in expenditure was accompanied by a notable rise in the proportion of teachers with masters' degrees, and by a considerable broadening of the school curriculum. Because of these accompanying factors, Riew pointed out, it was still arguable that the system was providing 'value for money.'

Further evidence was produced by Osburn's [17] study in Missouri. Although he showed significant cost savings, they were much lower than those indicated by Riew. A school of 500 pupils, he suggested, had unit costs $12.74 less than a school of 200. Corresponding reductions were $16.74 in a school of 1,000 pupils, $11.14 in a school of 1,500 pupils, $5.53 in a school of 2,000 pupils, and $0.66 in a school of 2,244 pupils. Although this suggested ongoing economies of scale, the majority of savings had been achieved when student numbers reached 1,500. Osburn suggested that one factor explaining the difference between his figures and Riew's might have been the omission of transportation costs from Riew's analysis.

White & Tweeten [23] built on the need to include transportation costs by seeking the point at which the sum of instruction and transportation costs was lowest. Their work focused on districts rather than individual schools, but nevertheless contains important methodological insights for those concerned with institutional size. The research was conducted in 27 districts in Oklahoma in 1970, and highlighted the impact of population density. Minimum unit costs were $760 in areas having student density ratios of 0.6 students per square mile, and $660 in areas with a density of 3.0 students per square mile. The optimum district size was 300 students in low density areas and 1,075 students in high density areas.

Three years later, Johnson & Mitten [15] published a study of elementary school costs in Pennsylvania. Their methodology was partly based on Riew's, but their paper claimed (p. 45) to be the first study of its kind at the elementary school level. When making this statement, the authors had evidently overlooked the work by

TABLE 1

Unit Costs in 109 Wisconsin High Schools, 1960-1961

No. of Pupils	Operating Expenditure per Pupil*	Average Teacher's Salary	% of Teachers with Master's Degree	Pupil-Teacher Ratio
143-200	$531.9	$5,305	18.1	17.3
201-300	480.8	5,187	15.1	18.2
301-400	446.3	5,265	18.8	20.0
401-500	426.9	5,401	18.5	20.9
501-600	442.6	5,574	23.5	20.7
601-700	413.1	5,411	22.5	20.9
701-900	374.3	5,543	22.3	24.1
900-1,100	433.2	5,939	34.0	21.4
1,101-1,600	407.3	5,976	36.5	24.4
1,601-2,400	405.6	6,230	54.5	24.2

*Includes expenditure on administration, teachers' salaries, and other instruction, operation and maintenance. Does not include transportation, meals, recreation or health programs.

Source: Riew [18, p. 282)].

Cumming in Scotland. Nevertheless, their work added useful data, based on 42 schools in 1973-74. They found that, *ceteris paribus,* an increase in a school's Average Daily Membership (ADM) from 100 to 300 would save $308.88 per pupil; an ADM increase from 200 to 400 would save $229.32 per pupil; and an increase from 300 to 586 would save $165.22 per pupil. Regrettably, the authors did not indicate the mean unit costs at each level, and it is therefore difficult to assess these savings in proportional terms. However, they suggested (p. 44) that the savings were "considerable."

In 1976, Holland, Baritelle & White [14] produced a further study to show the importance of tranportation costs, which had been neglected by both Riew and Johnson & Mitten. The study focused on Lincoln County in Washington State, and built on White & Tweeten's work by obtaining optimum institution costs as well as district ones. In contrast to White & Tweeten, however, they found little scope for saving. Reorganization of the schools would have caused considerable upheaval, and would only have saved 1.1 percent of the total budget.

3. Canada

Two Canadian studies are worth highlighting. The first was conducted in Ontario and is reported in Dawson [8] and Dawson & Dancey [9]. The second was conducted in Prince Edward Island by Keane [16].

Like Riew, but rather more convincingly, Dawson & Dancey attempted to control for quality. They administered the Canadian English Language Achievement Test, plus the Canadian Scholastic Aptitude Tests in mathematics and verbal ability. Their study focused on both elementary and secondary schools. By the time they had weeded out various schools which did not fit their requirements of comparability, they had a sample of 417.

Dawson & Dancey used a carefully-constructed set of weightings to test different circumstances and assumptions. Although each weighting produced slightly different results, they concluded from their study of secondary schools (p. 194) that economies of scale existed up to an enrollment of 4,000 pupils. After that point, calculations based on some assumptions indicated diseconomies of scale, though this was not consistent among all calculations. At the elementary level, they found little evidence of economies of scale at any point in the system.

