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AUTHOR	Ching, C. T. K.; Detering, Stanley G.
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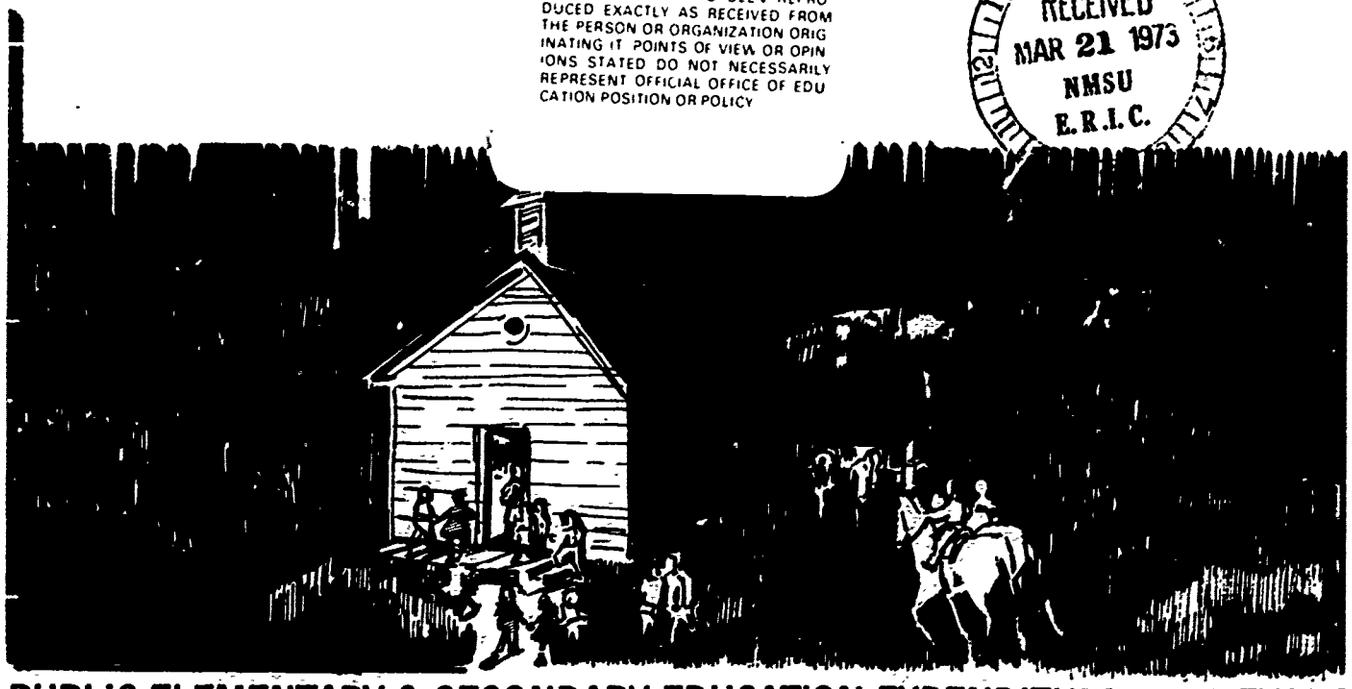
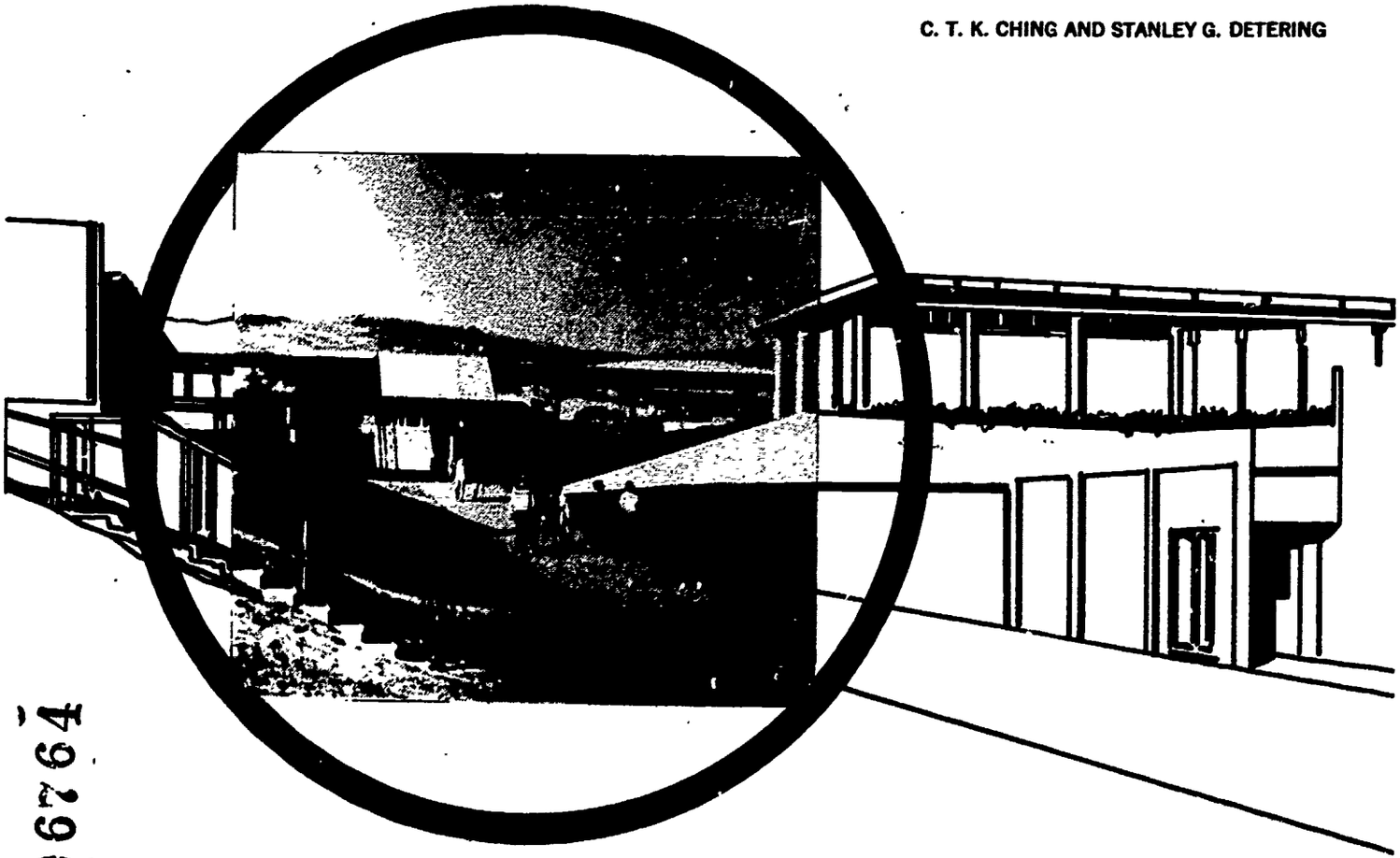
ABSTRACT

The relationship between expenditures for public elementary and secondary education and the factors related to these expenditures in Nevada were investigated in this study. The major components of the public education problem were listed as follows: the high proportion of tax revenue spent on education, the inadequacy of present methods of financing education, the quality of educational inputs, and the presumed disparity in quality of education between urban and rural areas. Two separate analyses of data were performed. A time series-cross sectional model was estimated using data for the 1968 through period for the 17 county school districts and a cross sectional model was estimated for fiscal year 1970. Major conclusions were that there have been pronounced changes in real per student expenditures since fiscal 1968, that school district expenditures per student decreases as district size increases, that a negative relationship holds between expenditures and rural-urban status, that per student expenditures are positively related to input quality, and that educational expenditures and community wealth are positively related. (PS)



PUBLIC ELEMENTARY & SECONDARY EDUCATION EXPENDITURES IN NEVADA

C. T. K. CHING AND STANLEY G. DETERING



AGRICULTURAL EXPERIMENT STATION ● MAX C. FLEISCHMANN COLLEGE OF AGRICULTURE ● UNIVERSITY OF NEVADA RENO

DALE W. BOHMONT, DEAN AND DIRECTOR

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SUMMARY

This study was designed to identify the net effects of various factors hypothesized to influence educational expenditures as they exist among Nevada school districts. Specifically, relationships between expenditures per pupil and community wealth, community educational level, quality of educational inputs, size of district, and rural-urban status of district were investigated. A statistical model with expenditures per student as the dependent variable was formulated and estimated by least squares.

