# AN ANALYTICAL APPROACH TO THE CONSOLIDATION OF COUNTIES IN NORTH AND WEST FLORIDA BASED ON EDUCATIONAL EFFICIENCY CRITERIA*

William D. Ricker
Fred H. Tyner

Both public officials and private organizations are becoming increasingly concerned with the need for improved efficiency in and reorganization of local governments. The seriousness of the financial crises in both state and local governments is nowhere more evident than in the President's proposal for federal revenue sharing with the state and local governments.

The fiscal problems of local government, however, are more pervasive than temporary funding solutions alone can deal with.Exhaustive studies of the origins, political and social influences, organization and accomplishments of local governments themselves and their relationships with other units and levels of government are needed in order to develop a governmental organization consistent with contemporary needs. Several areas in the South have dealt forcefully with governmental reorganization through city-county consolidation. Notable examples of this are Miami-Dade and Jacksonville-Duval in Florida, and Nashville-Davidson in Tennessee.

Another method suggested for local governmental reorganization is the consolidation of two or more counties. While several studies have proposed county-county consolidation [1, 2, 5], only one [4] has made an examination of the effects of consolidation on financial benefits and costs for both the involved governments and the involved citizenry. This paper will deal with county-county consolidation, referred to simply as county consolidation, and will present a method that can be used to approach the consolidation problem. The reader should keep in mind that the results obtained are conditioned by the available data and by the simplifying assumptions employed.

## OBJECTIVES AND PROCEDURES

The main objective of this study was to develop an analytical model for consolidation of the study area counties based on a criterion of efficiency for in-school costs (all costs excluding transportation and capital improvement). The methodology used in developing the model for the study included multiple linear regression analysis to examine the economies of size characteristics of Florida public education–the relationship between expenditures per pupil and average daily attendance. The results of the economies of size study were then used to develop cost coefficients for a linear programming model that assigns the study area counties to groups of contiguous counties which minimize in-school expenditure.

Two approaches could be used in developing a technique for county consolidation. The first would combine all governmental functions, either in the economies of size study or in the linear programming model, to achieve one optimum plan for the entire area under study and for all functions of the governments. The second approach would select the relevant services of government, analyze each in an economies of size context, and then model each separately–resulting in an optimum plan for each service studied, rather than one optimum plan for all functions. The second approach would appear to lend itself more readily to the realities of the political process–allowing for more give and take in the adoption of a consolidation plan–and was, therefore, selected as the approach to follow.

Public primary and secondary education was chosen as the service for this study for three reasons.

William D. Ricker is a graduate student and Fred H. Tyner is associate professor of agricultural economics at the University of Florida.

*This paper is based on Ricker's unpublished master's thesis [7].

First, because Florida counties and school districts are coterminous, the results of the study can be easily compared to similar studies focusing on other county governmental services. Secondly, school expenditures are the largest single expenditure on the county level–being larger than the combined total of all other county services. Finally, the availability and reliability of school expenditure data increased both the empirical usefulness of this study and the potential of the model for use in analyzing other services.

## THE ECONOMIES OF SIZE STUDY

The purpose of the economies of size analysis was to determine if the consolidation of counties would decrease expenditure per pupil (i.e., lower total expenditures for a given student population). The importance of such a relationship would be to show that savings could be realized through more efficient-sized governmental units. Previous studies have shown that school systems in other states do exhibit efficiencies of size, suggesting that a similar relationship could reasonably be expected for Florida [3, 7].

A multiple regression analysis was used in the economies of size study to examine the variation in expenditure per pupil among all 67 Florida counties for influences due to several socio-economic and structural variable. The effect of non-size related variables[1] was removed from expenditures per pupil and the resulting residual was regressed against the size variable--average daily attendance–to demonstrate the "net" relationship between cost and output.

### Non-size variables

Two socio-economic variables were included in the linear regression analysis. Income per capita was used as an indicator of wealth in the community (measuring each county's ability to support education). This variable was found to be statistically significant and positively correlative with expenditure per pupil. The ratio of local revenue raised for education to total revenue received for education was expected to measure the motivation of the county in financing education at greater than the minimum level required by Florida law. This variable was also significant and positively correlated with the dependent variable.