Keane's study, by contrast, was based on only 17 schools. He excluded two schools which were obviously different from the rest, but made no other attempt to control for quality, merely assuming (p. 50) that the differences between the schools were "not very significant." His regression analysis indicated (p. 50) that at the elementary level,

> an increase in enrollment by one student would result in a reduction of 69 cents per annum in per-pupil operating cost for a school of any size, *ceteris paribus.* Thus, for example, an increase in enrollment from 100 to 200 students would result in a reduction of 69.1 dollars in per-pupil operating expenditures. Increasing the enrollment to to 300 would realize a savings of 139.2 dollars per pupil.

Like Johnson & Mitten in the United States, Keane omitted mention of total unit costs, which makes it hard to assess the proportionate magnitude of these potential savings. Also, the implied linearity of his curve is not

very convincing. His overall conclusion, however, was that "economies are not very substantial."

4. Australia

The most prominent Australian work has been conducted by Hind [11; 12]. In 1971/72, he studied 116 schools in New South Wales which had an enrollment range from nine to 928 pupils. His results confirmed the existence of economies of scale at the primary school level. However, most instructional and administrative economies were exhausted by the 100 pupil enrollment level. Maintenance economies continued to exist at this level, but they were largely exhausted by the 200 pupil enrollment level. Once schools reached 600 pupils, an administrative structure with a high labor component led to diseconomies of scale.

5. Sudan

A recent Sudanese study [20] is the only one known to this author which examines the unit costs of schools of different sizes in a Third World context. A sample of schools was selected from different parts of the northern region, representing each major geographical area and both urban and rural locations. The study focused only on recurrent costs, and covered 90 primary schools, 54 intermediate schools, and 25 secondary schools.

Table 2 summarizes the study's findings on school size. From the viewpoint of this paper it is unfortunate that the researcher did not subdivide the first category, of schools with up to 200 pupils. Nevertheless, the figures show a clear overall trend. At all levels, total unit costs declined steadily as size increased, and at no point within the sample did total unit costs begin to rise again. The breakdown of costs into teachers' salaries, other salaries, and other recurrent costs showed a less consistent pattern, but the inconsistencies disappeared when aggregated.

II. Usefulness of the Studies

Administrators faced with decisions on school size would certainly find this collection of studies useful. However, they might still find it hard to determine appropriate action. The studies are limited in number, are specific to the locations in which they were conducted and to prices prevailing at that time, and show wide variations in their conclusions. The majority of studies indicate potential economies of scale at the bottom end of the system, but the extent of the economies and the point at which schools encounter diseconomies seem to vary widely.

The question of control for quality is particularly problematic. Riew [18] asserted that it was essential to control for quality because cost variations might otherwise merely indicate variations in quality. However, his indicators of quality were somewhat unconvincing. Dawson & Dancey were perhaps more convincing, but they themselves recognized shortcomings in their indicators [9, p. 194]. Subsequent researchers seem to have been unable to greatly improve the situation, and most have chosen to ignore the question altogether.

Sher & Tompkins [22, p. 57] add the point, which may be especially applicable to the Sudanese case, that the expenditures of different schools often merely reflect the amount of finance available. Small schools tend to be concentrated in rural areas, which are often less prosperous and therefore less able to generate as much taxation revenue. Also, they may be unable to attract the sort of teachers who occupy the upper points on the salary scale.

At the same time, it may be arguable that the details of the studies are irrelevant to the majority of administrators since costs will be determined by their own specific circumstances. It would be quite impossible to provide a single formula for optimum school size, even for a specific region in a specific country, let alone one which would apply across the globe. This being so, the greatest use of these studies lies in their methodological value. The studies by Cummings [7], White & Tweeten [23], Holland, Baritelle & White [14], and the Commission for Local Authority Accounts in Scotland [6] are particularly useful.

REFERENCES

1. Aston University. *The Social Effects of Rural Primary School Reorganization: Final Report,* Aston University, U.K., 1980.