Among the major findings are: First, there have been pronounced changes in "real" per student expenditures since 1968. While no changes were verified between 1968 and 1969, expenditures in 1970 and 1971 were 9 and 11 percent greater than those in 1968, respectively. Second, a reliable inverse relationship exists between expenditures per student and size of district. If size were to increase by 10 percent, expenditures per student tended to decline by 0.5 percent. Third, a reliable negative relationship was found between expenditures and rural-urban status. This result suggests that districts in areas of low urban concentration either choose to spend more on education or are forced to spend more due to external diseconomies.

Fourth, if average years' of teaching faculty experience is accepted as a measure of quality of educational input, expenditures and input quality are positively related. This means that increased quality of education inputs require increased expenditures. While this result is not particularly startling, it becomes significant in conjunction with the fifth result - education expenditures and wealth are positively related. Together, these results suggest that if improved quality of educational inputs requires increased expenditures, and ability to increase expenditures depends on wealth, there is justification for further inquiries into the wealth educational quality relationship presumed in California Supreme Court's Serrano vs. Priest decision.

Throughout the study, it became obvious that any meaningful inquiry into educational expenditures with an ultimate objective of increasing efficiency or enhancing planning decisions requires explicit consideration of educational quality. Equally obvious and important is the fact that quality measures for cross section analysis of the Nevada school system are not available. Accordingly, a major "result" of this study is the recognition of educational quality as a major variable in education decision making and a challenge to educators to develop operational and realistic measures of education quality and make them public.

PUBLIC ELEMENTARY AND SECONDARY EDUCATION EXPENDITURES IN NEVADA

By

C. T.K. Ching and Stanley G. Detering[1]

I. Introduction: Statement of the Problem and Objectives

This study investigated the relationship between expenditures for public elementary and secondary education and the factors related to these expenditures. Specifically, these relationships will be identified as they exist among Nevada school districts. While this report deals only with cost relationships in Nevada, the problem considered exists on a nation wide scale. The authors view the public education problem as containing four major components:

1. The high proportion of tax revenue spent on education;
2. The inadequacy of present methods of financing education;
3. The quality of educational inputs; and
4. The presumed disparity in quality of education between urban and rural areas.

These four topics, while distinct, are inseparable in analysis.

The high proportion of tax revenue expended on public education is perhaps best illustrated by estimates of educational expenditures and total revenue collected as published by the Advisory Commission on Intergovernmental Relations (1971). This Commission notes that in 1966-1967 for the United States as a whole, expenditures from state and local sources for education were 39 percent of "overall fiscal capacity."[2] For comparison, expenditures for highways; fire and police protection; and public welfare, health and

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[1] Associate Professor of Agricultural Economics and Assistant Agricultural and Resource Economist, Division of Agricultural and Resource Economics.

[2] The overall fiscal capacity of any particular area is the "total amount of revenue that would result by applying, within the area, the national average rate of each of the numerous kinds of state-local revenue sources" (Advisory Commission on Intergovernmental Relations, 1971, p. 7).

hospitals were 11, 5 and 12 percent. Average current expenditure per pupil was $858 in 1969. Aggregate expenditure for education amounted to $44.4 billion while aggregate expenditure for police protection amounted to $3.9 billion. Clearly, among public services, education uses a large portion of public monies.

The increasing refusals of communities to pass school bond issues exemplifies the growing dissatisfaction with the property tax as a method to finance public education. The magazine, Changing Times, (April 1972), describes this attitude as follows:

> "It's enough to make anybody mad. You live in a modest suburb, work hard at your job and conscientiously make the payments on your mortgage. You don't even complain about the 5½ percent of the assessed value of your house you shell out every year in property tax. After all, it pays for things like police and schools. This year those taxes let you and your neighbors support the local schools to the tune of $577 per pupil, counting some money the state kicks in.
>
> "But just a few miles away, in the same county, another town is spending $1,232 on each of the youngsters in its schools. And it's managing to put together that much money while taxing property at the relatively comfortable rate of about 2½ percent of assessed value. In other words, by making less than half the effort you do to support local schools, residents there spend more than twice as much per pupil."

In essence, property taxes are an inadequate means of financing education for two reasons. First, as noted by Changing Times, the tax base or assessed valuation of real property varies from area to area within the same general locale. Second, local revenue needs tend to be increasing at a faster rate than assessed values. For example, for the United States as a whole, assessed values on property (real and personal) increased about nine percent each year over the 1956-1966 period. For the same period, property taxes increased by about 11 percent each year (United States Bureau of the Census, 1958, 1960, 1971).

Closely related to costs and financing problems of public education are issues of educational quality and equality of educational opportunity. In response to Section 402 of the Civil Rights Act of 1964, the Office of Education, United States Department of Health, Education and Welfare, prepared a report, "Equality of Educational Opportunity," (Coleman, 1966). This report, known as the Coleman Report, discusses the availability of equal educational opportunities for individuals in public institutions at all levels in the United States. Of particular interest is the finding that expenditures for inputs to education are only slightly correlated with output as measured by achievement scores. Influences of parents and peers were a more significant factor in explaining variations in achievement scores.

In sharp contrast, other researchers have assumed that an adequate measure of educational quality is expenditure per pupil. Rather than making this assumption, Stinson and Kramer (1969) have indicated that while expenditure per pupil is not significantly correlated with educational quality (as measured by achievement test scores), expenditure per teacher is significantly correlated with educational quality. Finally, the California Supreme Court ruled that funding education on the basis of a real property tax is unconstitutional because it makes the quality of a child's education dependent upon the wealth of his parents and neighbors, and as such, violates the Fourteenth Amendment (equal protection under the law). Similar rulings were issued by Federal Courts in Texas, Minnesota and New Jersey. Such rulings are contrary to the Coleman Report findings and suggest the existence of a relationship between educational expenditures (input) and educational quality (output).

The above remarks were intended to show the current controversy regarding the relationship between educational expenditures and quality. Of course, inherent in this controversy is the source of funds for education and more specifically, the adequacy of real property taxes in financing education.

Lastly, there is growing recognition and concern for the disparity between the quality of education in rural and urban areas (e.g., Marshall and others, 1971). In his opening remarks before the Select Committee on Equal Educational Opportunity of the United States Senate (Equal Educational Opportunity, 1971), Senator William B. Spong noted:

> "Today, 30 percent of our Nation's youth live in nonmetropolitan areas. Approximately 32 percent of all school districts in our country serve fewer than 300 children.
>
> "Yet, in our understandable concern over the serious problems facing urban school districts, we have, too often, ignored the problems in our rural areas.
>
> "We should not allow this situation to continue. Studies show persistent and significant disparities between metropolitan and nonmetropolitan education. Research has, for example, found that youth in nonmetropolitan areas tend to complete fewer years of schooling than their urban counterparts, that teachers tend to have less preparation, that fewer funds are available for educational purposes.
>
> "In our efforts to improve nonmetropolitan life in general, where 17 percent of the residents have incomes below the poverty line as compared with 13 percent in our inner cities, and in our attempts to prepare youth to pursue an occupation wherever they, as part of our mobile society, may eventually reside, we must focus on education.
>
> "We must act now to identify the problems of nonurban education and to devise means of improving it, so that the rural youth will have an educational opportunity equal to that of the urban youth."

In general, the tone of these Senate hearings suggested the inferior nature of rural education relative to urban education on a national scale. Rural education was characterized as having many school districts, many small schools with limited breadth of curricula, inadequate sources of funds, and typically operating under conditions of low population densities with high costs of transporting students.