The ratio of local revenue to total revenue is especially important in Florida since the state's Minimum Foundation Program (MFP) allocates a minimum amount of money to each county for educational expenditures based on the number of students in attendance. In turn, each county must raise a certain amount of money to participate in the program but is allowed to raise as much more as it wishes within the millage limits set by law. It is the revenue raised from local taxes in excess of the minimum required that the variable "ratio of local to total revenue" is measuring.

Another non-size related variable used in the analysis was transportation expenses per pupil for busing pupils to and from school. Transportation expenses per pupil are not an in-school cost but are related to the geographical location of the school centers and the dispersion of the population. This variable was also statistically significant and positively correlated with expenditure per pupil.

The three variables above ($X_4$, $X_5$, and $X_6$ in Table 1) were included as explanatory variables in equation (1). Then, observation on these variables were multiplied by their respective estimated regression coefficients and subtracted from the dependent variable (expenditure per pupil) to provide a "net" expenditure per pupil variable involving only in-school costs.[2]

### Size variable

Two alternatives were available with respect to the choice of the appropriate independent size variable: (1) enrollment and (2) average daily attendance. Average daily attendance was chosen over enrollment due to the feeling that actual attendance was a better measure of the real size of the school district.

However, the use of average daily attendance (or any attendance variable) raises problems of measuring the quality of educational output. Although an economies of size study assumes that output quality is equal at all levels of production, it is known that school systems differ greatly in the quality of education they provide. In order to standardize the output of the school districts, the ratio of the mean county score to the maximum possible score of a statewide twelfth grade testing program was multiplied by the actual daily attendance. The premise was that high scoring counties receive a higher quality of output per dollar of expenditure

[1] Non-size related variables are discussed below.

[2] Consolidation of administrative functions across counties need not necessarily affect student transportation. It was assumed that school locations and transportation expenditures would not be altered, at least in the short run.

than do lower scoring counties. The result of the transformation was to reflect the presumed quality differential by weighting the output variable ($X_7$ in Table 1).

## Analysis and Results

Data were collected for all 67 Florida counties for the four school year periods 1966-67 to 1969-70. A combined time series-cross sectional analysis was used in order to reduce distortions due to annual major changes in expenditures such as large increases in salaries. The data were fit to both logarithmic and quadratic equations, with the logarithmic equation providing a better fit to the data. However, while a logarithmic equation can express an economies of size relationship, it does not allow for diseconomies of scale. The poorer results of the quadratic equation may follow either from the fact that there are only two counties in Florida with an average daily attendance greater than 100,000 (resulting in an inadequate number of observations to measure any diseconomies) or it may be that, in fact, the effect has not yet occurred.

Equation (1) in Table 1 shows the estimated relationship between the dependent variable (expenditure per pupil) and the explanatory variables (size, non-size, and intercept shifters). Variables $X_1$, $X_2$, and $X_3$ are 0, 1 dummy variables used to account for variation in the dependent variable due to differences among the four years (i.e., to "group" each year's observations). All variables were significant at the probability level .01, with a coefficient of multiple determination equal to .70.

Equation (2) reflects the removal of the effect of non-size related variables from the dependent variable, as discussed above. The regression coefficients are the same, of course. The $R^2$ is lowered slightly to .66, but the standard errors of the regression coefficients in Equation (2) are also lower.

Equation (2) reflects our best estimate (given the available data) of a "pure" cost-output relationship for primary and secondary education in Florida, and indicates that as the size of the school district increases (in terms of adjusted average daily attendance) expenditures per pupil (for in-school costs) can be expected to decrease. Cost coefficients needed for the linear programming model are later derived from this equation.

Table 1 RESULTS OF REGRESSION ANALYSIS OF COST-OUTPUT RELATIONSHIP FOR IN-SCHOOL EXPENDITURES, 67 FLORIDA COUNTIES, 1966-70.

| No. | Dependent Variable | Inter-cept | Independent Variables $X_1$ | $X_2$ | $X_3$ | $X_4$ | $X_5$ | $X_6$ | $X_7$ | $R^2$ |
|---|---|---|---|---|---|---|---|---|---|---|
| (1) | $Y_1$ | 5.2476 | .90681 * (.020252) | .32479* (.022717) | .36344* (.023241) | .099161* (.019553) | .10333* (.027066) | .13056* (.038074) | -.028138* (.0097217) | .70 |
| (2) | $Y_2$ | 5.2476 | .096081* (.019708) | .32479* (.019714) | .36344* (.019734) | | | | -.028138* (.0048195) | .66 |