TABLE 2

Unit Recurrent Costs in Primary Schools of Different Sizes, Sudan, 1984 (Sudanese Pounds)

		— — —SIZE OF SCHOOL (NUMBER OF PUPILS)— — —					
		1-200	201-400	401-600	601-800	Over 800	All
Primary:	Costs	133.0	90.9	86.7	75.7	60.9	89.4
	(N)	(13)	(58)	(12)	(5)	(2)	(90)
Intermediate:	Costs	123.7	110.9	98.7	96.1	—	108.0
	(N)	(21)	(21)	(8)	(4)	—	(54)
Secondary:	Costs	—	229.3	178.4	182.4	170.9	181.1
	(N)	—	(6)	(6)	(4)	(9)	(25)

Source: Salih [20, pp. 4.2, 5.2, 6.2].

2. Bell, A. & Sigworth, A. *The Small Rual Primary School: A Matter of Quality.* Brighton: The Falmer Press, 1987.

3. Bray, M. *Are Small Schools the Answer? Cost-Effective Strategies forRural School Provision.* London: Commonwealth Secretariat, 1987.

4. Curry, N. & West, C. Internal economies of scale in rural primary education. In *Rural Settlement Policy and Economics* (Edited by Curry, N.), Gloucestershire Papers in Local and Rural Planning, *12*, 1981.

5. Coatesworth, D. Is small still beautiful in rural Norfolk? *Education, 10*, October, 275-276, 1976.

6. Commission for Local Authority Accounts in Scotland. *Value for Money Study on School Occupancy Costs.* Edinburgh, 1984.

7. Cumming, C.E. *Studies in Educational Costs.* Edinburgh: Scottish Academic Press, 1971.

8. Dawson, D.A. Economies of scale in the Ontario public secondary schools, *Canadian Journal of Economics*, V, *2*, 306-309, 1972.

9. Dawson, D.A. & Dancey, K.J. Economies of scale in the Ontario public school sector, The Alberta Journal of Educational Research, XX, *2*, 186-197, 1974.

10. Gilder, I.M. Rural planning policies: An economic appraisal, *Progress in Planning*, II, *3*, 213-271, 1979.

11. Hind, I.W. Estimates of cost functions for primary schools in rural areas. *Australian Journal of Agricultural Economics, 21*, 1, 13-25, 1977.

12. Hind, I.W. Some economic aspects of the provision of education services in rural areas. In *Rural Education: In Pursuit of Excellence* (Edited by Darnell, F. and Simpson, P.M.), pp. 129-140. Nedlands: National Centre for Research on Rural Education, University of Western Australia, 1981.

13. Hirsch, W.Z. Expenditure imiplications of metropolitan growth and consolidation. *Review of Economics and Statistics*, XLI, *3*, 232-240, 1959.

14. Holland, D., Baritelle, J. & White, G. School Consolidation in Sparsely Populated Rural Areas: A Case Study. *Educational Administration Quarterly, 12*, 1, 67-79, 1976.

15. Johnson, G.P. & Mitten, R.L. Economies of Scale in the Operation of Public Elementary Schools. *Educational Planning, 3*, 1, 38-45, 1976.

16. Keane, M.J. Economics and the size of rural schools. *Canadian Journal of Agricultural Economics, 26*, 3, 47-52, 1978.

17. Osburn, D.D. Economies of size associated with public high schools. *The Review of Economics and Statistics*, LII, *1*, 113-115, 1970.

18. Riew, J. Economies of Scale in High School Operation. *Review of Economics and Statistics*, XLVIII, *3*, 280-287, 1966.

19. Sabulao, C. & Hickrod, G. Optimum Size of School District Relative to Selected Costs. *Journal of Educational Administration, 9*, 2, 1971.

20. Salih, L.T. *Costs of Primary, Intermediate and Secondary Schools in Sudan.* Prg.CT/86.264, Paris: International Institute for Educational Planning, 1986.

21. Schmandt, H.J. & Stephens, G.R. Measuring Municipal Output. *National Tax Journal*, III, *4*, 369-375, 1960.

22. Sher, J.P. & Tompkins, R.B. Economy, efficiency, and equality. The myths of rural school and district consolidation. In *Education in Rural America: A Reassessment of Conventional Wisdom* (Edited by Sher, J.P.), pp. 43-77. Boulder, Colorado: Westview Press, 1977.

23. White, F. and Tweeten, L. Optimal school district size emphasizing rural areas. *American Journal of Agricultural Economics, 55*, 1, 45-53, 1973.