Most important, the hearings emphasized the significance of the rural education problem by suggesting an explicit relationship between rural and urban problems. For example, the hearings contained testimony to the effect that inner-city problems were directly related to the in-migration of poorly educated and trained rural residents.

The specific objectives of this report are to provide insights regarding the following questions related to Nevada school districts.[3]

1. Among Nevada school districts, do expenditures per student vary directly with property value assessments (or some other indicator of community wealth) per student?

2. Assuming that the relevant quality of educational input variables can be identified, what is the relationship between quality and costs?

3. In Nevada, do school districts in urban areas spend significantly more on a per student basis than those in rural areas?

4. Among Nevada school districts, do economies of size exist (i.e., as number of students increase does cost per student decrease)?

5. Since 1968, have there been significant shifts in the average cost function of Nevada school districts?

6. Among Nevada school districts, do expenditures per student vary directly with the educational level of the communitys' residents?

7. Among Nevada school districts, do those with a higher proportion of high school students tend to have higher costs than those with a lesser proportion?

8. Among Nevada school districts, do those operating above their full capacity tend to reflect lower costs than those operating below full capacity?

This study is designed to identify the net effects of various determinants of educational expenditures. For example, the effect of size of school district (number of students) on cost, holding all other factors constant at specified levels, will be estimated. This type of partial analysis will be achieved through the formulation and estimation of a multiple regression model. Specific procedures are described in the following section.

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[3] In this study, school districts are synonomous with counties since Nevada school districts coincide exactly with county boundaries.

II. Procedure

To fulfill the objectives stated above, the following relationship between expenditures and factors affecting expenditures was hypothesized:

(1) $Y = f(X_1, X_2, \ldots X_8)$

Where:

- Y = educational expenditure per pupil in a particular school district
- X_1 = wealth of the community
- X_2 = quality of educational inputs in the school district
- X_3 = rural-urban character of the school district
- X_4 = size of school district
- X_5 = specific time period of observation
- X_6 = education level of the residents of the community
- X_7 = proportion of high school students within the school district
- X_8 = relative capacity of the school district

The functional form of equation (1) has been purposely stated in general terms since linear and various nonlinear forms will be assumed during the estimation process.

The primary focus of this model is upon the relationship between the variables identifying social and economic attributes (X_1, X_2, X_3, and X_6), and expenditure per student (Y). Of secondary interest are the variables related to the process of providing education which influences average costs through this process. These include district size (X_4), physical capacity (X_8), proportion of high school students (X_7), and quality of educational inputs (X_2).

To adequately measure the net effect of each variable in the primary set, variables of the secondary set must be included. It should be noted that some variables in the two sets are not mutually exclusive in their effect. For example, rural-urban status may be associated with a community's propensity to spend for education while also being associated with the price of educational inputs.

Discussion of Variables

The dependent variable (Y) in this study was based on each school district's total expenditure allocable to current maintenance and operation not including expenditures on transportation (State of Nevada, Department of Education). Thus, expenditures include costs of administration, instruction, maintenance and operation of plant, fixed charges, and all auxiliary services except food services. Costs unrelated to current operation, such as debt service, were not included. Total expenditures were expressed in 1971 dollars and divided by the number of students in average daily attendance (ADA) to yield per student expenditures. The consumer price index (United States Department of Commerce) was used to convert expenditures to a 1971 dollar basis. Average expenditure derived in this manner was used as a dependent variable in the model described by equation (1).

Wealth of the community (X_1) was defined as the total assessed value of property in the county school district divided by the number of students in ADA (Nevada Tax Commission). An alternative measure of community wealth was the median income of families and unrelated individuals (United States Bureau of the Census, Census of Population, 1970). Positive coefficients are expected for both measures, reflecting a direct relationship between a school district's expenditures and the community's ability to support the school system.

Quality of educational inputs of the district (X_2) is perhaps the most difficult variable to quantify of those being considered. Ideally, the quality of educational outputs rather than inputs should be measured. Quality of educational output is perhaps best measured by change in achievement scores of students. However, since standardized achievement scores are not currently available on a statewide basis in Nevada, such an index of output quality cannot be used.[4]

In its place, three sets of quality measures of inputs were considered. First, following the precedent set by Riew (1965) and Osburn (1970), average salary of instructional personnel is used as a measure of quality. The use of average salaries is justified, a priori, in that the quality of instruction may be ultimately reflected in teachers' salaries. Second, the value of the physical assets of each school district (e.g., library and school texts and special educational facilities such as audio visual equipment) is used to reflect the physical assets conducive to providing a high quality of education (State of Nevada, Department of Education).

Third, a set containing four variables was developed as logical explanatory variables reflecting instructional input quality. This set included average years' of experience of teaching personnel, average years' of training of teaching personnel, course diversity (i.e., total number of distinct curricula offered), and percent of instructional personnel without

[4] A study recently completed by the State Department of Education does provide such measures for third grade students for the 1971-1972 school year. Results, however, were not tabulated by school district.

multiple teaching assignments. Each of these figures was compiled on a county school district basis. The coefficients of all input quality variables are expected to be positive, indicating that high quality education requires commensurate expenditures.

The rural-urban character of the school district (X_3) is included to account for cost differences between rural and urban school districts. This characteristic will be measured through use of a population concentration figure called "population proportion in towns." This measure is defined as the proportion of district (county) residents living in towns containing 1,000 or more. This measure was chosen over the usual population density measure--population per square mile--to reflect the fact that in Nevada, there are vast areas which are virtually unpopulated. A positive coefficient is expected for this explanatory variable. Such an expectation reflects the previously cited low resource commitment of rural relative to urban school districts for all cost components except transportation.

Size of school district (X_4) was defined as the number of students in average daily attendance (State of Nevada, Department of Education). The number of students in ADA was used rather than the number of students enrolled since the former figure more nearly reflects actual attendance. Further, use of students in ADA would make the results of this study comparable with previous studies such as those by Riew (1965) and Osburn (1970). A negative coefficient for this variable is expected--i.e., cost per student will decrease as district size increases.

Time (X_5) will be incorporated into the analysis to measure real changes in education costs over the 1968-1971 period. Real changes in costs are measured since costs have been adjusted to 1971 dollars by the consumer price index. Time will be measured by a set of four zero-one variables defined as follows. For observations corresponding to 1968, the first variable is equal to one, all other variables are equal to zero. For observations corresponding to 1969, the second variable is equal to one and all other variables are equal to zero. For observations corresponding to 1970, the third variable is equal to one, all other variables are equal to zero. For observations corresponding to 1971, the fourth variable is equal to one, all other variables are equal to zero. We expect that estimated coefficients to the time variables will be positive, reflecting real increases in expenditures relative to the 1968 base.

Education level of the residents of the community (X_6) was defined as the median number of years of school completed by males 25 and over in each county school district (United States Bureau of the Census, Census of Population, 1970). A positive coefficient for this variable is expected, reflecting the hypothesis that communities with a higher level of formal education are more willing to support public education than those with a lower level of formal education.

Commitment to high school education (X_7) is defined as the ratio of students in grades 9, 10, 11 and 12 to the total number of students. This variable is included to adjust for differences in costs for districts with different compositions of high school to total students. A positive coefficient to

this variable is expected. In other words, those districts with a large high school proportion are expected to have higher average costs than those with a small high school proportion.

Relative capacity of the school district (X_8) was defined as the ratio of the number of students in ADA to the number of instructional personnel. The importance of including a measure of relative capacity was recommended by Bressler (1945) in his studies of firm cost functions. Bressler pointed out that if a firm were operating below full capacity, average costs would be overstated. Accordingly, if a firm were operating above full capacity, average costs would be understated. In the case of school systems, one would expect understated or low average costs in districts with high student-teacher ratios; and, overstated or high average costs with low student-teacher ratios. Thus, a negative coefficient for this relative capacity measure is expected.

III. Empirical Results

Data on expenditures, size, community wealth measured in terms of assessed property values, quality of educational inputs, relative capacity, commitment to high school education, and rural-urban character of the districts were available for fiscal 1968 through 1971.[5] Data on wealth of the community as measured by median family income and educational level of the community as measured by median school years completed were available only for 1970.