*Significant at .01 level

$Y_1$ = log (Expenditure Per Pupil)

$Y_2 = Y_1 - .099161X_4 - .1033X_5 - .13056X_6$

$X_1$ = 1 in 1967-68, 0 otherwise

$X_2$ = 1 in 1968-69, 0 otherwise

$X_3$ = 1 in 1969-70, 0 otherwise

$X_4$ = log (Ratio of Local Revenue to Total Revenue)

$X_5$ = log (Transportation Per Pupil)

$X_6$ = log (Income per Capita)

$X_7$ = log (Adjusted Average Daily Attendance)

## THE LINEAR PROGRAMMING MODEL AND RESULTS

The 29 county region north and west of, and including, Alachua County was chosen as the study area for the linear programming analysis. This region exhibits several unique characteristics relative to the rest of Florida, including a high dependence on the agricultural sector and low economic and demographic growth rates compared to South Florida. An analysis of the region which more clearly demonstrates how it differs from the rest of Florida may be found in Tyner [8].

The activities used in the linear program were all possible combinations of the 29 study area counties subject to two restrictions. The first restriction was that the counties in a combination be contiguous and the second that no combination of counties have a width greater than 100 miles. These restrictions reduced the number of possible combinations to 148. The procedure used in selecting the combinations was to move across the study area selecting all combinations of two counties which satisfied the restrictions. The process was then repeated for all combinations of three, four, five, six and seven counties. The result was 29 combinations of single counties, 31 combinations of two counties each, 35 combinations of three counties each, 32 combinations of four counties each, 16 combinations of five counties each, four combinations of six counties each and one combination of seven counties.

Once the allowable combinations had been selected, the single constraint internal to the model was that each original study area county enter the final plan in its entirety and that it appear only once. The constraint was satisfied by setting the right hand side values for the resources equal to 1. The resulting $a_{ij}$ matrix was composed of 0's and 1's where $a_{ij}$ equaled 1 if resource (county) i was in activity (combination) j. Otherwise, the cell had a 0 value.

The cost coefficients for the linear programming model were derived from equation (2) which was adjusted to 1969-70 by adding the coefficient of variable X to the intercept. The 1969-70 adjusted average daily attendance (in logs) for each of the 148 combinations of counties was then inserted in the equation to give adjusted expenditure per pupil for each combination. These results were converted to natural numbers and multiplied by the actual average daily attendance to give the estimated total expenditure due to size for each combination (this result is the cost coefficient to be used in the programming model). Mathematically the model is:

$$\text{Minimize } Z = \sum_{j=1}^{r} K_j E_j$$

subject to the constraint

$$\sum_{j=1}^{r} a_{ij} K_j = 1$$

where:

- $Z$ = total educational expenditure for the study area
- $K_j$ = 1 if combination j is in the solution, 0 otherwise
- $E_j$ = total expenditures for combination j
- $a_{ij}$ = 1 if county i is in combination j, 0 otherwise
- $r$ = number of activities (combinations of counties).