Since there were two sets of data, two separate analyses were performed. First, a time series-cross sectional model was estimated using data for the 1968 through 1971 period for the 17 county school districts. This model considered all independent variables described in equation (1) except the educational level of residents of the school district. Second, a cross sectional model was estimated for fiscal year 1970. The primary concerns of this model were the effect of educational level of district residents and community wealth (median earnings) as they affect school district expenditures.

Linear and various nonlinear functional forms of equation (1) were considered. Of the nonlinear forms, quadratic, square root, and logarithmic transformations were performed on all variables as well as selected sets of variables. Generally, best fits (reliability of coefficients and goodness of fit) were achieved by logarithmic transformation of all variables. Only parameters estimated under natural logarithmic transformations are reported here.

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[5] See Appendix for specific descriptions of data used and their sources. Further note that data on years' of experience and years' of training of teaching personnel were not available for fiscal 1968. Data for these variables were, however, available for fiscal 1969 through 1972. These data were related to time through regression analysis for each district (county). Using these relationships, years' of experience and training were estimated for fiscal 1968.

A. Time Series-Cross Sectional Analysis: 1968-1971

As noted above, the time series-cross sectional model contains all the independent variables in equation (1) except education level of school district residents. However, due to intercorrelation problems, certain variables were deleted in order to better understand the effect of the remaining variables of the model. The statistical problem and steps taken to circumvent it are summarized in the Appendix. The estimated parameters for the time series cross sectional model are presented in Table 1, also in the Appendix.

The equation which appeared to most reliably describe the relation between educational expenditures and related factors is equation (5), Table 1. In this equation, wealth of the community (assessed valuation per student), quality of educational input (average years' of experience of teaching personnel), rural-urban status (population proportion in towns), size (students in ADA), and time (zero-one variables) were included as independent variables. The coefficients of all of these variables, except the 1969 time variable, were statistically reliable at the one percent level of confidence. This means the probability is less than one percent that each of these variables had no association with expenditures per student. The coefficient of determination (R^2), which is a measure of goodness of fit, was 0.87. This statistic indicated that 87 percent of the variation in expenditures was explained by variation in the independent variables included in the equation.

Since the variables have been transformed by logarithms, the estimated parameters have convenient interpretations in terms of percent changes or elasticities. For example, in equation (5), the coefficient relating size to expenditure is -0.055 which indicates that a one percent increase (decrease) in size was related to a 0.055 percent decrease (increase) in cost per student. Similar interpretations are valid for the coefficients to years' of experience, assessed value, and rural-urban status. That is, a one percent increase in average years' of experience of teaching personnel was related to a 0.257 percent increase in expenditures per student. A one percent increase in assessed value per student (community wealth) was related to a 0.073 percent increase in expenditures per student. Finally, a one percent increase in population proportion in towns of 1,000 or more (rural-urban status) was related to a 0.023 percent decrease in expenditures per student. In other words, population concentration was inversely related to per student expenditures. This last result indicates that expenditures per student (exclusive of transportation costs) were higher among the Nevada school districts with lower population concentrations.

The coefficients to the zero - one variables representing time are 0.001, 0.082, and 0.106 for 1969, 1970 and 1971, respectively. The ways in which the coefficients for these variables were estimated and interpreted are discussed in the Appendix. The coefficient for 1969 is not statistically reliable which means that expenditures per student in 1969 are essentially unchanged relative to 1968 - the base year. In contrast, the coefficients for 1970 and 1971 are statistically reliable and indicate that expenditures in 1970 and 1971 are approximately 9 and 11 percent higher than those

in 1968, all other variables held constant. This is an important result since the regression coefficients representing the percent increase estimates were statistically reliable at the one percent level of confidence. One should also note that these shifts in expenditures relative to 1968 are "real" shifts in expenditures rather than those reflecting inflation. Recall that expenditures were converted to constant (1971) dollars through use of the consumer price index.

Perhaps the most interesting portion of this analysis is the investigation of partial effects--that is, the effect on per student expenditure of changes in a specifc variable holding all other independent variables constant. For example, using the estimated coefficients of equation (5), size can be varied while holding all other variables other than time at their mean (or any other) value. The zero-one variables representing time must also be specified. If the variable corresponding to 1971, say, is set equal to 2.71828, the resulting average cost function would represent an estimated cost-size relationship for 1971. Such cost-size relations are depicted graphically in Figure 1 for two years, 1968 and 1971.

Since this cost-size relationship is nonlinear, cost differences due to changes in district size vary according to size of the school district. For example, in the 1968 relationship, costs per student for districts with 100 students was $120 greater than those with 1,000 students. However, a district having 15,000 students would have per student costs approximately $3 greater than a district with 16,000 students. In 1971, the cost-size relationship is slightly different--especially for district sizes in the 100 to 1,000 student range. In 1971, cost per student for districts with 100 students was $133 greater than districts with 1,000 students. For this same year, however, the difference in per student costs remain about $3 per student between school districts of 15,000 and 16,000. Generally, cost per student was about $75 to $100 higher in 1971 than in 1968, depending on size of district. We emphasize that these cost-size relationships are net relationships. To the extent that quality of educational input has been measured by years' of experience, wealth by assessed value, and rural-urban status by population proportion in towns, the cost-size relations in Figure 1 have been "corrected for" or adjusted for quality, wealth, and rural-urban status. In other words, the cost-size relationships depicted in Figure 1 reflect changes in per student expenditures among school districts, as size of school districts vary--assuming all school districts have equal quality, wealth, and rural-urban status.

Expenditure/quality (years' experience), expenditure/wealth (assessed valuation), and expenditure/rural-urban status (population proportion in towns) relationships for 1968 and 1971 are depicted in Figures 2, 3 and 4. Again, these figures illustrate net relationships between per student expenditures and the selected independent variable. While the direction of change in expenditures was discussed in terms of percentages, above, these graphs indicate expenditures in dollar terms as the level of the corresponding independent variable (e.g., size or years' of experience) is varied.

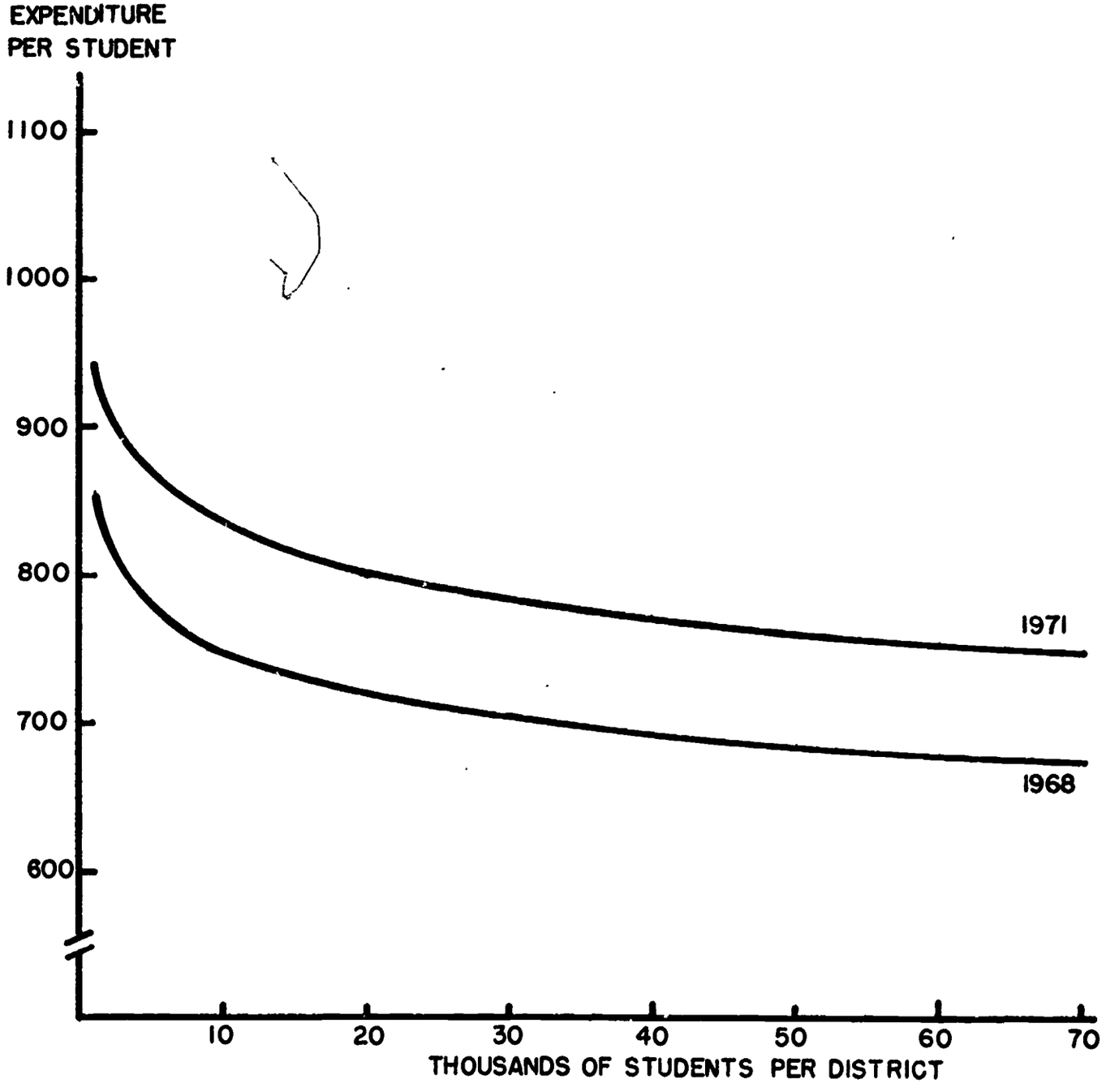

FIGURE 1. PER STUDENT EXPENDITURES RELATED TO SIZE (NUMBER OF STUDENTS), OTHER VARIABLES HELD CONSTANT.

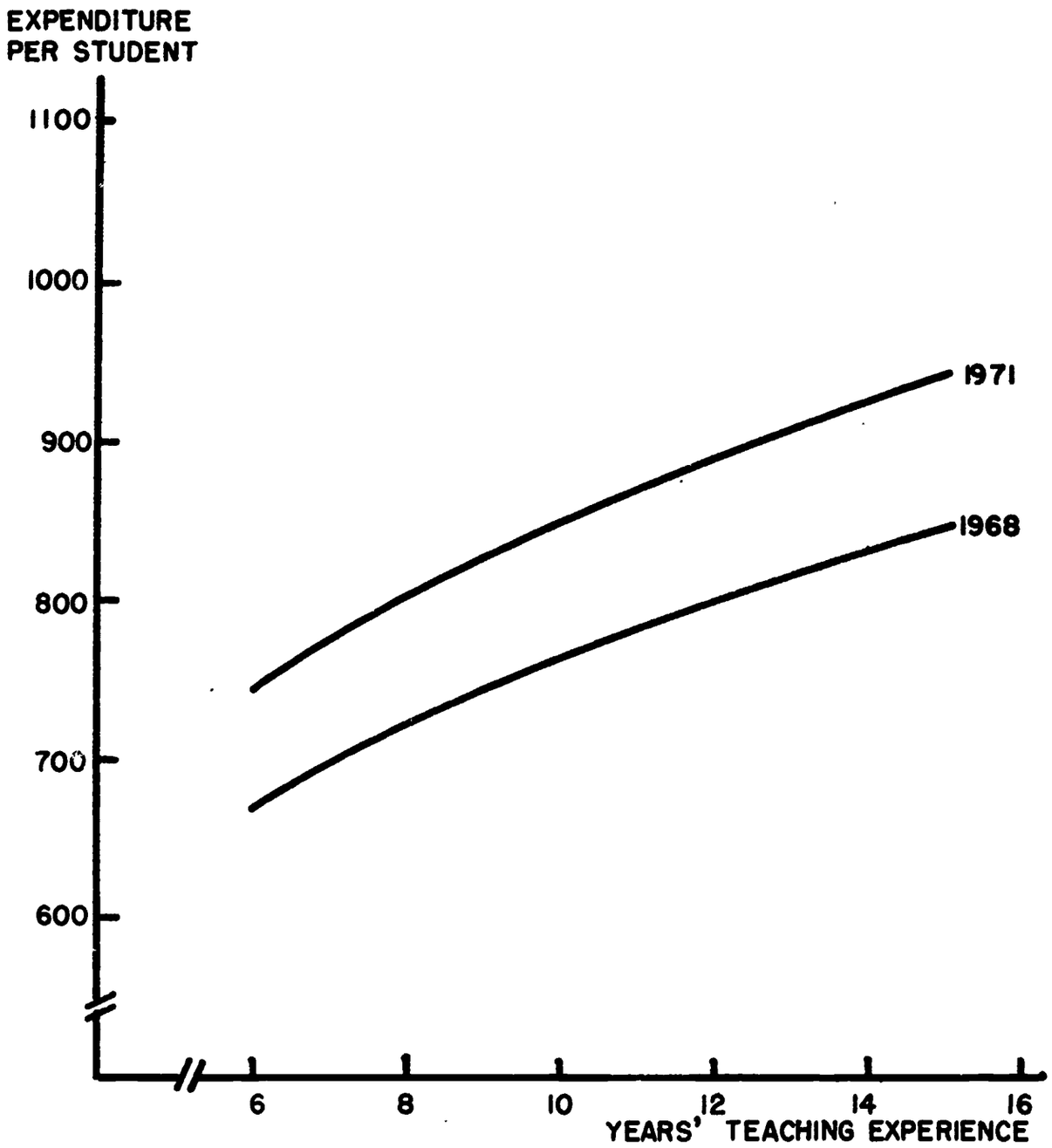

FIGURE 2. PER STUDENT EXPENDITURES RELATED TO QUALITY (YEARS' OF EXPERIENCE), OTHER VARIABLES HELD CONSTANT.