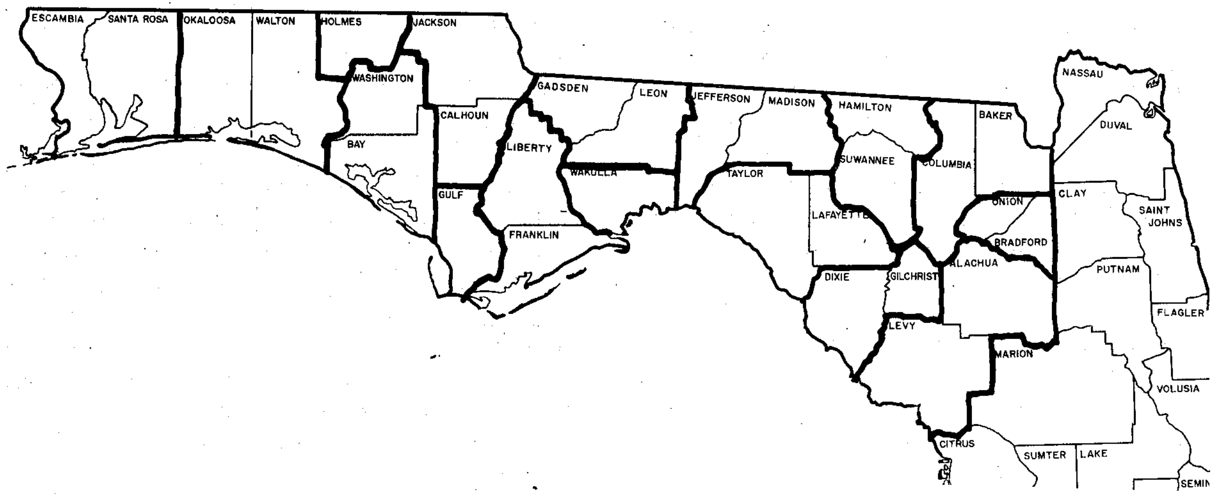
The three maps in Figure 1 illustrate three different consolidation plans derived by reducing the size–in terms of the number of counties–and the number of combinations allowed in the linear programming model. Projected annual savings for the first plan (combinations involving one and two counties) was $600,000, for the third plan (combinations of from one to five counties) was $1,362,000, with projections for the second plan falling between these two extremes. These figures represent the immediate annual savings in current expenditure to be expected due to increasing the size of each school district in terms of average daily attendance and to corresponding administrative efficiencies.

## CONCLUSIONS

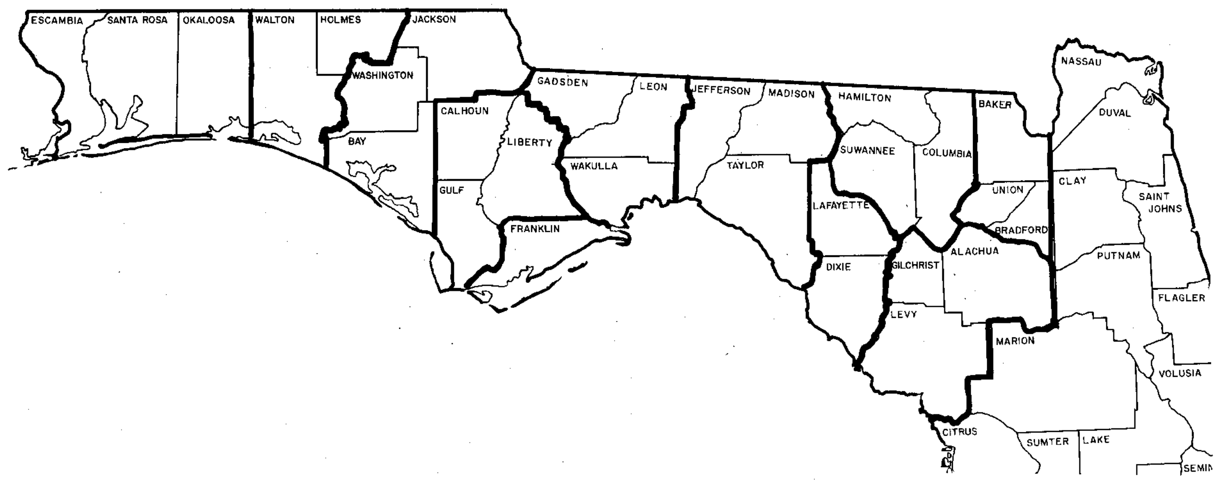
The purpose of this study was to explore one possibility for increased efficiency in local government expenditures, using primary and secondary education expenditures (in-school or "administrative") as the example.

The results are encouraging from an analytic standpoint. That is, the economies of size analysis was successful in isolating the effects of size on educational expenditures, and the linear programming model reallocated the study area counties such that sizeable savings are indicated from consolidation of the educational function.