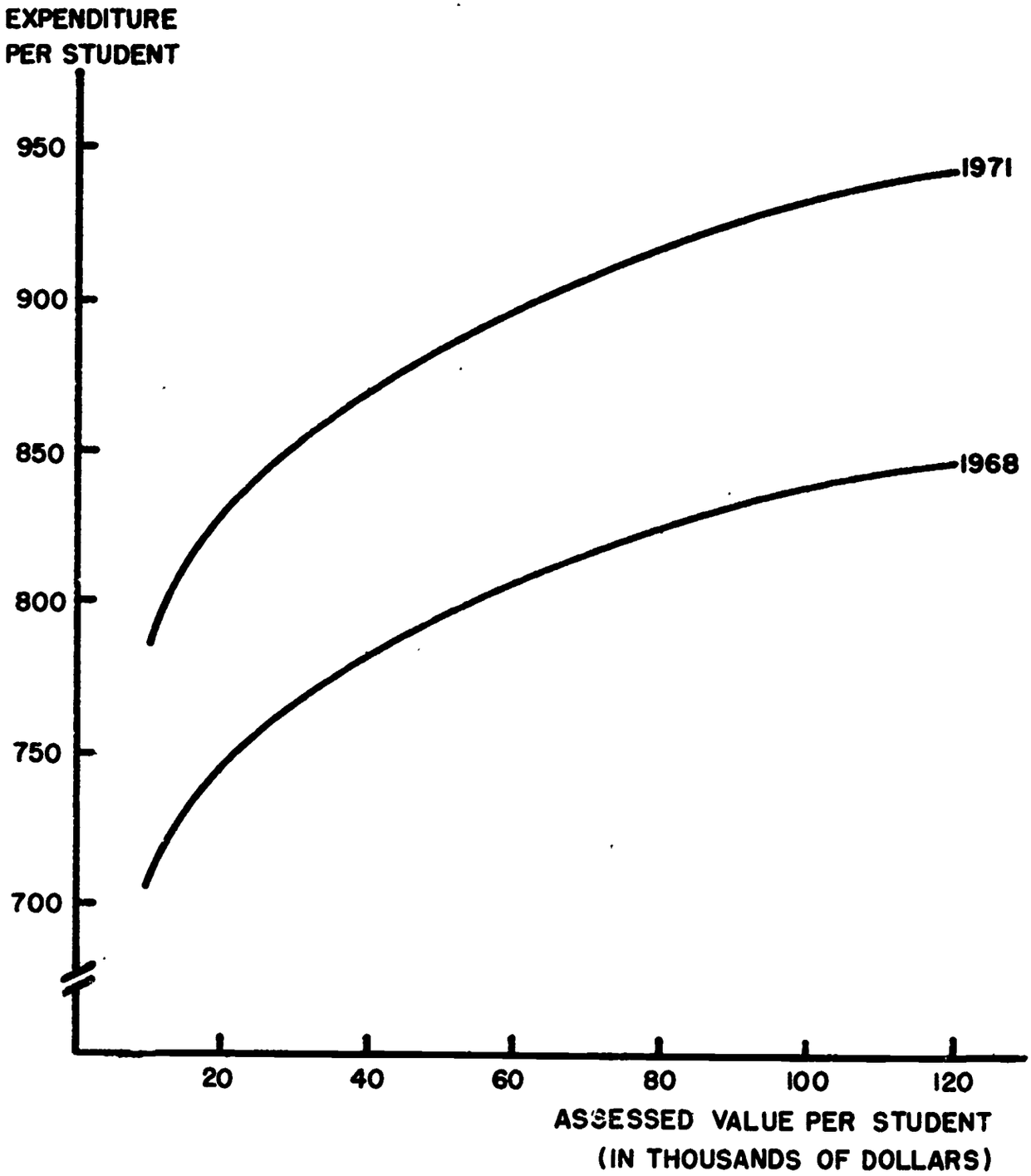

FIGURE 3. PER STUDENT EXPENDITURES RELATED TO WEALTH (ASSESSED VALUE), OTHER VARIABLES HELD CONSTANT.

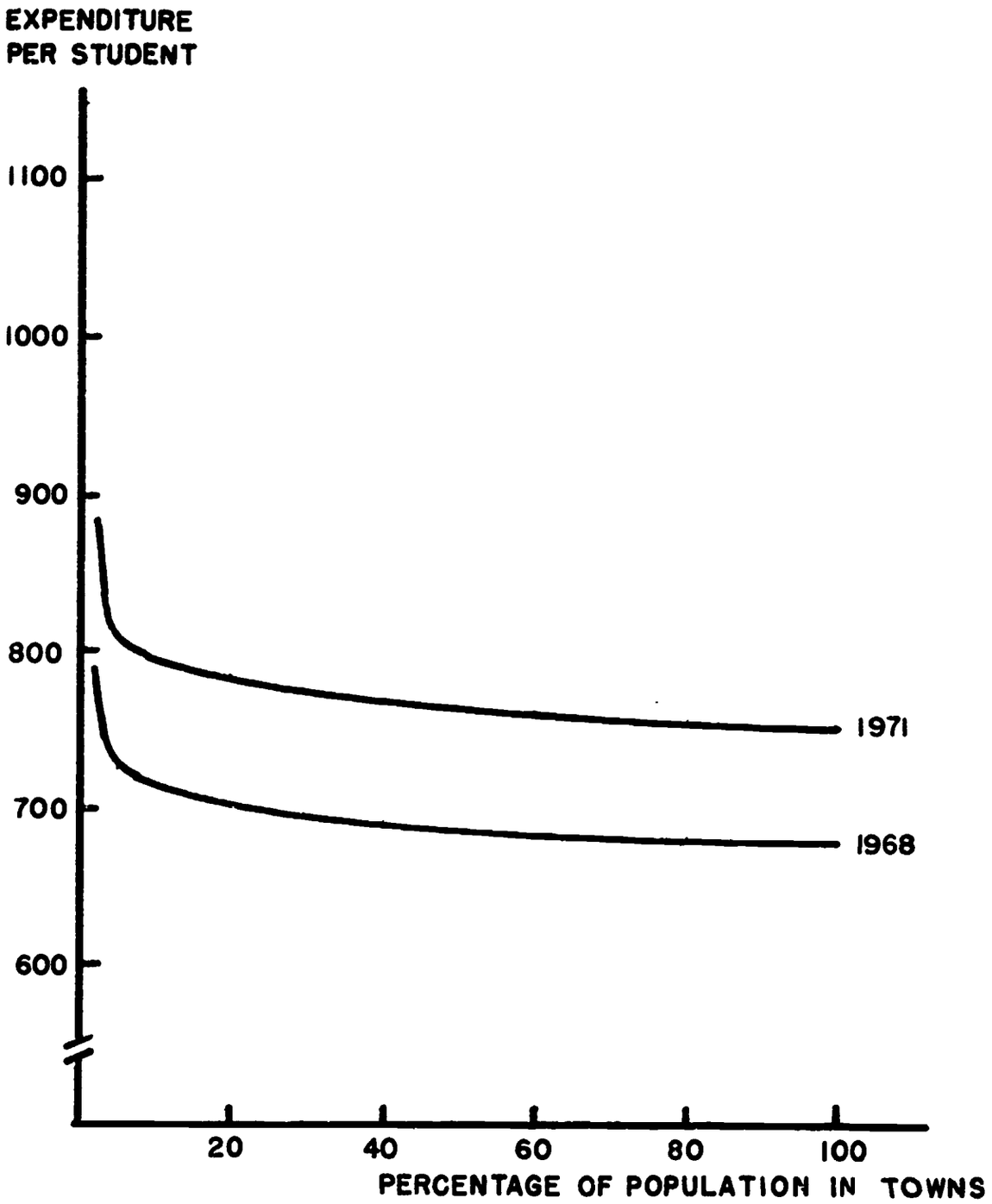

FIGURE 4. PER STUDENT EXPENDITURES RELATED TO RURAL-URBAN STATUS (POPULATION PROPORTION IN TOWNS), OTHER VARIABLES HELD CONSTANT.

B. Cross Sectional Analysis: 1971

This section seeks to evaluate the impact of educational attainment (median school years completed) and wealth (median earnings of families) of district residents on educational expenditures. A detailed development of this model is in the Appendix. Results indicate that coefficients to median earnings and median school years completed were not statistically reliable in any of the equations considered. In other words, the estimated coefficients for these variables were statistically indistinguishable from zero. Further analysis to estimate the net explanatory effect of these variables on per student expenditures also yielded a negligible impact on expenditures. Accordingly, the results of the cross sectional analysis fails to indicate a relationship between expenditures and median earnings and educational level. This does not necessarily mean that these relationships do not exist but indicates the inability to detect such relationships from available data.

IV. Conclusions

The objective of this study was to investigate the relationship between public expenditures on elementary and secondary education and the factors related to these expenditures as they exist among Nevada school districts. Insights into such relationships were intended to suggest answers to several questions relating to the "public education problem." Among the more frequently asked questions were those involving education costs and their relationship to community wealth, community education level, district size, and rural-urban status.

Research procedures included formulation of a statistical model which related per student expenditures to the several factors hypothesized to affect costs. The method of least squares was used to estimate parameters of the statistical model.

Due to statistical, measurement and conceptual problems, the authors feel that reliable estimates of certain relationships were not attainable. For example, high school proportion and student-teacher ratio were deleted from consideration since they were both computed as a function of size. Further, of all quality variables considered, average years' of experience of teaching personnel was selected as the most reasonable single variable to include. High intercorrelations among input quality variables further warranted such a decision.

The most reliable equation fitted was equation (5) where costs were related to size, assessed value, average years' of teaching experience, population proportion in towns and year. Coefficients to each of these variables were statistically reliable at the one percent level of confidence. Further, the signs of these estimated coefficients were consistent with expectations.

An analysis was also performed to measure the impact of median earnings and educational level of district residents on expenditures. Statistically significant relationships between costs and these two variables were not detected in the analysis.

In general, empirical results suggest the following conclusions. First, there have been pronounced changes in "real" per student expenditures since fiscal 1968. Changes are real in the sense that expenditures have been adjusted to constant dollars through use of the consumer price index. While no changes were observed between 1968 and 1969, expenditures in 1970 and 1971 were 9 and 11 percent greater than those in 1968.

Second, results indicate that, holding other variables constant, school district expenditures per student decreases as district size increases. The magnitude of the size coefficient indicates that if size were to increase by 10 percent, per student expenditures would decline by about 0.5 percent. Of course, this result does not warrant recommending extremely large districts since about 60 percent of the economies due to increase in size from 100 to 70,000 students (the observed range in size of districts) was achieved at a size of district equal to 4,500 students.

Third, a negative relationship was found between expenditures and rural-urban status, holding all other variables constant. This means that if two districts were equal in terms of size, input quality and wealth, but different in terms of rural-urban status, the more urban one would have lower costs per student. This result suggests that districts in areas with low urban concentration either choose to spend more on education (on a per student basis) or are forced to spend more because of external diseconomies.[6] Unfortunately, the above analysis was not sufficiently definitive to indicate which of these reasons is most plausible.

Fourth, if average years' of teaching personnel experience is accepted as a measure for quality of educational input, per student expenditures are positively related to input quality. A 10 percent increase in input quality, as measured by an increase in average experience of teaching staff, would result in a 2.6 percent increase in per student expenditures. Thus, holding other variables constant, improved quality of educational input would require increased expenditures.

Lastly, assuming assessed property valuation is a correct measure of community wealth, educational expenditures and wealth are positively related. As exhibited in Table 1, the estimated coefficients to assessed value are fairly consistent in all six equations. In those equations where the coefficients are statistically reliable, the coefficient is approximately 0.07. This would mean that if district A had an assessed value per student which was 10 percent higher than district B, the expenditures per student of the former would be greater than that of the latter by about 0.7 percent.

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[6] Districts in areas with low urban concentration may suffer the effects of external diseconomies simply because of being further from market areas where many of the inputs to education are distributed. Accordingly, such districts may pay more for educational inputs than districts located in more urban areas.

In conjunction with prior conclusions, this is a practically significant result. For if improved quality of educational inputs requires increased expenditures, and ability to increase expenditures is reflected by community wealth, it appears that there is some justification for further inquiries into the wealth-educational quality relationship presumed in the California Supreme Court's Serrano vs. Priest decision. In other words, these results provide some evidence for not rejecting the hypothesis that there is a positive relationship between the quality of education and the wealth of the neighborhood or community in which a district is located.

In closing, the authors wish to reiterate both the critical role of educational quality in education planning and the apparent lack of a measure of educational quality in schools and Nevada school systems. If meaningful and effective education planning is to evolve, educators and other decision makers concerned with education must develop satisfactory measures of educational quality and make them public.

A-1. DESCRIPTION AND SOURCES OF DATA USED IN THE ANALYSIS

Type of Data	Source
Number of Students in Average Daily Attendance (ADA) Number of High School Students in ADA Number of Teachers	State of Nevada, Department of Education, Biennial Report of Selected Data by the Superintendent of Public Instruction, July 1, 1966 to June 30, 1968; and July 1, 1968 to June 30, 1970.
Valuation of School Texts and Supplementary Books Average Salary of Teaching Personnel Total Expenditures Allocable to Current Maintenance and Operation Transportation (of pupils) Expenditures	State of Nevada, Interim Report of Selected Data by the Superintendent of Public Instruction, July 1, 1970 to June 30, 1971
Median School Years Completed by Males 25 and Older Median Income of All Families Population Proportion in Towns	U. S. Bureau of Census, Census of Population: 1970, General Social and Economic Characteristics, Final Report PC (1) - C30 Nevada, U.S. Government Printing Office, Washington, D.C., 1972.
Years' of Experience of Teaching Personnel	State of Nevada, Department of Education, Financial Programs Office, unpublished data.
Total Course Diversity Percent of Teaching Personnel without Multiple Instructional Assignments	State of Nevada, Department of Education, Educational Directory, 1967-1968, through 1970-1971.

A-2. DETAILED DEVELOPMENT OF THE TIME SERIES-CROSS SECTIONAL MODEL

Estimated parameters and related test statistics corresponding to the model expressed by equation (1) are presented in Table 1. Parameters were estimated for each independent variable specified in equation (1) except the variable 'education level of district residents.' Further, of the three alternative sets of quality variables, the set containing the four variables (years' experience, years' training, course diversity, and percent of teachers without multiple teaching assignments) has been reduced to a single variable. Due to the high intercorrelation of these four variables with each other and with other variables, the authors selected years' of experience as the available measure which best represent quality of educational input. In addition to these estimates, equation (2) in Table 1, parameters were also estimated for subsets of the variables in equation (1). Selected variables were deleted--those which were highly intercorrelated and/or statistically unreliable--in order to observe the stability and consistency of estimated parameters of the remaining variables.

In equation (2), the coefficients of high school proportion, student-teacher ratio, average teacher salary, years' experience, and rural-urban status were statistically reliable estimates. The coefficients to size, school texts, assessed value, and time were not statistically different from zero. Of the statistically reliable coefficients, all signs except those of high school proportion are consistent with prior expectations. This coefficient is negative which would indicate that as the commitment to high school education in a district increased, expenditures per student decreased. This is contrary to the hypothesis that high school education requires larger expenditures per student than elementary and junior high education. However, the negative sign to high school proportion may be more reflective of school size than of proportion of students in high school. Accordingly, those districts with a high proportion of high school students are also the larger districts. Hence, the negative coefficient reflects the influence of size rather than structure.

The coefficient of determination (R^2) in equation (2) is 0.95 which indicates that about 95 percent of the variation in expenditure per student has been explained by the variables included. The F statistic is 88.9 which suggests that the hypothesis "all coefficients except the intercept term are jointly equal to zero" should be rejected. Thus, while the overall fit of equation (2) is good, over half of the estimated coefficients are statistically unreliable. Since part of the reason for these results is due to inter-correlation of independent variables, selected variables were deleted and coefficients to remaining variables were re-estimated.

In equation (3) size was deleted since size was directly related to the computation of high school proportion and student-teacher ratio. The resulting estimated parameters are similar to those in equation (2) with the same variables being statistically reliable and of comparable magnitude. Since size is viewed as an important variable, size was included in equation (4) while high school proportion and student-teacher ratio were deleted. In this case, size and community wealth were found to be statistically reliable in addition to years' of experience (quality) and rural-urban status. In equation (4) about 88 percent of the variance in expenditures per student was explained by the independent variables.

TABLE 1

ESTIMATED REGRESSION COEFFICIENTS WITH COST PER STUDENT AS DEPENDENT VARIABLE, NEVADA SCHOOL DISTRICTS, 1968-1971[a]

General Variables Related To Educational Expenditures	Specific Variables Used in the Analysis	Equation Number 2	3	4	5	6	7
Wealth of community	Assessed valuation per student	.028 (.018)	.029 (.018)	.078* (.025)	.073* (.024)	.070** (.028)	.056*** (.028)
Quality of educational inputs	Value of school texts and other books	-.023 (.025)	-.024 (.025)	.042 (.034)		.070*** (.037)	
	Average salary of teaching personnel	.733* (.195)	.687* (.189)	.076 (.262)			.231 (.296)
	Average years' of experience of teaching personnel	.142* (.047)	.141* (.047)	.239* (.060)	.257* (.058)		
Rural-urban status	Population proportion in towns	-.010*** (.006)	-.010*** (.006)	-.017** (.008)	-.023* (.006)	-.015*** (.009)	-.027* (.007)
Size	Students in ADA	-.009 (.010)		-.055* (.012)	-.055* (.010)	-.053* (.011)	-.062* (.014)
Time	1969	.004 (.022)	.008 (.021)	-.003 (.032)	.001 (.030)	-9.452×10^{-4} (.034)	-.006 (.036)
	1970	-1.654×10^{-5} (.035)	.008 (.034)	.066 (.051)	.082* (.031)	.079** (.034)	.052 (.057)
	1971	-.003 (.043)	.008 (.041)	.086 (.062)	.106* (.031)	.113* (.035)	.075 (.070)
Commitment to high school education	High school student proportion	-.028* (.006)	-.029* (.006)				
Capacity	Student-teacher ratio	-.88* (.105)	-.935* (.087)				
Intercept		9.193	15.198	135.068	316.361	432.911	89.960
R^2		.946	.945	.877	.873	.842	.834
F		88.882*	97.866*	45.765*	58.986*	45.572*	43.032*

[a]Figures in parentheses beneath the estimated regression coefficients are standard deviations of corresponding coefficients.