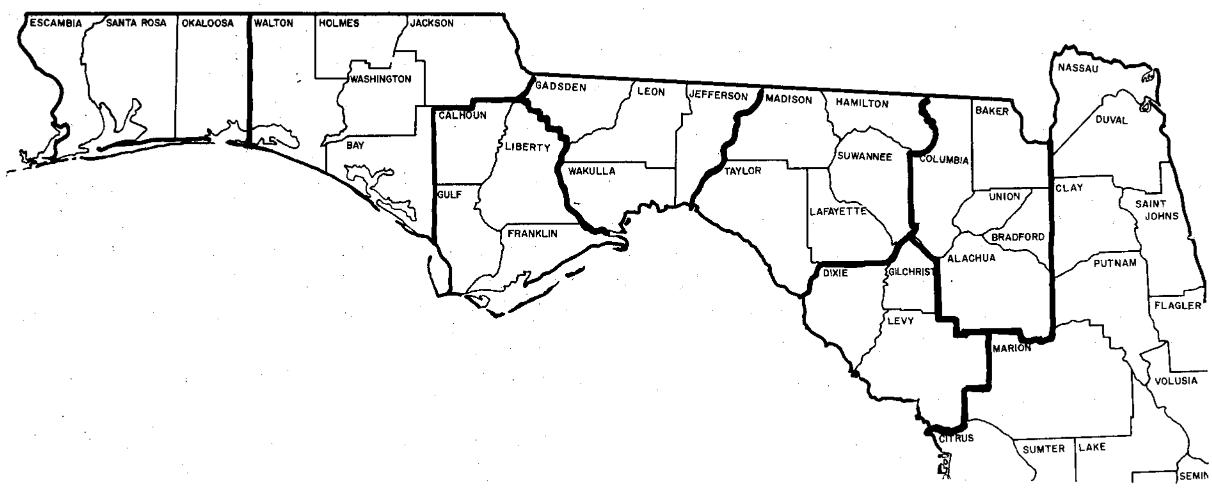
FIGURE 1.




Optimal Solution Using Combinations of 1 and 2 counties (60 combinations)




Optimal Solution Using Combinations of 1, 2 and 3 counties (94 combinations)




Optimal Solution Using Combinations of 1, 2, 3, 4 and 5 counties (143 combinations)

Limitations of a study are generally as important as the accomplished results. Data were not available on expenditures for individual schools. A cost-efficiency analysis by this breakdown could be as important as an analysis focusing on attendance at the county level. Transportation costs were eliminated on the assumption that county consolidation need not necessarily disrupt established schools and attendance patterns. School size and location (including a study of economies of size for individual plants and a detailed transportation cost study) are essential considerations if total educational expenditure is to be minimized.

On the positive side, the success of the economies of size study in isolating the effects of size on educational expenditures, plus the linear programming model which optimally allocated the original counties in the study area among more efficient combinations, suggests that the methodology presented could be profitably extended to other functions of government. For instance, if the major governmental services of law enforcement, public health and general government were studied in a similar context, the results could be used for a regional planning approach to local government. There will be difficulty in selecting the proper variables to measure the effects of size since each governmental function will present unique problems to be solved. However, the ability to present state legislatures with more efficient and more relevant organizations of governmental units would make the effort worthwhile.

## REFERENCES


[1] Appelt, Judy P., "A theoretical Combination of Texas Counties," *Texas Business Review,* 39: 300-303, Nov. 1965.

[2] Atchison, Jere and Lewis, John E., *A Suggested Objective Methodology for Combining Georgia Counties,* Research Paper No. 44, Bureau of Business and Economic Research, School of Business Administration, Georgia State College, Atlanta, Georgia, July 1968.

[3] Hanson, Nels W., "Economy of Scale as a Cost Factor in Financing Public Schools," *National Tax Journal,* 17: 92-95, March 1964.

[4] Klindt, Thomas and Braschler, Curtis. *Costs Revenues and Simulated Consolidation of Selected Missouri Counties,* Missouri Agr. Exp. Sta. Res. Bull. 949, March 1969.

[5] Otenson, Thomas K., "Reorganization of County Governments in North Dakota," Department of Agricultural Economics, North Dakota State University, Fargo, North Dakota, 1964.

[6] Ricker, William D., "Consolidation of Counties in North and West Florida Based on Educational Efficiency Criteria," Unpublished Master's Thesis, University of Florida, Dec. 1971.

[7] Schmandt, Henry J. and Stephens, G. Ross., "Measuring Municipal Output," *National Tax Journal,* 13: 369-375, Dec. 1960.

[8] Tyner, Fred H., *The Changing Economic Structure of North and West Florida,* Florida Agr. Exp. Sta. Ag. Econ. Report 17, March 1971.