*Statistically reliable at one percent level of confidence.

**Statistically reliable at five percent level of confidence.

***Statistically reliable at ten percent level of confidence.

Finally, in equations (5), (6) and (7), two of the three input quality variables were deleted in rotation. In equation (5), years' of experience is included while school texts and average teacher salary are deleted. In equation (6), school texts are included; and, in equation (7), average salary is included. In these three equations, years' of experience, equation (5), was the only quality variable found to be statistically reliable at the one percent level of confidence. In addition, size, years' of experience, assessed value, rural-urban status, and two of the zero-one time variables were statistically reliable at the one percent level of confidence. The coefficient of determination was 0.87 which indicates that 87 percent of the variation in expenditures was explained by variation in the selected variables. In contrast to equations (6) and (7), in which a single quality variable appears, equation (5) is superior in terms of both statistical reliability of coefficients and goodness of fit. According to these statistical criteria and the "correct" signs of the estimated coefficients, equation (5) appears to be the most reliable equation describing the relation between educational expenditures and related factors.

A-3. DETAILED DEVELOPMENT OF CROSS SECTIONAL MODEL

Using the results of the time series-cross sectional analysis as a starting point, in particular equation (5), median earnings and educational level were included as independent variables. After removing the time variables, the remaining variables, for 1970, were transformed by logarithms and the parameters were estimated by least squares, equation (8), Table 2.

In this equation, approximately 90 percent of the variation in educational expenditures was explained by the explanatory variables. However, only the coefficient to size (number of students) approach statistical reliability--it was different from zero at the 10 percent level of confidence. All other coefficients had large standard deviations and were, in a statistical sense, indistinguishable from zero. In other words, no statistically significant relationship was found between expenditures and the independent variables except size.

Since the intercorrelation between the two measures of wealth, assessed value and median earnings might be sufficient to cause large standard deviations of their respective coefficients, assessed value was deleted from equation (9). The resulting variation explained by regression was reduced slightly relative to equation (8). However, in addition to size, rural-urban status as measured by population proportion in towns was statistically significant at the five percent level of confidence. Deleting median school years completed and median earnings in equations (10) and (11), respectively, left previous results essentially unchanged. Variance explained by regression remained approximately equal to 88 percent with both size and population proportion being statistically different from zero.

When estimating the same model as equation (5) from cross sectional data, the results, equation (12), indicate that about 90 percent of the variation in expenditures has been explained by the independent variables. Only the coefficients to size and years' of experience are statistically different from zero. Thus, in comparison to equation (8) and (9), the explanatory powers of median earnings and median school years are negligible.

A-4. ZERO ONE VARIABLES UNDER LOGARITHMIC TRANSFORMATION

In order to use zero-one variables under logarithmic transformation, a prior transformation of variables was necessary--zeros were set equal to ones; and, ones were set equal to "e" or 2.71828. Then, under logarithmic transformation, the zero-one status of the time variables was preserved. Because of these necessary transformation, interpretation is somewhat different than the usual zero-one variable interpretation. Consider, for example, the coefficients of the time variables in equation (5). The coefficients for 1969, 1970 and 1971 are all relative to 1968. Accordingly, to evaluate the effect of 1969 on expenditures, set the value of the variable corresponding to 1969 equal to 2.71828 and evaluate the term $(2.71828)^{0.001}$ - since 0.001 is the coefficient for 1969. Using natural logarithms to evaluate this term reduces to finding the anti-log of 0.001, which is just fractionally greater than one. If this coefficient were reliable, it would indicate that in 1969, expenditures per student were fractionally higher than in 1968.

TABLE 2

ESTIMATED REGRESSION COEFFICIENTS WITH COST PER STUDENT AS DEPENDENT VARIABLE, NEVADA SCHOOL DISTRICTS, 1971[a]

General Variables Related To Educational Expenditures	Specific Variables Used in the Analysis	Equation Number 8	9	10	11	12
Wealth of community	Assessed valuation per student	.075 (.052)				.086 (.048)
	Median earnings of families in district	-.188 (.396)	-.340 (.401)	-.382 (.402)		
Quality of educational inputs	Average years of experience of teaching personnel	.190 (.152)	.162 (.158)	.273*** (.121)	.134 (.153)	.282** (.111)
Rural-urban status	Population proportion in towns	-.016 (.013)	-.018** (.011)	-.031** (.011)	-.028** (.011)	-.017 (.013)
Size	Students in ADA	-.050*** (.023)	-.049*** (.024)	-.057** (.023)	-.057** (.022)	-.062** (.019)
Educational level of community	Median school years completed by males over 25 years	-.927 (.906)	-1.027 (.947)		-1.105 (.931)	
Intercept		20,090.5	219,476	20,150.8	14,342.8	289.166
R^2		.906	.886	.874	.879	.893
F		16,061*	17.157*	20.844*	21.775*	25.108*

[a]Figures in parentheses beneath estimated regression coefficients are standard deviation of corresponding coefficients.

*Statistically reliable at one percent level of confidence.

**Statistically reliable at five percent level of confidence.

***Statistically reliable at ten percent level of confidence.

REFERENCES

Advisory Commission on Intergovernmental Relations, "Measuring the Fiscal Capacity and Efforts of State and Local Areas," Washington, D.C., M-58, March 1971, p. 116.

Bressler, R. G., Jr., "Research Determination of Economies of Scale, " Journal of Farm Economics, Vol. 27, 1945.

Changing Times, "We Need New Ways to Pay for Our Schools," April 1972, p. 25.

Coleman, James, et. al. Equality of Educational Opportunity, Washington, D.C.: U.S. Government Printing Office, 1966.

"Equal Educational Opportunity--1971," Hearings before the Select Committee on Equal Educational Opportunity of the United States Senate, 92nd Congress, Part 15--Education in Rural America, Washington, D.C., September 1, 2, 3, 1971.

Marshall, J. Paxton, et. al. "The Real Property Tax: Adjusting to Reality," Cooperative Extension Service, Extension Division, Virginia Polytechnic Institute and State University, M.B. 152, December 1971.

Nevada Tax Commission, "Ad Valorem Tax Rates and Budget Summaries for Nevada Local Governments," various issues.

Osburn, Donald D., "Economies of Size Associated with Public High Schools," The Review of Economics and Statistics, Vol. 42, 1970.

Riew, J., "Economies of Scale in High School Operation," Review of Economics and Statistics, Vol 41, 1965.

State of Nevada, Department of Education, Biennial Report of the Superintendent of Instruction, various issues.

Stinson, Thomas F. and Edward F. Kramer, "Local School Expenditure and Educational Quality: A Correlation Analysis," paper presented at the Annual Meeting of the American Agricultural Economics Association, Lexington, Kentucky, August 17-20, 1969.

U.S. Bureau of the Census, Census of Population: 1970, General Social and Economic Characteristics, Final Report Pc (1) - C30, Nevada, U.S. Government Printing Office, Washington, D.C., 1972.

U.S. Bureau of the Census, Statistical Abstracts of the United States: 1958 (79th Edition), Washington, D.C., 1958.

REFERENCES (continued)

U.S. Bureau of the Census, Statistical Abstracts of the United States: 1960 (81st Edition), Washington, D.C., 1960.

U.S. Bureau of the Census, Statistical Abstracts of the United States: 1971 (92nd Edition), Washington, D.C., 1971.

U.S. Department of Commerce, Office of Business Economics, "Survey of Current Business," Table 16, various issues.